Using Technology to Improve Access, Equity, Quality, and Relevance of TVET

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Introduction

Formal technical and vocational education and training (TVET) systems function in a context of rapid global technological development. Information and Communication Technology (ICT)[1] is enabling exponential increases in the transfer of data through increasingly globalized communication systems and connecting growing numbers of people through those networks. Due to rising connectedness and the proliferation of Web 2.0[2] technologies, there has been an explosion in collaboration, sharing, and knowledge generation. Improvements in access to information, collective intelligence, and mass participation in previously specialized disciplinary areas are extending the boundaries of scholarship, while dynamic knowledge creation and social digital tools and processes are becoming more prevalent. In response, TVET systems are grappling with how best to harness Educational Technology (EdTech) [3] to the benefit of students, workplaces, and countries. The COVID-19 pandemic has added urgency to the quest to harness EdTech effectively, both for teaching and learning, and to support managerial and administrative operations at TVET institutions.

TVET is also grappling with advancements associated with the Fourth Industrial Revolution (4IR). The convergence of digital innovations is referred to as the advent of the 4IR, which is characterized by integration between digital, biological, and physical worlds.[4] Those who have a favorable view of 4IR indicate that developments in digitization, computerization, and the internet will, in time, spark unprecedented positive social and economic changes (some of which is already underway and has been accelerated by COVID-19). Educationally, these include promising innovations through learning analytics,[5] instructional technologies, and institutional management and planning tools, to name a few.

Advancements associated with the 4IR provide an opportunity to create and share a greater diversity of learning resources, thereby accommodating varying student needs. Increasing digitization is driving changes in areas such as organizational structures and processes, technological infrastructure, and pedagogical approaches. It also enables internationalization by allowing education providers to offer online and increasingly flexible educational programs.[6] Further, digitization of information in all media, combined with its increasingly widespread access, has introduced significant challenges in dealing with issues of intellectual property rights (IPR). Copyright regimes, and their associated business models, which worked effectively prior to the explosion of ICT, are rapidly transforming.

Technological trends are global, but their impact on high-income and technically advanced countries is very different from that on low- and middle-income countries (LMICs). LMICs have typically depended heavily on forms of labor that have not required high levels of skills, which are increasingly becoming redundant in a digital economy due to automation. Given rapidly shifting demands in labor

[1] Technologies that provide access to information focusing primarily on communication technologies such as the Internet, wireless networks and cellular phones. It includes all devices, networking components, applications and systems that, combined, allow people and organizations to interact in the digital world.

[2] Investopedia describes Web 2.0 as 'the current state of the web, which has more user-generated content and usability for end-users compared to its earlier incarnation, Web 1.0. In general, Web 2.0 refers to the Internet applications that have transformed the digital era in the aftermath of the dotcom bubble.'

[3] We consider EdTech to encapsulate the development and use of technological tools, processes and resources, combined with educational theory and practice that assists in teaching and learning.

[4] Ndung'u, N. and Signé, L. (2020). The Fourth Industrial Revolution and digitization will transform Africa into a global powerhouse. Brookings. Retrieved from https://www.brookings.edu/research/the-fourth-industrial-revolution-anddigitization-will-transform-africa-into-a-global-powerhouse/

[5] Learning Analytics is the measurement, collection, analysis and reporting of data about students, their contexts and how they engage with educational materials and other support resources.

[6] Tømte, C.E., Fossland, T., Aamodt, P.O. and Degn, L. (2019). Digitalisation in higher education: mapping institutional approaches for teaching and learning. Taylor and Francis Online. Retrieved from https://www.tandfonline.com/doi/full/10.1080/13538322.2019.1603611

market demands, LMICs are at significant risk of becoming consumers of digital products and services being produced in the developed world or being consigned to low-level economic functions.

These trends require formal TVET systems to transform, both in terms of the kinds of programs they offer and how they offer them. It is thus imperative that LMICs overhaul their skills development systems to allow them to become active producers in the digital economy. This requires an overhaul of curricula, capacities of skills systems (including teaching/training capacity), and the way in which programs are delivered so that they can prepare the people they are training (the labor market supply) to operate successfully in the digital economy in places where growth opportunities lie, rather than supplying skills predominantly to economic activities that are in decline. Formal TVET systems have typically been slow to change, especially in LMICs. Thus, the need for transformation is most urgent in the system that is possibly least reformed in public education, at least in LMICs. Whilst EdTech cannot solve these problems by itself, it provides innovative options that can help to radically accelerate curriculum reform and transform how skills programs are delivered.

Key dimensions of this report

Focus on formal TVET

TVET usually refers to a range of learning experiences relevant to the world of work, which may occur in various learning contexts, including training institutions and the workplace. It usually offers students technical training with a more hands-on, practical focus. TVET is generally thought of as training that provides employment-ready technical skills and learning experiences, which may include reinforcing foundational learning requirements that relate to being work-ready. It can encompass 'formal learning' within institutions where outcomes are accredited, 'non-formal learning'[7]and 'informal learning'[8] such as skills development in the workplace and self-directed micro learning by an individual.

The focus of this paper is on formal TVET. Definitions of formal education usually encompass the following:

- Education delivered in a systematic intentional way, usually provided within an education institution (such as schools or colleges).
- It usually involves direction/guidance from a teacher/trainer.
- It is recognized as part of the national education system, usually leading to formal certification.[9]

TVET can also occur at various levels, from very basic or primary to secondary and post-secondary. The focus of this paper is on the **secondary and post-secondary** levels. Within this, it explores how EdTech is used to improve access, equity, quality, and relevance in formal TVET systems and institutions. Each of these concepts is thus unpacked briefly below.

Access

Access relates to the opportunity of students to enroll and meaningfully participate in education and training. UNESCO-UNEVOC notes the following with regard to TVET and access:

> *While the fundamental right to education and training has been well established and recognized within numerous political frameworks across the world, young people and adults still face difficulties accessing or completing TVET programmes. Systemic discrimination, inequalities related to course materials and school infrastructure, and discriminatory career*

[7] Learning that is not provided by a training institution and typically does not lead to certification.
[8] Any learning that is not formal learning or non-formal learning, such as self-directed learning or learning from experience.
[9] UNESCO-UNEVOC. (nd). Formal education and training. Retrieved from https://unevoc.unesco.org/home/TVETipedia+Glossary/filt=all/id=222

guidance practices are examples of barriers affecting access and participation in TVET programmes.[10]

The concept of improving access can focus on various types of barriers that individuals face in delivering and participating in education. For example, it can involve measures such as affirmative action for some groups in the population to encourage them to benefit from available opportunities; addressing barriers for those who are working full-time or too far away from the institution to attend face-to-face classes; or for persons with disabilities, improving access might involve providing accessible infrastructure or making accommodation and training allowances to enable them to take up and complete training courses.[11] Ultimately, however, promoting access focuses on increasing the flexibility of teaching and learning so that people can decide where, when, by what instructional methods and which modes they access opportunities. This choice should not depend on their identity or background. Moreover, access involves a policy or set of strategies to make TVET available to all members of a community, to increase participation, and to improve outcomes.[12]

EdTech possesses varying characteristics that can play a significant role in improving access. It is scalable, allowing larger numbers of students to access instructional content at a relatively low cost. Related to this is that it improves the efficiency of educational provision by streamlining processes. Further, EdTech offers opportunities for bespoke design and delivery options, meaning that it can be personalized to a student's educational level and individual context, thus improving the likelihood of student success.

Equity

Equity implies that opportunities for learning are not reduced based on a student's gender, income, residence, ethnicity, language or other characteristics [UNESCO (2008)].The Organization for Economic Co-Operation and Development (OECD) defines two dimensions of equity in education:

- *Fairness, which means ensuring that personal and social circumstances do not prevent students from achieving their academic potential.*
- *Inclusion, which means setting a basic minimum standard for education that is shared by all students regardless of background, personal characteristics, or location.*[13]

Thus, equity usually deals with measure of achievement, fairness, and opportunity in education. It is essentially the process of ensuring that that educational, models, programs and strategies are fair, ensuring that every student has a reasonable chance of success. EdTech aids this by improving capacities to measure achievement, fairness, and opportunity in education. EdTech can also improve support to the learning process.

Quality

Quality broadly refers to being taught well, meaning that education and training approaches are pedagogically and developmentally sound so that as many students as possible complete TVET programs having acquired the skills they set out to learn.

[10] UNESCO-UNEVOC. (nd). Access to Quality TVET for All. Retrieved from https://unevoc.unesco.org/home/Equity+and+gender+equality

[11] International Labour Organization. (2017). Employment Policy Brief - Making TVET and skills systems inclusive of persons with disabilities. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_605087.pdf

[12] TVETipedia glossary. (nd). Access and Equity. Retrieved from https://unevoc.unesco.org/home/TVETipedia+Glossary/filt=all/id=4

[13] Thinking Maps (nd). Equity in Education: What it Is and Why it Matters. Retrieved from https://www.thinkingmaps.com/equity-education-matters/

In TVET, quality is directly related to achievement of the learning outcomes (knowledge, skills, and competence achieved at the end of the learning process) in ways that fulfil key stakeholders' expectations (students, parents, employers, trade and occupation focused quality agencies, and community in general).[14] EdTech can improve the quality of the learning process and align education with learning outcomes.

Relevance

Relevance of TVET provision relates to aligning the skills acquired through TVET with skill demand, which is essential to ensure that TVET optimally contributes to employability, productivity and growth. Relevance also often refers to something interesting and worth knowing, and relevance in education is frequently linked with the popular idea of personalized learning.[15] In TVET, this often relates to the extent to which learning responds to the requirements of the labor market, [16] contributes to a skilled workforce, and the role it plays in reducing unemployment and underemployment, access to decent work, and in influencing the competitiveness of businesses and sectors. EdTech solutions can assist with responding to labor market needs, and allow student control over time, place, path, or pace of learning.

Level of technology

This paper explores roles for high and low EdTech within the formal TVET system. EdTech encapsulates the development and use of technological tools, processes, and resources, combined with educational theory and practice that assists in teaching and learning. For the purposes of the paper, 'high tech' refers to technology that is at the cutting edge, the most advanced technology available, the most complex, the newest technology on the market, or technology involving the production or use of advanced or sophisticated devices. Conversely, 'low tech' refers to digital tools or resources that are not recent, using old materials, or having simple operations. These include television with low interactive activity, and basic (non-smart) mobile phones combined with interactive voice response (IVR) technology. Of course, this distinction is more nuanced, as technology is advancing at a rapid rate and with constant new and improved functionality. Further, some technologies are a hybrid between high and low technologies (depending on the type of device, functionality, and level of interactivity). However, for the purposes of analysis, the paper retains a distinction between low and high technologies as outlined above.

Why does technology in TVET matter?

To achieve more inclusive socio-economic growth, countries need to provide equal access to quality TVET that is relevant to current and future job needs. Digitization provides flexible ways of disseminating information, while online delivery of TVET can promote inclusiveness 'by making flexible training and lifelong learning available to a wider group of potential students. Possible beneficiaries include marginalized people who do not have access to education and skills development because of their geographical, financial, religious, or ethnic circumstances'.[17] Thus, if well used, technology can

[14] Ayonmike, C.S., Okwelle, P.C., and Okeke, B.C. (2015). Towards Quality Technical Vocational Education and Training (Tvet) Programmes in Nigeria: Challenges and Improvement Strategies. Journal of Education and Learning; Vol. 4, No. 1. Retrieved from https://files.eric.ed.gov/fulltext/EJ1075172.pdf

[15] Lynch, J. (2017). How Relevant is Relevance to Teaching? Retrieved from https://medium.com/@quixotic_scholar/how-relevant-is-relevance-to-teaching-414653b8f975

[16] International Labour Organization. (2017). Employment Policy Brief - Making TVET and skills systems inclusive of persons with disabilities. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_605087.pdf

[17] Di Cara, M., and Chatani, K. (2019). Policy Note - Distance and e-Learning in TVET. International Labour Organization. Retrieved from https://www.ilo.org/jakarta/whatwedo/publications/WCMS_732618/lang--en/index.htm

allow education to be more scalable and affordable, thereby fostering the democratization of education.

TVET systems focus on developing technical skills and unlike the program design for education sectors like primary, secondary and higher education, TVET programs are generally developed with specific occupations and/or functions in mind, and seek to provide occupation-ready skills.[18] There is growing emphasis on continuous and lifelong learning to help people adapt to and participate in the changing landscape of work. With shifting labor market demands, the rapid pace of 4IR, and global phenomena that have had significant effects on the global economy like the COVID-19 pandemic, formal TVET can play a significant role by addressing the dynamic requirements for upskilling and reskilling the labor force through lifelong learning.

An important aspect of a lifelong learning system is its flexibility, or seamless education, which traditionally incorporates catering for diverse people (for example, marginalized groups or those with different educational or employability statuses), diverse circumstances (for example, religious restrictions; family care; etc.), and including a variety of institutions (for example, public, private, or ranging from school level to training providers). In line with this, one of the key advantages that TVET holds is that because skills development is more focused and practical, courses tend to be shorter (through, for example, short courses and microlearning), more affordable, and more aligned with employment outcomes, meaning that they offer a significant opportunity to deliver in-demand skills in a flexible manner. This is especially the case as online education in particular and EdTech solutions in general can reduce the limitations of time, space, and place and offers students convenient access to education at various stages of their lives.

Exponential technology advancement will see education being transformed by new capabilities in mobile devices, cloud delivery systems, video streaming and other broadband-intensive applications, and learning management systems. TVET teachers/trainers can reach students using these diverse digital resources, which can provide TVET students greater choice and more flexibility in learning opportunities,[19] thereby enhancing access to TVET. Further, EdTech has the potential to transform passive learners into active and independent ones, able to take charge of their own learning by choosing and using a range of resources,[20] thereby enhancing the relevance of their education. It allows for the individualization of education by allowing for greater flexibility and more customization in what, how, and where courses are delivered, while supporting faster and more relevant feedback. Further, EdTech also has great potential for helping teachers/trainers to keep up to date with the latest developments in their field via online continuous professional development (CPD).[21]

Within TVET institutions, automating processes can streamline costs. EdTech can enable more cost-effective educational delivery where it reduces the cost of infrastructure needed to accommodate students within the physical learning and enables students to be reached without necessarily being bound to a learning campus/training center.[22] In addition, via the deployment of learning analytics,

[18] Chakroun, B., and Keevy, J. (2018). Digital Credentialing - Implications for the recognition of learning across borders. Unesco. Retrieved from https://unevoc.unesco.org/home/Digital%20Cred%20Report

[19] Obwoge, E., and Kwamboke, O.S.. (2016). E-Learning in TVET: An Opportunity for Developing Countries. IRA International Journal of Education and Multidisciplinary Studies (ISSN 2455–2526), 3(3). Retrieved from https://www.researchgate.net/publication/304496725_E-Learning_in_TVET_An_Opportunity_for_Developing_Countries/link/59c0b6560f7e9b48a29db651/download

[20] Di Cara, M., and Chatani, K. (2019). Policy Note - Distance and e-Learning in TVET. International Labour Organization. Retrieved from https://www.ilo.org/jakarta/whatwedo/publications/WCMS_732618/lang--en/index.htm

[21] A continuous process of gaining new knowledge and skills as individuals progress through their professional and personal careers.

[22] Obwoge, E., and Kwamboke, O.S.. (2016). E-Learning in TVET: An Opportunity for Developing Countries. IRA International Journal of Education and Multidisciplinary Studies (ISSN 2455–2526), 3(3). Retrieved from

institutions can track student success, progress, and educational inputs, thereby enhancing the quality and relevance of offerings.

The 4IR is also inspiring new ways of working, learning, and thinking. New skills will be required to create, maintain, and leverage these new technologies.

> *In view of the rapid socio-economic and technological changes, jobs and the skills required to perform them continue to evolve. Many jobs in labor intensive sectors, which tend to be occupied by economically vulnerable groups of people (such as women and the poorly educated), are at high risk of being automated.*[23]

This will require the formal TVET system, working in partnership with government Ministries and employers, to repurpose and reconfigure curricula considering lifelong learning and the need for a broader and more agile skills systems to respond to skills needs as they arise. This will help to ensure relevance of TVET to labor markets. Further, digitalization and automation in the workplace require new and continually advancing skills. As a result, employers need training opportunities for their employees to access continuing, and increasingly personalized education.[24]

Conceptual framework

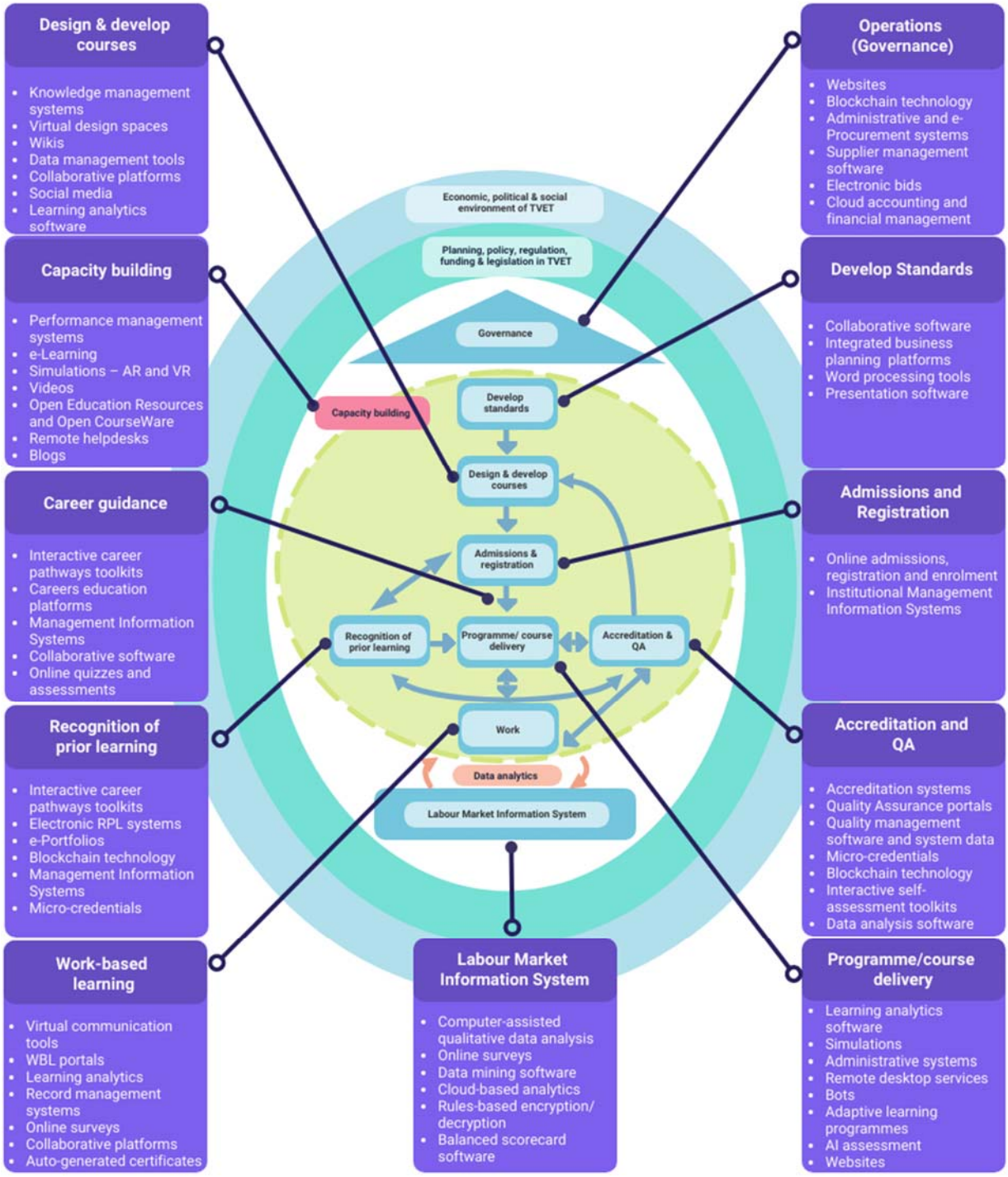
In developing a conceptual framework that maps possible roles for EdTech in TVET, the aim was to cut through the complexity and focus on core elements and functions of formal systems. Figure 1 outlines the core functions of formal TVET systems and highlights key areas where EdTech might play a key role.

https://www.researchgate.net/publication/304496725_E-Learning_in_TVET_An_Opportunity_for_Developing_Countries/link/59c0b6560f7e9b48a29db651/download

[23] Di Cara, M., and Chatani, K. (2019). Policy Note - Distance and e-Learning in TVET. International Labour Organization. Retrieved from https://www.ilo.org/jakarta/whatwedo/publications/WCMS_732618/lang--en/index.htm

[24] Adapted from BCG. (nd). A Future Skills Assessment Advances Lifelong Learning and Labor Productivity. Retrieved from https://www.bcg.com/industries/public-sector/successfully-transitioning-digital-education

Figure 1 Conceptual framework



The last few years have seen accelerating evolution and diversification of roles for technology in education and training, with profound implications for planning and decision-making. There is a wide range of possible roles for technology in formal TVET systems, and technological innovations are expanding the possible scope of these roles exponentially, introducing significant opportunities.

This report focuses on a few specific core functions where EdTech has the greatest immediate potential to improve access, quality, equity, and relevance TVET systems in LMICs. It does not explore management and administrative functions of TVET as technology associated with these functions may not necessarily be specifically relevant to education only (for example, it may have applications in other business settings). Rather, it focuses on functions related to curriculum development and the processes of teaching, learning, and assessment:

- **Design and develop courses**: The process of creating and/or adapting teaching and learning materials for skills development, using various media forms (audio, video, print [both digital and physical], computer-based multimedia, simulations, virtual reality [VR], etc.). This is an area in which there has been significant innovation in terms of software applications and online platforms that have increasingly become industry standards in content creation.
- **Program/course delivery**: The process of delivering training experiences, which is where most historical uses for technology in TVET have tended to focus, exploring how to create online and blended learning opportunities and considerations for acquiring practical skills.
- **Work-Based Learning (WBL)**: This is an educational approach that aligns academic and workplace practices for the mutual benefit of students and workplaces. It is an intentional experiential learning process which combines academic studies with professional work experience to integrate theoretical, conceptual knowledge with practice in the workplace through directed or supported educational activities. This can take many forms, such as apprenticeships, learnerships, volunteering, and practicums, to give practical experience of work while learning. From a lifelong learning perspective of the working individual, the workplace is also a place of vocational learning. Where there are skills gaps, employees can also return to participate in program or courses to close skills gaps (and enter different levels of education depending on their prior learning).
- **Recognition of Prior Learning (RPL)**: Students who have knowledge and skills obtained through informal and non-formal learning and work experience can apply for RPL to obtain credit, access, inclusion or advancement in the formal education and training system, or workplace. RPL is a means of formally certifying prior learning as per accreditation standards. Such certification will allow students entry into the training course/program or could qualify them for a specific job. Micro-credentialing, which is a small/short competency-based recognition/credential can be recognized using RPL procedures and may have explicitly defined learning outcomes at a particular qualification level.

Access, quality, relevance, and equity are central to this framework because they determine who has access to different functions in the system as well as the type of experience that they have when doing so. Considerations about how to ensure that these dimensions permeate the TVET system at all levels are key to building a system that is relevant and fair to all communities. The framework relies on the realization of these four dimensions to ensure that TVET systems serve the greatest number of people effectively. Central to this is promoting access by ensuring the flexibility of teaching and learning so that people can decide where, when, by what instructional methods and which modes they can use to access opportunities; suffusing quality by making sure that education is well-designed and pedagogically and developmentally sound; making education relevant and responsive to labor market needs; and promoting equity by ensuring that educational models, programs and strategies are fair so that every student has a reasonable chance of success.

Opportunities for EdTech in TVET

There are many potential ways in which technology can improve the performance of formal TVET systems. The table below highlights some of these, noting which enable access, quality, equity and relevance respectively. It outlines key areas of growing trends highlighting opportunities for the public

and private sector to play a significant role in formal TVET. It is illustrative rather than comprehensive, given the range of technologies and their applications, as well as the complexity of TVET systems.

Table 1 Examples of the scope of EdTech opportunities in formal TVET systems

Function(s)	Area of opportunity	Description	Opportunities in formal TVET systems
Design and develop courses	Technology-enabled Materials Design and Development	The process of creating teaching and learning materials using various media forms such as audio, video, print (both digital and physical), computer-based multimedia, simulations, and virtual reality.	• Online reviewing systems can support the scalable development of online courses. This saves time and increases efficiency by eliminating lost paper forms. **(quality)** • Websites and repositories provide access to existing teaching and learning material (e.g. open educational resources, open access repositories, open textbooks, and Massive Open Online Courses (MOOCs). This significantly reduces the cost of digital learning materials for students and democratizes access to knowledge. **(access, equity)** • Personal learning platforms use a subscriber-based model so that institutions can deliver course texts to students around an aggregated, single bookshelf. This dramatically decreases the cost of textbooks for students, provides valuable data to institutions on achievement of student outcomes, and centralizes access to core texts. **(access)** • Open licenses, such as the Creative Commons licenses, enable wider sharing of materials and promote accessibility. **(access, equity)**
Program/Course Delivery	Online and blended learning	Online learning refers to any form of learning that takes place over the Internet. Blended learning involves a combination of traditional face-to-face instruction and web-based online learning, including gaming, virtual reality, text messaging, and social networking sites. Online technology is not just used to supplement, but to transform and improve the learning process. It usually includes some element of student control over time, place, path, or pace.	• Management and administration software provides support to the learning process. **(equity)** • Collaboration technologies enable interaction between students and teachers/trainers. This assists the learning process by allowing students greater access to teachers/trainers and fellow students as resources. (**access, equity)** • Apps, simulations, and games using augmented reality and virtual reality technologies allows students to apply theory to practice in a realistic, safe, and controlled way, facilitate the learning process, and equip students with skills that are easily transferable to real-life situations. They allow students to practice techniques repetitively without additional expense. (**quality, relevance)** • E-Books and textbooks can be more affordable, are convenient, can be delivered instantly, can be edited more easily to suit students' contexts (when openly licensed), and can accommodate more learning styles. (**access, equity, relevance)**
	Assessment of learning	The process of gathering data to measure the progress of a students' learning. This data helps better understand the	• There has been growth in e-assessment services using technology for assessment activity, such as design and delivery of assessments, recording responses, marking, reporting, and storing data. **(quality)**

Function(s)	Area of opportunity	Description	Opportunities in formal TVET systems
		strengths and weaknesses of students' learning. It usually encompasses both summative and formative assessment. Summative assessment is the evaluation of student learning by comparing it against intended learning outcomes to quantify achievement, usually at the end of a learning program. Formative assessment covers the methods used to gather feedback on student academic progress and learning needs during the learning process to inform and modify in-process teaching and learning activities to improve student learning.	• Learning Management Systems (LMS) and software facilitate online and continuous assessments (e.g. quizzes, reflections, exams). This enables more secure efficient feedback that students can access as soon as they have been assessed. **(access, quality)** • Artificial Intelligence (AI)-based assessment makes it easy to grade bulk assignments within a short deadline. This allows teachers to focus more on in-class activities and student interaction than grading, improving student outcomes and saving time. **(quality)** • Formative and summative assessment tools and applications allows teachers/trainers and institutions to track student progress and encourage collaboration or discussion between students. This allows students to receive feedback in real-time, saves time, reduces costs, and can motivate students to invest in their learning. **(quality, relevance)** • Assessment software enables teachers/trainers to create and administer tests to students via digital devices, grading student answers, and analyzing results. This streamlines the process of delivering tests and examinations, allows teachers/trainers to gain a holistic view of a student's performance, provides information to facilitate instructional decisions, and gives them the opportunity to provide continuous feedback to students. **(quality)** • Data analytics[25] helps keep track of the progress of every student individually, allowing teachers/trainers to get individual feedback on the performance of every student and of the entire cohort/class and modify their teaching approach appropriately. It can identify at-risk students and automate processes of pointing students to specific support interventions. When these assessments are done in a digital environment, the data can be used to identify and support at risk students in a more personalized manner. **(quality, relevance)**

[25] Data analytics is the science of analysing raw data to make conclusions about that information. Data analytics techniques can reveal trends and metrics that would otherwise be lost in the mass of information. This information can then be used to optimize processes to increase the overall efficiency of a system.

Function(s)	Area of opportunity	Description	Opportunities in formal TVET systems
Program/Course Delivery Work	Work-Based Learning (WBL)	An educational approach that aligns academic and workplace practices for the mutual benefit of students and workplaces. It is an intentional experiential learning process which combines academic studies with professional work experience to integrate theoretical, conceptual knowledge with practice in the workplace through directed or supported educational activities.	• Virtual/online WBL allows WBL placements to be undertaken remotely, rather than physically in the workplace. This allows students to gain work experience whilst experiencing agile work environments and new ways of working, as well as learning about new collaborative technologies. These provide a means of accessing WBL for those who are unable to complete a required number of hours in a workplace due to difficulties with travel. **(access, relevance, equity)** • A central WBL portal/platform/Management Information System (MIS) permits students' registration, placement, and progress to be recorded centrally. This can maintain student records and assign students to specific programs or activities with a particular industry partner to provide better matches between a student's aptitude and industry partner. **(access, relevance, quality)** • Portal and websites that records relevant information related to WBL programs such as sharing and listing available WBL opportunities and storing and registering CVs and resumes enhances access to WBL opportunities. **(access)**
Recognition of Prior Learning Admissions and Registration Accreditation and QA	Recognition of Prior Learning (RPL)	RPL is an assessment process that involves assessment of an individual's relevant prior learning (including formal, informal, and non-formal learning) to determine the credit outcomes of an individual application for credit[26]	• Electronic e-Portfolio systems help individuals build their e-Portfolios and align it with a competency framework for RPL purposes. This can save time and avert cumbersome paperwork. **(access, quality)** • MIS that tracks and verifies learning that takes place on the job, during the apprenticeship period, and throughout an individual's career, in applications for RPL allows students and institutions to easily track performance and achievement over time. **(relevance, quality)** • Blockchain technology can provide a single secure record of educational attainment accessible and distributed across many institutions. This allows certificates to be delivered in blockchain. thereby simplifying the verification process for employers and countering forged certificates and false résumés. **(equity)** • Systems that enable RPL assessments to take place up front allow students to progress faster through programs without repeating work where they already have skills. **(quality, access)** • Automated certification for short courses to provide evidence of completion could be used in RPL ePortfolios. This saves time, is cost effective, and easy to manage and share. **(quality)**

[26]Australian Qualifications Framework. (2012). Recognition of Prior Learning: An Explanation. Retrieved from https://www.aqf.edu.au/sites/aqf/files/rpl-explanation.pdf

Function(s)	Area of opportunity	Description	Opportunities in formal TVET systems
	Micro-credentialing and certification	A micro-credential is a short, competency-based recognition demonstrating mastery (skills, knowledge, and/or experience) in a particular subject area. Examples are open digital badges, e-portfolios, verified certificates, and nanodegrees). They provide a pathway to personalize and recognize professional learning.	• Micro-credentials are flexible and cost effective to implement, have the potential to train students quickly to fill new, emerging skill gaps, and helps businesses to fill specialized skill gaps that might not be addressed with traditional credentials. Micro-credentials are also nimble enough to support rapid changes in industry. **(access)** • Blockchain technologies allow for the issuing of academic and professional micro-credentials. This can improve data verifiability, availability, and reliability for the evidence of learning. **(quality)**

Key trends and approaches

Technology-enabled materials design and development

Over the past decade, there has been significant growth in content creation tools and platforms, with learning materials increasingly being delivered online in various formats. This context has provided a foundation for significant innovation in the private sector in terms of software applications and online platforms that have increasingly become standard tools for use in content creation. There has been an explosion in cloud-based content creation services. This is fundamentally changing the way in which materials are being designed and developed, which is largely dependent on an array of factors such as available tools, the required learning outcomes, and variations in access. The proliferation of digital technologies, including open educational resources (OER), machine learning and artificial intelligence (AI) in education and training provide new tools for the development of learning materials and teaching and learning processes, while also offering the potential to transform pedagogical approaches.[27] There are several trends and promising approaches within the realm of materials design and development which are explored in greater detail below.

Open Educational Resources and Open Courseware

The Open Learning[28] movement has experienced significant growth over the last decade, particularly regarding the use of OER and open courseware (OCW). OER and OCW refers to teaching and learning materials, course modules and entire courses in digital formats that are placed in the public domain or online and openly licensed. This licensing convention allows teachers/trainers and students to legally and freely copy, use, adapt, and share these resources for their own purposes. Both OER and OCW can promote pedagogical advancements, avoid redundancies and duplication of content, diminish the costs of producing and distributing course materials, expand access and be particularly beneficial to students in the developing world.[29] They also enable learning designers to curate, repurpose and develop materials in ways that copyrighted materials do not.

OER increases access to high-quality educational materials related to skills development and improves the relevance of materials. Because the development of knowledge is increasingly dynamic and rapid, openness had become a valuable feature for educational materials to possess.[30] This is particularly so for those living in the developing world. There are various technologies that enable and promote the use of OER in LMICs. For example, search engines and advanced metadata tools such as JSON-LD, schema.org and OAI-PMH, allow OER to be labelled, distinguished from closed-license content, and to be searchable. In addition, repositories and cloud computing allow institutions to store large numbers of OER at a relatively low cost.[31] In Zambia, OER and wikis were used to support Entrepreneurship Training in TVET and promote a learner-centered approach at institutions.[32] In another example, TVET

[27] International Labour Organization and Unesco. (2020). The Digitization of TVET and Skills Systems - Geneva: ILO. Retrieved from https://www.ilo.org/skills/areas/skills-policies-and-systems/WCMS_752213/lang--en/index.htm

[28] Open learning refers to activities that either enhance learning opportunities within formal education systems or broaden learning opportunities beyond formal education systems. Open learning involves but is not limited to: classroom teaching methods, approaches to interactive learning, formats in work-related education and training, the cultures and ecologies of learning communities, and the development and use of open educational resources. See https://en.wikipedia.org/wiki/Open_learning

[29] Latchem. C. (ed). (2017). Using ICTs and Blended Learning in Transforming TVET. Commonwealth of Learning. Retrieved from http://oasis.col.org/bitstream/handle/11599/2718/2017_Latchem_Using-ICTs-and-Blended-Learning.pdf

[30] UNESCO UNEVOC. (2018). OER in TVET. Retrieved from https://unevoc.unesco.org/up/OER-in-TVET.pdf

[31] International Labour Organization and Unesco. (2020). The Digitization of TVET and Skills Systems - Geneva: ILO. Retrieved from https://www.ilo.org/skills/areas/skills-policies-and-systems/WCMS_752213/lang--en/index.htm

[32] Konayuma, G. (2013). Using Open and Educational Resources (OERs) and Wiki's to Support Entrepreneurship Training in Technical and Vocational Education and Training (TVET) Institutions in Zambia. Retrieved from http://oasis.col.org/handle/11599/1835

Academy conducted a pilot project in Cambodia, which was aimed at teacher/trainers and students in vocational training centers that were far from the main centers. The project sought to provide three services, one of which was a database of OER in mainly video format which were used for multiple purposes: First, local teacher/trainers could use the database for self-training and help in preparing their classes. Second, teacher/trainers could use the database in their teaching practice. Third, students could review the resources after class for revision purposes. The five-year project (2009–2013) produced over 200 hours of videos supporting four months of full-time (40 hours per week) study in twelve different subjects.[33]

Because users can adapt OER, materials become more valuable and effective because they can be contextualized and fashioned to directly suit learning outcomes. The TVET Academy example is particularly pertinent because the team designed a user interface that allowed any partner institution interested in creating their own version of a training program to reuse generic sections from other TVET Academy sources and to design and upload new content specific to their country needs.[34] This improves the relevance of materials and ensures that they can be altered to suit the needs of many more students.

Despite the promise that OER hold for TVET, a 2017 UNESCO-UNEVOC study found that TVET is one of the most neglected areas in the OER space, with much more information being available on OER in K-12 and higher education. The barriers to mainstreaming OER in TVET are much the same as for other education subsectors, including:

> *Lack of vision and supporting policy (both national and institutional), lack of awareness of OER among teachers and policy makers and human factors (fear of sharing because of possible copyright infringement, unwillingness to share), high teaching load and an infrastructure with insufficient capacity.*[35]

Given the potential to harness OER in the design and development of TVET teaching and learning materials, it is evident that more resources are required to enable wider use of these materials and training on how to use them effectively. Key to this will be to create an education and training ecosystem that includes enabling policies, advocacy efforts, and capacity building programs aimed at mainstreaming OER use in TVET. This is a particularly worthwhile opportunity to explore given resource constraints and limited investments in education in LMICs, as OER take advantage of collaborative approaches for materials development.

Online repositories and authoring tools

Online repositories promote access to materials that have been developed and provide a convenient platform for storing, curating, managing, and reusing digital resources at a low cost. They can be used for anything from OER, OCW and MOOCs to institutional materials, administrative information, or copyrighted materials. Repositories can be subject-focused, institutionally focused, stand-alone, networked, or federated.[36] One frequently cited example is YouTube, which is one of the most extensive educational repositories on the internet, accessed by 1 billion users a month.

An authoring tool is a software program that allows users to create learning content, lessons and courses using text, media, and interactions. It can be saved in various formats and used on different

[33] Latchem. C. (ed). (2017). Using ICTs and Blended Learning in Transforming TVET. Commonwealth of Learning. Retrieved from http://oasis.col.org/bitstream/handle/11599/2718/2017_Latchem_Using-ICTs-and-Blended-Learning.pdf
[34] Latchem. C. (ed). (2017). Using ICTs and Blended Learning in Transforming TVET. Commonwealth of Learning. Retrieved from http://oasis.col.org/bitstream/handle/11599/2718/2017_Latchem_Using-ICTs-and-Blended-Learning.pdf
[35] UNESCO UNEVOC. (2018). OER in TVET. Retrieved from https://unevoc.unesco.org/up/OER-in-TVET.pdf
[36] Latchem. C. (ed). (2017). Using ICTs and Blended Learning in Transforming TVET. Commonwealth of Learning. Retrieved from http://oasis.col.org/bitstream/handle/11599/2718/2017_Latchem_Using-ICTs-and-Blended-Learning.pdf

platforms, such as LMS' and repositories. Authoring tools tend to be highly user-friendly and users do not need programming expertise to use them optimally.[37]

As digital infrastructure investments, both online repositories and authoring tools provide a promising approach for introducing more advanced digital learning pedagogies in the long term, particularly because they serve the function of making creation of and access to digital materials more equitable. Repositories can also be curated, which allows the creators to control the quality of materials. The implementation costs of both are low, allowing these technologies to be scaled easily. There are also established methodologies on how to optimize these technologies in varying contexts. Thus, low-level, mature technologies such as repositories and authoring tools still hold the most significant promise for achieving sustainable educational gains in the short-term.

[37] Valamis. (2020). What is an Authoring Tool? Retrieved from https://www.valamis.com/hub/authoring-tool#what-is-authoring-tool

India's surge in EdTech offerings to provide upskilling and skill matching opportunities and alleviate access challenges to vocational education

India has become the second largest market for EdTech after the United States, with approximately 9.5 million users. EdTech offers an opportunity to assist India in meeting the skills requirements of a growing and rapidly digitizing economy. Young individuals have been especially affected by recent circumstances such as the COVID-19 pandemic and challenges relating to a skills mismatch in the Indian labor market, potentially exacerbated in non-metropolitan areas where access to traditional means for upskilling is more limited. The closures of educational institutions and their relatively limited adoption of digital tools to continue educational programs have impeded learning, especially for students in remote areas, and at least two thirds of WBL opportunities were completely interrupted due to the mobility restrictions Responding to these challenges, the upskilling segment has seen a substantial increase across skilling platforms such as: SP robotics, Toppr Codr, Udacity, and SOAL, with hybrid approaches to education becoming the norm. Newer, more sophisticated types of technology have become popular, including gamification of learning, edutainment, and use of AI in personalizing education (for example, data-driven insights). With EdTech funding still largely concentrated on EdTech giants such as: Byju, Unacademy, and Vedantu, new EdTech products are also likely to find significant unmet demand.

India's Ministry of Education is supporting the drive to expand vocational education and has implemented the scheme of vocationalization of School Education under the *Samagra Shiksha* scheme, which serves to integrate TVET with general academic education. One such example is the inauguration of 607 vocational labs, education portal and GIS portal in Jammu and Kashmir. India also proposed virtual labs called National Educational Technology Forums (NETFs) to bring up more technological interventions in primary and higher education and is planning to set up India's first AR and VR-based skill training center at IIT Varanasi. Vernacular learning could be one of the biggest trends, given the fact that only 10% of India's population can speak English. One of the key challenges in delivery has been a lack of infrastructure, particularly in rural areas: '"…a big challenge here is establishing a digital infrastructure that caters even to the remote areas…" To strengthen the infrastructure digitally or otherwise—the only way is to bring in a huge investment in this sector. How the funding for that is going to be managed, is yet another challenge.'

In August 2021, Cabinet approved the continuation of the *Samagra Shiksha scheme* for school education for another five years. The major objectives during this extension include installing smart classrooms and virtual labs in all rural schools, and to replace blackboards with digital boards.

Sources:

- International Labour Organization. (2019). Skills and jobs mismatches in low- and middle-income countries. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/documents/publication/wcms_726816.pdf
- International Labour Organization (2020). Tackling the COVID-19 youth employment crisis in Asia and the Pacific. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/documents/publication/wcms_753369.pdf
- KPMG-Google (2017). Online Education in India: 2021. Retrieved from https://assets.kpmg/content/dam/kpmg/in/pdf/2017/05/Online-Education-in-India-2021.pdf
- KPMG (2020). Higher education in India and COVID-19. Retrieved from https://assets.kpmg/content/dam/kpmg/in/pdf/2020/04/higher-education-in-india-and-covid-19-impact-on-admissions.pdf
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- World Economic Forum. (2014). Matching Skills and Labor Market Needs. Retrieved from http://www3.weforum.org/docs/GAC/2014/WEF_GAC_Employment_MatchingSkillsLaborMarket_Report_2014.pdf
- World Economic Forum. (2020). How COVID-19 deepens the digital education divide in India. Retrieved from https://www.weforum.org/agenda/2020/10/how-covid-19-deepens-the-digital-education-divide-in-india/
- World Bank Enterprise Surveys. (2014). Explore Indicators. Retrieved from https://www.enterprisesurveys.org/

Contributing to this promising approach is evidence of institutions pooling resources in aid of implementing these tools. For example, the West African initiative to pool vocational training resources, *la Plateforme de mutualisation des outils et ressources de la formation professionnelle,* was borne out of the desire of the governments of sub-Saharan countries to respond to challenges facing the entire region: youth unemployment and the need to design and implement training systems and

courses adapted to the skills needs of the world of work and promoting professional integration. The Platform improves access to important knowledge in the TVET sector; allows each country to discover best practices in other countries; promotes access to resources and tools while saving time and saving financial resources; and promotes sub-regional integration.[38]

There is still significant scope for improvement that moves away from the traditional one-size-fits-all industrial teaching model, where students are taught within a strictly confined curriculum.[39] Within this model, students are presented with the same materials, teaching styles and evaluation processes, regardless of their individual aptitudes or interests.[40] Repositories are an important part of this next step, as they provide on-demand, targeted materials to students and facilitate learning through exploration and research. They also allow teacher/trainers to access a wider variety of materials aimed at students with varying capabilities and learning levels. Similarly, authoring tools allow materials developers to create high quality digital content efficiently, and to tailor it according to student competencies. Potential drawbacks for students, however, is that accessing a repository, more often than not, means that learning is unfacilitated, which presents its own set of issues, including that students may not have access to support structures if they do not understand content, and that learning is not scaffolded – which may prohibit mastery of a topic.

Proliferation of digital materials online and the effect on student engagement and completion

Digital materials have created opportunities to increase access to education. Countries like Azerbaijan, Egypt, Georgia, and Turkey, amongst many others, have set out to reduce COVID-19-related learning losses by accelerating efforts to provide e-platforms and digital content. The Turkish government, for example, is building its Education 2023 strategy and accelerating access to and use of e-platforms, which include the 'Turkish VET map', 'E-graduates website', and platforms for teacher training and ICT based curricula. Armenia, Azerbaijan, and Georgia have been providing specific e-platforms and e-learning for teachers and trainers and developing digital content.[41]

Good instructional design has the power to transform teaching and learning materials by making them more engaging, digestible, and effective for students. The COVID-19 pandemic spurred an influx of cheaply available teaching and learning materials online, as both the demand and supply of these materials increased. China, for example, has made more than 30,000 online courses for higher education freely available.[42] Learning materials that have a good instructional foundation are those where the learning objectives, content, and modality align and form a cohesive learning pathway for the student. Normally, developing online courses would require inputs from a team of experts, including academics and instructional designers. However, COVID-19 has significantly influenced students' learning processes – especially because of the practical nature of many TVET programs. In many cases, institutions sought to address this by replacing sessions that would have occurred in a

[38] La Plateforme de mutualisation des outils et ressources de la formation professionnelle. (nd). Missions. Retrieved from https://www.mutualisation.ccmefp-uemoa.org/la-plateforme-de-mutualisation-des-outils-et-ressources-de-la-formation-professionnellse

[39] Aerts, C. (2018). Time for an EdTech rethink. Retrieved from https://www.globaleducationseries.org/media/4494/alliance-edtech-rethink.pdf

[40] Gng - Digital Initiative. (2016). Education: One size no longer has to fit all. Retrieved from https://digital.hbs.edu/platform-rctom/submission/education-one-size-no-longer-has-to-fit-all/#

[41] European Training Foundation. (2020). Coping with COVID-19: Mapping education and training responses to the health crisis in ETF partner countries. Retrieved from https://www.etf.europa.eu/sites/default/files/2020-04/mapping_covid_060420_0.pdf

[42] Teter, W. and Wang, L. (2020). COVID-19 and UNESCO: Monitoring the Impact on People and Places for Relevant Higher Education. Retrieved from https://headfoundation.org/2020/06/08/covid-19-and-unesco-monitoring-the-impact-on-people-and-places-for-relevant-higher-education/

laboratory or workshop with more passive types of learning such as videoconferencing or watching demonstrations online. Unfortunately, this often failed to successfully replace face-to-face learning.[43]

Afghanistan's Alternative Learning Plan

The Government of Islamic Republic of Afghanistan's Technical and Vocational Education and Training Authority (TVETA) embarked on an initiative (*Alternative Learning Plan*, or ALP) to introduce technology in TVET. This was mainly in response to school closures during the COVID-19 pandemic, but this was also recognized as an opportunity to reform teaching and learning in TVET using technology. The ALP emphasizes 'simplicity for quick roll out, localized solutions to account for ground realities, and provision through multiple modalities [channels] to reach and meet the needs of heterogeneous, hard-to-reach student groups'. The ALP has three main components, developing chapter notes and self-study material, producing educational videos, and developing an online web portal to host the videos, chapter notes, and study material.

Chapter Notes and Self-Study Material

Chapter notes

TVETA mobilized its curriculum experts to develop physical 'chapter note' packages for priority trades with the highest student enrolment. The chapter notes are designed to facilitate self-study, providing additional scaffolding through self-instructional plans, supplementary guidelines, and explanatory notes from teachers. Thus far, the following has been achieved:

- The TVETA identified and trained 115 teachers (of which 17% are female) to support the development of chapter notes.
- Approximately 2,100 chapters' notes are being converted to soft copies by data entry clerks.
- 50% of the chapter notes have been uploaded on TVETA web portal, and those with internet are able to access them via the portal.
- The chapter notes were also sent electronically to teachers/trainers, who, in turn, formed WhatsApp groups and circulated the chapters to their students.
- Those students without Internet access were provided with the chapter notes on hard drives by their teachers in their institutes.
- The chapter notes did not reach the provinces and districts that are located in distant and remote areas on time due to limited access to internet and electricity. The TVET Authority has identified various ways of distributing them to the students, including establishing collection points in schools. In addition, once schools re-opened, these students were provided with the chapter notes.

Self-study Material

- Relevant guidelines and templates to design self-study materials have been developed.
- 137 teachers (subject matter specialists) were recruited, of which 20% are female, to develop material in the following trades: Banking, Marketing, Management, Entrepreneurship, Electronics & Electrical, Veterinary, Oil & Gas and Mining.
- The self-study materials for these trades are completed and have been uploaded to the TVETA portal. They will also be printed and distributed to the students.

Thus far, approximately 40% of TVET teachers/trainers (82% male and 16% female) and 30% of students (84% male and 16% female) have benefitted from these materials.

Recording Educational Videos

To compensate for the lack of practical instruction, TVETA is also preparing a collection of video tutorials to supplement the chapter notes. This involves filming teachers delivering theoretical content and conducting practical demonstrations. To date, the following has been achieved:

- Teachers were selected to record videos for selected trades and courses
- A guideline for developing videos was produced, and teachers were oriented on how to record videos.
- 7,000 video tutorials were recorded and uploaded on YouTube. These are available to all TVET students country-wide as an alternative learning pathway for students during the COVID-19 pandemic.

Development of Online Web Portal

As part of a broader shift to expand distance learning, TVETA wishes to roll out a learning management platform, with the aim of serving as a content repository. Thus far, the A TVETA web portal was designed and chapter notes, self-study guides and educational videos have been uploaded.

[43] International Labour Organization, World Bank, UNESCO. (2021). Skills development in the time of COVID-19: Taking stock of the initial responses in technical and vocational education and training. Retrieved from https://www.ilo.org/skills/areas/skills-training-for-poverty-reduction/WCMS_766557/lang--en/index.htm

Conclusion
The ALP prioritized both physical paper-based 'chapter note' packages, as well as digital solutions. Data thus far indicates that high EdTech solutions are not the main answer for most students given the lack of access to digital devices or Internet connectivity. Low tech solutions were thus a more feasible option in this case. Further, while online platforms may mainly be currently accessible to urban students, TVETA's investments balance the need for an immediate response, while building capacity for future growth of the sector.

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- Email communication, Mr. Bashir Hilaman, ASDP II senior curriculum specialist. Received 15 July 2021
- Kabir, M., Larsen, K., Paksima, S., and Sofizada, A.H. (2020). Multi-modal TVET delivery during COVID-19: Expanding access to continued learning in Afghanistan. Retrieved from https://blogs.worldbank.org/education/multi-modal-tvet-delivery-during-covid-19-expanding-access-continued-learning-afghanistan
- The Government of Islamic Republic of Afghanistan, Technical and Vocational Education and Training Authority. (2020). Non-conventional Learning Approach for TVET Institutes "Considering the Outbreak of Coronavirus in the Country and Closure of Schools"

Potential challenges of such interventions in LMICs relate to digital literacy, digital infrastructure, funding, and motivation in integrating new digital technology into curriculum. Thus, EdTech should not be viewed as a panacea for TVET systems. While technology can be used as a tool to improve students' understanding of complex concepts or to promote peer-to-peer collaboration, many teachers/trainers face difficulties in implementing them. Issues include a lack of access, time, and resources to buy these technologies. The case study of Afghanistan's ALP illustrates this, where most TVET teachers were unfamiliar with the use of technology, and they lack access to basic equipment such as computers and the internet. Moreover, a lack of knowledge regarding the effective use of these technologies across subject matters can act as a barrier to adoption or optimal use.[44]

e-Books and e-textbooks

Standard e-books or e-textbooks are available in various formats, including ePubs and PDFs. These formats allow students to download and view titles offline; search for keywords or phrases; highlight important sections; and bookmark pages for quick reference. In addition to this common form of e-book, there has been a rise in the development of interactive e-books, which contain media-rich content that enhances the learning experience by allowing students to interact with the materials. Interactive e-books may include:
- Animations to help explain concepts;
- Videos showing scenarios and highlight big issues;
- Scenario-based activities and self-assessment exercises;
- Glossary pop-ups;
- Interactive infographics; and
- Audio podcasts.[45]

Desktop research suggests that use of e-books and e-textbooks in TVET is not yet mainstream. However, use of these tools in higher education provide a promising approach for consideration in the TVET system, particularly due to their potential to improve access to knowledge in an equitable manner. This is particularly the case because of the rising cost of physical books. For example, a four-year study at Florida Virtual Campus found that e-textbook use increased, particularly amongst younger students. The study found a 24% increase in the use of e-textbooks, adding:

> *Undergraduates, particularly those on the young side of the spectrum, consistently use e-textbooks at a higher rate than graduate students. This is not surprising, given the proliferation of digital materials throughout the K–12 school system. We predict that the rate of e-textbooks*

[44] Colombo Plan Staff College. (2021). Instructional Design Based on ICT and Digital Technology. Retrieved from https://www.cpsctech.org/2021/01/instructional-design-based-on-ict-and.html
[45] Pearson. (2021). eBooks. Retrieved from https://za.pearson.com/tvet-and-higher-education/Technical-vocational-education-training/digital-solutions/eBooks.html

will continue to increase because of the skills and familiarity with them of the incoming student population. However, a troubling issue is that students in 2016 reported lower self-efficacy than those in 2012 concerning e-textbook technical and study skills, and less than half felt that they could learn as effectively with an e-textbook as with a print textbook. And yet: more students are using e-textbooks than ever. These findings have implications at the student, instructor, university, and state levels.[46]

Program/course delivery (online and blended learning)

As TVET institutions aim to meet students' demands for more flexible, individualized training and with a view to creating a more responsive, demand driven TVET system, EdTech is increasingly being used to deliver flexible and blended learning opportunities, which enables more innovative teaching and learning models.[47] While the focus of this section is on EdTech opportunities for program delivery and the conceptual framework presents content development and program delivery as distinct functions, it is important to recognize that the features of technology solutions are increasingly becoming less discrete. Consequently, there is significant overlap between EdTech solutions for content development and program delivery – for example, LMS' enhance the learning process by creating, managing and delivering content simultaneously, as well as offering a variety of other capabilities like assessment.

An uptake in online and blended learning approaches and the increased adoption of digital technologies

As has been argued, there are multiple forces that are shaping the nature of TVET systems, the effects of which differ between developed countries and LMICs. This includes technological changes and digitization; the disruption of traditional markets; and the increasing importance of job mobility. Another key trend is the adoption of online and blended learning approaches, which offer significant opportunities to improve the quality, access, and relevance of TVET. Online learning refers to any form of learning that takes place over the Internet (web or app-based),[48] while blended learning involves a combination of traditional face-to-face instruction and online learning, including watching videos, gaming, virtual reality, text messaging, and social networking sites.[49] Online technology is not just used to supplement, but to transform and improve the learning process. It usually includes some element of asynchronous learning that gives the student control over the time, place, path, or pace of learning.

EdTech offers new ways to learn and customize the learning experience, such as advancements in data analytics and using AI to support continuous skills development and one's lifelong career and learning pathways. As a result, there has been an increase in efforts to move to online or blended TVET, which is enabled by multiple platforms and EdTech solutions such as digital repositories, collaborative technologies and formative or summative evaluations tools.

[46] Noyelles, A. and Raible, J. (2017). Exploring the Use of E-Textbooks in Higher Education: A Multiyear Study. Educause Review. Retrieved from https://er.educause.edu/articles/2017/10/exploring-the-use-of-e-textbooks-in-higher-education-a-multiyear-study

[47] Pavlova, M. (2020). A Framework for Success: A regional overview of the ICT-enhanced practices in TVET. Anticipating and Preparing for Emerging Skills and Jobs. Retrieved from https://link.springer.com/chapter/10.1007/978-981-15-7018-6_24

[48] Academic Partnerships. (nd). A Guide to Quality in Online Learning. Retrieved from https://idea-phd.net/images/doc-pdf/Guide_to_online_post_traditional_highered.pdf

[49] Commonwealth of Learning. (2020). Open and Distance Learning – Key Terms & Definitions. Available from: http://oasis.col.org/bitstream/handle/11599/3558/2020_COL_ODL_KeyTerms_Definitions.pdf

Senegal's online platform – Ejàng

The Ejàng (school from home) platform (https://e-jang.sec.gouv.sn/) is headed by the Senegalese government. It was set up after schools were closed in Senegal due to the COVID-19 outbreak. It makes training content available to students enrolled in TVET courses, with the aim of ensuring learning continuity. Students have online access to the basic guides and manuals, which are mostly used for practical training in schools or in the workplace. A library of digital resources and audiovisual content is also available. Ejàng also enables trainers to schedule and run virtual classes and assess learning outcomes.

Sources:

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- Ejàng. (nd). Ejàng la solution d'apprentissage en ligne du MEFPA. Retrieved from https://e-jang.sec.gouv.sn/

Existing and new EdTech solutions incentivize adoption of online and blended learning modalities because they can make education delivery more efficient, accessible, and pedagogically sound. One example of a general increase of available e-learning solutions is the platform Atingi, which is a digital learning platform developed within the framework of the Global Project 'Africa Cloud' and implemented by the *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ) on behalf of the Federal Ministry for Economic Cooperation and Development. Atingi seeks to tackle challenges in accessing learning content and lifelong learning opportunities in many African countries. The Africa Cloud team develops educational content that is local and geared towards improving vocational training and employability for jobs of the future. Africa Cloud then partners with political, economic, and civil society actors for project implementation. The Smart Africa Secretariat, an alliance of 29 African digital ministries, is the most important strategic partner for project implementation.[50] This example demonstrates the promise of online learning in increasing access – the platform is mobile-friendly and, in its first year it reached over 800,000 people, with 100,000 registered users.[51] A second example is Mexico's *Capacítate Para El Empleo* online portal, which is currently offering free access to its hundreds of courses and several diploma degrees for technical occupations and has developed partnerships with organizations to expand this access to several Central American countries.[52] In addition, the Alison platform[53] provides free, quality, certified online courses for TVET students. Other such platforms include Coursera and edX – although these sometimes require payment for a verified certificate. Such services provide students with learning opportunities, as well as supporting the development of a more equitable global learning community.[54]

Both new and improved EdTech solutions can also have a significant impact on remedial education, particularly because they allow students to learn at their own pace. Online learning solutions may also offer learning analytics capabilities, which provides insight into learning progress of students with varying educational needs. This allows teachers/trainers and other stakeholders to measure students' comprehension, the extent of learning, and areas for improvement among other things. For example, teachers with insights about students' learning behavior can provide remedial resources for students on an individual basis or set additional self-check quizzes that are targeted at specific learning

[50] See https://www.atingi.org/en/tool

[51] AIT News Desk. (2021). atingi eLearning Platform Reaches Nearly 1 Million African Youth in 1st Year. AIThority. Retrieved from https://aithority.com/technology/education-and-research/atingi-elearning-platform-reaches-nearly-1-million-african-youth-in-1st-year/

[52] E.g. Honduras (http://www.conatel.gob.hn/index.php/2020/04/15/conatel-y-la-fundacion-carlos-slim-te-brindanuna-importante-oportunidad-para-que-aproveches-tu-tiempo-y-estudies-en-casa-de-forma-gratuita/) and Guatemala (https://www.guatemala.com/noticias/sociedad/inscripcion-para-cursos-virtuales-gratuitos-capacitate-para-empleo2020.html).

[53] See https://alison.com/

[54] UNESCO-UNEVOC. (2020). Promoting quality in TVET using technology: A practical guide. Retrieved from https://sea-vet.net/images/seb/e-library/doc_file/773/promotingqualityintvetusingtechnology.pdf

difficulties or competency gaps.[55] Learning analytics thus provides a powerful online tool to personalize the learning journey, thereby offering the opportunity to improve student outcomes.

As a result of its value add to the overall learning journey, EdTech is becoming increasingly integrated at all levels of learning and career pathways – as noted at the beginning of this section. Digital technology is increasingly being used throughout the entire student journey, which means that the boundaries between the applications and uses of EdTech are becoming blurred. A good example of this is in India, where PricewaterhouseCoopers (PwC) has been digitizing the student journey in over 200 government colleges based in rural areas of India through its Student Life Cycle Management (SLCM) Solution. SLCM is a one-stop solution to manage the entire life cycle of students from registering for admission through graduation and as an alumnus. Key functions of SLCM include Admission Management, Course Management, Academics Management, Fees Management and Examination Management. This system has been developed by PwC using Microsoft Dynamics; it has transformed the functioning of the colleges and is providing an efficient digital interface to more than 200,000 students based in rural India. The potential for learning analytics to improve the quality of education services is also being explored.[56]

Coupled with the integration of EdTech into all levels of the learning and career pathway is that online and blended learning approaches have become crucial in countries' attempts to align labor market demand with the supply of skills. EdTech advances make it possible to achieve greater integration between on-the-job and off-the-job learning, allowing key concepts to be reinforced theoretically exactly when they are being applied practically. The Philippines is one of the largest labor-exporting countries in the world. Most of these workers are women who are employed in low-skilled positions, such as domestic helpers or boutique sales attendants – jobs that are susceptible to exploitation. To provide opportunities for Filipino workers who are abroad, Technical and Education and Skill Development Authority of the Philippines (TESDA), a UNEVOC Centre in the Philippines, developed an online learning platform that provides self-paced learning for its users. The platform is used to carry out blended learning in formal training programs offered by TESDA, as well as to upskill Filipino overseas workers. Users have access to the courseware and can learn new skills, undergoing a formal assessment by TESDA at its training centers in the country or through satellite assessment events conducted abroad. After they complete the assessment, students receive a National Certificate.[57]

[55] Yian, T.T.T., and Park, J. (2017). Beyond Access: ICT-enhanced Innovative Pedagogy in TVET in the Asia-Pacific. UNESCO. Retrieved from https://en.unesco.org/sites/default/files/ict-enhanced_innovative_pedagogy_in_tvet_in_the_asia_pacific.pdf

[56] PWC. (2019). Changing minds in a changing world - The future of education in the Fourth Industrial Revolution. Retrieved from https://www.pwc.co.za/en/assets/pdf/changing-minds-in-a-changing-world.pdf

[57] UNESCO UNEVOC. (2018). Boosting skills learning through mobile technology: the skills-pedagogy-technology nexus. Retrieved from https://unevoc.unesco.org/up/UNESCO-UNEVOC_Workshop_-_MLW2018v2.pdf

Blended 'Foreman for Road Maintenance' course in Lebanon

The International Labour Organization (ILO) in Lebanon embarked on an initiative to pilot one of its TVET programs, *Foreman for Road Maintenance*, as an online course. This formed part of the SKILLS-UP program – a joint program of the ILO and the Norwegian Ministry of Foreign Affairs aimed to help the ILO Member States enhance their skills systems. The process began in 2019 when ILO conducted a skills anticipation study on in-demand occupations in the public infrastructure, and one of the identified areas of need was road maintenance. The integration of technology was not initially planned for this course but given the COVID-19 pandemic together with the political instability in the country at the time (2019-2020), ILO explored contingency plans to address disruptions in skills training. ILO decided to pilot the course on road maintenance to explore online learning in TVET and learn lessons on how to shift to digital learning:

> *This would be [a] great opportunity to explore and collect lessons learned and how to shift to digital learning. In particular, we were hoping that online learning would allow for greater participation and increase inclusiveness and access to education.*[58]

The initial preparation involved conducting further in-depth research, including literature reviews, to identify skills gaps. In collaboration with an implementing local partner, ILO held meetings with the private sector to define competence and skills relevant to the occupation and identified areas requiring improvement. Preparation also involved identifying stakeholders, potential training providers, and potential employers; and coordination with relevant government bodies. The ILO representative pointed out that whilst online learning has been deployed at the university level in Lebanon, it was completely new within TVET. The ILO team thus engaged in discussions and consultations with government TVET institutions to discuss the feasibility of pursuing online learning in TVET and to identify content areas that could be provided online and complement on-site training. The team explored how to redesign material to enable it to be delivered online whilst simultaneously ensuring that skills and competence could be developed during practice. They also assessed the available technology options in the country to ensure that the approach takes cognizance of the context.

Curriculum development
ILO appointed a curriculum developer to develop the curriculum. The curriculum, which covered 16 competencies, was developed over two months. It covered online training (100 hours) as well as face-to-face on-the-job training (50 hours), under the guidance and supervision of employers on site. The curriculum included practical exercises that were linked to real-life settings and the workplace. The curriculum was also designed to be sufficiently flexible to allow for additional materials to be integrated at a later stage (i.e. during the online course implementation to allow for greater clarity of concepts). The National Vocational Training Centre provided accreditation and certification of the course. In addition, the course had third-party international accreditation.

Implementing partner
The Safadi Foundation, which runs a nationally accredited training institute, implemented the project from March 2020. ILO coached the team at Safadi on the approaches and methodologies it wished to deploy,[59] and the Safadi Foundation implemented the course, screened applicants, and ensured student placement in industries (note that these employers were engaged from the outset in planning stages of the project). As this was the first time an online TVET training was offered in Lebanon, the program included ongoing monitoring and evaluation, which was done by the Foundation.

Improving lab facilities and trainer/teacher capacity
One of the requirements for the course to be successfully deployed was to improve the existing laboratory facilities to enable online learning. As part of the implementation agreement between ILO and Safadi Foundation, the Safadi Foundation training center was able to equip their lab with the necessary equipment to conduct the online training. This included two web cameras, HDR video conferencing, smart whiteboards, and subscription to WebEx software to allow for streaming and recording.

The Safadi Foundation selected two trainers to facilitate the online course. These trainers underwent two days of face-to-face training in the week prior to training. The training of trainers (ToT) adopted a participatory approach, with the curriculum designer providing training on the materials. The training also covered the pedagogy of online learning to deliver the content appropriately and to keep students engaged, and the use of digital equipment, tools and assessment tools. The two days were regarded as sufficient in terms of enhancing the knowledge and skills of trainers. The Safadi Foundation also provided ongoing support to trainers during the training.

Students
In total 28 students participated in the course. The course required students to have baseline knowledge and experience for entry into the course, and this included digital literacy as a key requirement. Students were divided into two groups to ensure good interaction between teachers/trainers and students. At the start of the course, students participated in an introduction training session to prepare them for the online training approach. Students participated in the online training for four hours a day over a 25 days period, and had daily contact with trainers depending on student needs. Students were assessed online, as well as verbally in one-on-one assessments with trainers. The tests included both

theoretical and practical parts. Trainees underwent a pre-test and post-test and an evaluation test after the completion of each competency to assess progress made throughout the course.

Main Challenges

Weak internet and interruption of electricity

One of the main challenges identified during the planning stages of the course was the interruption of electricity in the country, as well as weak internet connectivity. To mitigate these challenges, the following was explored.

- All training sessions were recorded and made accessible to all trainees via the online platform. Thus, recording classes allowed students to access lessons at a later stage in the event that they had power cuts or unstable internet connectivity at the time of their live classes.
- Students had access to support from trainers and students via a WhatsApp group.
- Students without access to devices were provided with a tablet, laptop, or smartphone. All students received 4G internet bundles to connect to the online course.

Inclusivity

ILO aimed to include students who were refugees, female as well as persons with disabilities in the course. The Safadi foundation engaged in awareness raising and outreach. However, ILO and the implementers were unable to identify suitable persons with disabilities to participate. In total, four students (14% of students enrolled in the course) were female. Although not a large number, this was regarded as a 'major breakthrough' in an occupation usually stereotyped as a man's job.

Success factors

Blended learning model

One of the main lessons learned is that a blended learning approach is possible within TVET, with both online (covering theoretical aspects) and on-the-job training (covering practical training). Online learning is useful as it provides flexibility, allowing students already working to fulfil their work commitments whilst also learning. Blended learning also ensures that a practical learning component is incorporated in training.

Selecting students

Another lesson learned was that it was important to 'profile' students based on their capacity and curricula requirements. In selecting students to participate, one of the requirements was that they needed to have digital skills and understand how to use the technology deployed during course. They also required certain basic skills identified as market demands during the market needs analysis, for example, numeracy and literacy skills.

Compatibility of tools

It was important that the training center was well equipped with the relevant infrastructure and facilities to deliver and support the online training. The ICT tools used for the online training were selected keeping in mind the infrastructure and internet capabilities in the country. Thus the 'logistics' of the training matched the available infrastructure, and this also ensured success.

Multimodal learning

The online training used visual materials (such as videos, pictures) to allow students to see how things work, with the aim of fostering a better understanding of concepts and curriculum content. This was regarded as particularly useful in exploring scenarios in the training materials. In addition, students were provided with assignments which required them to go into the real world to test a concept which they were then required to present in class. This involved conducting observations, providing feedback or reviews or analysis on aspects related to the course. This was also regarded as useful in providing them with real life exposure and applicability to what they were learning.

Duration of online sessions

The duration of the online sessions were planned such that it took into consideration ICT infrastructure limitations in Lebanon (power cuts), as well as students' availability (for those who were working). Online sessions were for four hours daily, divided into short sessions to sustain students' attention.

Capacity of stakeholders

All the stakeholders involved required the necessary capacity to implement the initiative. In the event that the stakeholder did not have the required capacity (e.g. the trainers), the implementing partner ensured necessary training to develop their capacity. Capacity requirements were an important consideration in selecting the implementing partner. An important lesson learned was that it is important to improve the institutional capacity of all stakeholders involved to

[58] Interview with Rania Hokayem, National TVET Program Coordinator, Regional Office for Arab States, International Labour Organization Lebanon, 13 July 2021

[59] Based on the ILO guidelines for Non-Formal Market Based Skills Training in Lebanon https://www.ilo.org/beirut/publications/WCMS_666243/lang--en/index.htm

ensure smooth and successful projects implementation(either build or ensure that the required capacity is available). This might require convincing each stakeholder group of the value and benefit of participating. This also needs to be balanced with ensuring inclusivity, and support to improve digital skills of trainers and students, especially when they are exposed to new technologies.

Accrediting the course

Programs that are accredited are regarded as more valuable by employers and students, assuring employers that students have the necessary competence to complete a job.

Considerations for the future

- There is no legal framework for online learning in Lebanon. Whilst universities have been implementing online learning, there are no specific regulations or policies focused on online learning in TVET. This calls for further in-depth review with government institutions to design a standardized framework for online learning in TVET education.
- It is not possible for all skills and competencies to be developed online, as practical training is required, and some occupations require skills in operating heavy equipment. It may thus be worth exploring where VR and AR can be used to augment training.
- It may be worth tracking student placement and job trajectory of students who completed the online learning compared to face-to-face learning. Whilst the program was rated highly by students, ILO has embarked on a tracer study for this pilot to gain a sense of impact.
- Whilst the two days of ToT was regarded as effective, future programs will consider conducting complementary awareness sessions with trainers continuously to inform them about new updates in the field (techniques, tools, etc.) and not just rely on a once-off ToT training.

Sources:

- International Labour Organization. (nd). SKILL-UP Programme: Upgrading skills for the changing world of work. Retrieved from https://www.ilo.org/skills/projects/skill-up/lang--en/index.htm
- Interview with Rania Hokayem, National TVET Program Coordinator, Regional Office for Arab States, ILO Lebanon, 13 July 2021
- International Labour Organization. (2018). Guidelines for Non-Formal Market Based Skills Training in Lebanon. Retrieved from https://www.ilo.org/beirut/publications/WCMS_666243/lang--en/index.htm

COVID-19 has accelerated this integration and move towards online and blended modalities. This is particularly the case since it has been shown, through cases such as the blended 'Foreman for Road Maintenance' course in Lebanon (see case study box), that blended learning is possible within TVET, with both online (covering theoretical aspects) and on-the-job training (covering practical training). Findings from an ILO-UNESCO-World Bank survey suggest that, since the COVID-19 outbreak in March 2020, the adoption of online learning approaches in TVET has accelerated. In the survey, most respondents from the TVET sector in 46 out of 92 countries indicated that they were providing courses entirely based on remote learning during the pandemic. There was also an increase in freely available online learning opportunities. In China, following the outbreak of COVID-19, the government issued several notices related to educational platforms including 'China Vocational Training Online' providing free online skills courses.[60]

Private providers of online courses have also launched initiatives to allow governments to access their courses to promote skills development of unemployed during the pandemic. In addition, some idle workers have been engaged as alternative teachers/trainers for TVET students. Where TVET teachers/trainers cannot provide training to their students remotely, they can be connected virtually with idle workers in appropriate fields, which allows them to revise their knowledge on work-floor practices.[61]

[60] Wang, L. (2020). Policy Framework and Platform Development in China. Retrieved from: https://internationaleducation.gov.au/news/latest-news/Pages/China-announces-majer-reform-to-vocational-education-sector.aspx

[61] World Bank. (2020). TVET Systems' response to COVID-19: Challenges and Opportunities. Retrieved from https://documents1.worldbank.org/curated/en/930861589486276271/pdf/TVET-Systems-response-to-COVID-19-Challenges-and-Opportunities.pdf

The rapid evolution of EdTech and recent phenomena like the COVID-19 pandemic mean that teacher/trainers and students alike are required to assume new roles in the educational environment – particularly because of new educational configurations like online and blended learning. Teacher/trainers need to adapt their practices creatively to align face-to-face and online sessions into a coherent learning experience. Teacher/trainers also need to recalibrate time allocations between teaching, student engagement, and administration. In many ways, EdTech is making these processes more efficient through online grading and analytics. However, this new context means that teacher/trainers need to think innovatively about addressing individual student needs – there is an increasing amount of data available on student learning and progress, and tailoring the learning experience to each student requires a multipronged approach. Students face their own set of demands in this dynamic environment, including the need to be digitally literate, adaptable to new modes of learning, and able to communicate effectively both in the classroom and remotely.

Although there has been some progress in moving to online and blended learning, key obstacles remain in implementing EdTech effectively – particularly in LMICs. Despite the imperative to expand access to remote learning opportunities, people in LMICs are less able to make the transition to online or blended learning than their counterparts in developed countries. Access issues relating to online and remote learning modalities and infrastructure risks marginalizing disadvantaged students unless adequate measures are taken to overcome the digital divide. This is compounded by adoption hurdles such as attitudes towards technology and teaching and learning configurations, which present an additional layer of complexity in effective implementation. Various other factors need to be considered, as adoption of online or blended learning should not be construed with better learning outcomes. Considerations include issues of equity, as low-income and vulnerable trainees may be unable to access online remote learning due to technical limitations in connectivity and equipment. Access could also be limited by other factors, such as limited learning structure and guidance.

Given these gaps within online and blended TVET education delivery, there is a significant need for rigorous research and evidence on EdTech implementation in LMICs, as well as conducting research on how different EdTech solutions can make meaningful improvements in teaching and learning. These insights will be invaluable in providing evidence on what interventions work and why, thus significantly improving the quality of TVET education delivery.

A Blended Learning Approach to Industrial Welding Skills in Kenya

Background

Turkana County, located in the north of Kenya, is one of the most marginalized areas in the country and home to the Kakuma refugee camp and the Kalobeyei integrated settlements. The county faces tough socio-economic conditions such as food insecurity, limited access to basic social services, limited economic infrastructure, and poor livelihood opportunities, resulting in the refugees and the host communities struggling to find sustainable ways of reducing poverty. Garissa County is in the former North Eastern Province of Kenya. The County is most known for Garissa town which has been bestowed the title of the safest town in Eastern and Central Africa.

Due to the Government infrastructure projects' planned and ongoing oil and gas exploration in Turkana and Garissa Counties in Kenya (including the construction of a pipeline), it is predicted that industrial welding skills will be in high demand, especially from local communities. However, there are limited skills in industrial welding within those local communities, with companies sourcing skilled people from other areas in Kenya and Uganda. Thus, ILO identified the need for local skills development so that the local community can gain from employment in key sectors.

Project overview

ILO responded to the need by initiating a project that focused on developing these skills in collaboration with the Turkana County Government, the Kenya Association of Manufacturers, and the East African Institute of Welding. The program is funded by the Ministry of Foreign Affairs of the Netherlands. The initiative involved designing a five-month dual learning industrial welding skills program targeting youth from both the refugee and host communities. The main objective of the program is to provide market-relevant skills through TVET using a Competence-Based Education and Training (CBET) curriculum in welding. The program builds these skills through three levels: welder training at level 1 (known as fillet welding); level 2 (plate welding); and level 3 (pipe welding). The institution-based training and work-based learning components qualify the graduates for the TVET-CDACC (Curriculum Development Assessment and Certification Council) level 4 welding and fabrication certification that means that the training is in line with the national qualification framework. A dual learning approach was adopted with 60% of the course involving company training and 40% involving institutional based training.

According to the Ministry of Education's (MOE) National Education Sector Strategic Plan 2018-2022, Kenya experiences significant inequalities in access to TVET, especially regarding participation of females and people with disabilities. The program thus had low barriers to entry and deliberately targeted female youth and people with disabilities.

> *The aim of the programme is to prepare refugees and members of the host communities for the labour market by ensuring that they have skills that are in demand, and that these skills are recognized and certified. It also prepares them for self-employment and gives them the entrepreneurial skills that enable them to become job creators*.[62]

The project involved creating partnerships with several stakeholders:

- **East African Institute of Welding** – private training provider to provide institutional-based learning. The institute is a center of excellence in welding that was able to meet the quality standards for training.
- **Kenya Association of Manufacturers** – Placement of trainees for WBL through its affiliates and in particular companies and industries in the steel sector that rely heavily on welding to provide WBL for the students.
- **AHK Germany Chamber of Commerce**- provided capacity building to the WBL supervisors at companies/ in industries. These supervisors have technical skills, and they were trained in pedagogy and didactics of training to allow them to support students in their WBL.
- **Ministry of Foreign Affairs of the Netherlands** – funded the initiative.

The program also worked closely with County Governments of Turkana and Garissa, UNHCR, Film Aid Kenya and Humanity and Inclusion for the mobilization and recruitment of students and the development of inclusive materials tailored to the needs of women and persons with disabilities. These focused efforts led to the enrolment of fourteen female students and two students with disabilities.

The initiative was meant to commence in 2020 but was delayed due to the COVID-19 pandemic and the subsequent closure of training institutions. The Ministry of Health issued safety precautions on re-opening of TVETs due to COVID-19. This reduced capacity (intake) of institutions to accommodate students. The MOE recommended e-learning as a solution to the crisis.

Using Technology to tackle COVID-19 challenges

The East African Institute of Welding had an existing course in Industrial Welding that is certified by the TVET Curriculum Development Assessment and Certification Council (TVET CDACC). The institute also had an existing LMS. ILO supported East African Institute of Welding in digitizing their existing content so that they could offer aspects of the course via the LMS. The theoretical lessons hosted on the LMS were digital skills, entrepreneurship, employability, and environmental and occupational health and safety. This approach was in line with the MOE's call to provide training content digitally.

The project tapped into existing institutional resources to develop a blended approach to learning, whereby theoretical lessons would be conducted online via the LMS and practical training would be conducted at the institute in shifts consisting of small groups of 20 students, adhering to social distancing and other COVID-19 institutional protocols.

Technology features included online lectures via Zoom, notes (text, audio, video), exercises and discussions/chat sessions. These technological features were compatible with mobile devices such as smart phones and tablets to complement computers for remote access of content. The technology was set up such that it worked both online and offline – content was updated when online and could be accessed when offline.

In November 2020, 70 students were enrolled for the course. The training commenced in January 2021, and 68 students graduated in June 2021.

In January 2021, enrolled students were provided with devices to familiarize themselves with the LMS and the content. They were also introduced to basic tools used in the course such as Zoom and were shown how to access and use audio and video files and learning exercises. Students were able to access the content online and were able to download and access it for offline use as well. The initiative tracked students' usage on the LMS platform. Students had two weeks to familiarize themselves with the system.

Challenges

Some initial challenges experienced were:

- Digital literacy skills among students were low, with more than 50% of enrolled students not computer literate. The minimum criteria for entry into the course was Level 4 (completion of primary education) as per the TVET curriculum development assessment and certification council. Computer and digital literacy is not covered in the curriculum at that level.
- Access to internet was scarce at student accommodation - there was slow internet connectivity and low bandwidth. Thus, students needed to go to the institution to access the internet and update content on their devices.
- At the start, students were using devices for unintended purpose such as installation of other apps and for social media. Due to this, few students accessed the LMS and completed the required course components during the first two weeks.

To mitigate these challenges, the following was done:

- To enhance digital literacy skills, at the start of the initiative face-to-face classes were held to familiarize students with the LMS so that they could access the system and participate in self-study. Students were also paired to learn from each other which ensured the digitally challenged ones catch up.
- Internet access at student's accommodation was upgraded in February 2021 with the support of Safaricom (a local ISP).
- To mitigate the unintended use of devices, program implementers restricted access to certain apps and began tracking use on the devices using a device management application called Meraki.

Success factors and lessons learned

The project identified the following as success factors and lessons learned:

- The approach depends significantly on the trainer's capacity to deliver digital lessons. A lot of training is required to build their capacities. One of the main success factors was working with an institution that had the required trainer capacity, and whose trainers had the required digital skills and were able to moderate the LMS:

  For you to have a completed digital training, it highly depends on capacity of trainers. The reason we had success, is because this was a private institution and they already had capacity on this, so it was easy for us to navigate… That was key for us.[63]
- Not all content can be delivered digitally in TVET, however with reality modelled practical training (welding simulators) students can practice some of their skills digitally. TVET CEDACC had already trained the trainers on how to digitize materials, so trainers had the capacity to design material and to convert the material into digitized content.
- Use of digital technologies allows teachers/trainers to design learning opportunities, therefore becoming part of their learning process. Almost all (90%) of students are actively working in the LMS, accessing the content, and using the system features including the chats and assignment submissions. The promise of gaining digital skills also attracted students to this course, and trainers were able to reach more students via the webinars and were able to provide support via chats and discussions.
- Student intake can be improved by creating interest in training (by providing digital skill training). The approach to digital literacy helped ensure that students use the LMS. This approach was both face-to-face instruction at the start

[62] International Labor Organization. (2020). Empowering youth through welding training and job placements. Retrieved from https://www.ilo.org/global/programmes-and-projects/prospects/countries/kenya/WCMS_755858/lang--en/index.htm

[63] Interview with Geofrey Ochola, National Skills Officer, International Labour Organization Kenya. 27 May 2021

of the program, coupled with pairing students who were more tech savvy with those who had never/rarely used a digital device – who were living in the same accommodation.
- Adopting a blended learning approach can improve capacity of institutions to accommodate more students in shifts.
- The institution's LMS was 'upgraded' to allow students to use it for learning. Prior to this initiative, although there was an LMS it was not used much for learning. It was mostly used for life skills and there was not much welding content as the content was still in the process of being digitized. With the support from ILO, this process was accelerated.
- ILO is also building capacity at the government level. It is supporting four officers from TVET CEDACC to improve their curriculum development skills by participating in e-learning design labs training. This training covers issues such as how to digitize content and how to deliver digital content. Developing this capacity will help digitize other TVET curricula.
- Choice of a partner is key. Private institutions are flexible and have capacity to leverage (in terms of resources) as opposed to public institutions. Partnering with TVET CEDACC who quality assured the process as the content was digitized allowed the team to leverage on their capacity and accelerated the process of digitizing materials.

Moving forward, the following is being explored/considered:
- ILO is engaging in discussions with a company that develops simulators to explore how welding simulators can be used in the digital workspace. Whilst the cost of a simulator is great, in the long-term costs can be diminished by reducing wastage of physical resources and sharing the simulation software via a server.
- Partnering with internet service providers to provide the necessary internet infrastructure. Sustainability is a challenge that needs to be addressed.
- Enlisting the support of TVET CEDACC when rolling out the initiative to other counties to support training providers in digitizing materials.

Sources:

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Developing practical skills through technology

TVET's emphasis on developing occupation-specific practical skills requires innovative solutions for shifts to online and blended learning. Practical skills are often acquired through learning-by-doing, which occurs in school-based workshops and laboratories or through gaining hands-on experience in work environments. Traditional remote learning approaches have tended to be a weak substitute for practical exercises.[64] However, technologies like virtual reality (VR) provide a promising innovative approach in improving student engagement. For example, survey research on the educational uses of VR technology revealed that the unique capabilities of VR boosted academic achievement and even improved the effectiveness of education for students with special needs. A recent meta-analysis of 31 primary studies and 90 experiments also demonstrated that VR training can be more effective than traditional training in developing technical, practical, and socio-emotional skills – findings which are especially promising in fields relating to technical education. Moreover, in one of these studies, students who underwent welding training in virtual labs self-reported higher levels of peer

[64] World Bank. (2020). TVET Systems' response to COVID-19: Challenges and Opportunities. Retrieved from http://documents1.worldbank.org/curated/en/930861589486276271/pdf/TVET-Systems-response-to-COVID-19-Challenges-and-Opportunities.pdf

communication and collaborative learning. Students also learned to be more efficient in their use of materials.[65]

VR can be deployed in two main ways. The first is through a traditional desktop setup where one can interact with the screen using a keyboard, mouse, wand, joystick, or touch screen. The second is an immersive environment, either using multiple screens in a room or through a head-mounted display unit that contain sensors which track head movement. The former configuration has been most used as it does not require any special equipment. VR has been shown to improve perceived learning and satisfaction for students.[66] These approaches can enhance the learning experience and make learning more flexible, and can set the foundation for building more inclusive, effective, resilient, and efficient training systems. One example of this is a training app in Southern Africa[1] that uses VR to teach users how to properly operate chainsaws in forest industries. The mobile 3D teaching platform is being piloted in South Africa and replicated in Malawi, Zambia, and Zimbabwe. It uses engaging content to teach young people best practices when using the tool – keeping them both engaged and safe.[67]

EdTech solutions that provide various capabilities such as extended reality (which includes virtual and augmented reality), flipped classrooms[68] and blended learning, and robotics, demonstrate the variety of tools that can be used to develop practical skills in both online and blended contexts. These tools can be used either to replace face-to-face learning or augment it. In a series of studies on VR applications in the field of welding, authors found that integrated learning environments, where traditional teaching was blended with VR, led to improvements in weld quality, higher certification rates, reduced training time, improved physical skill learning, and reduced costs for simpler welds.[69] In a follow-up study, they compared training entirely delivered via VR with blended models.[70] They found that performance levels between the two groups were indistinguishable for low and medium task difficulty. It was only for the highest level of difficulty that VR systems alone were not sufficient.

Such interventions can provide a powerful means of improving access to and relevance of practical education – particularly for minority groups and those in remote settings. In Uganda, the Belgian government provided funding for the Enabel program, which recorded several 360-degree videos that were designed to provide students in remote areas (including refugee settlements in Northern Uganda) with exposure to workplace settings. Students use VR glasses or Google Cardboard[71] to view the videos. The Ecuadorian government and the World Bank are also collaborating on the ActiVaR program to introduce VR into technical education provision for disadvantaged youths who are

[65] Angel-Urdinola, D.F., Castillo-Castro, C. and Hoyos, A. (2021). Meta-Analysis Assessing the Effects of Virtual Reality Training on Student Learning and Skills Development. World Bank. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/35299/Meta-Analysis-Assessing-the-Effects-of-Virtual-Reality-Training-on-Student-Learning-and-Skills-Development.pdf?sequence=1&isAllowed=y

[66] Ogbonna, O.N. (2019). Virtual Reality: A Tool for Improving the Teaching and Learning of Technology Education. IntechOpen. Retrieved from https://www.intechopen.com/books/virtual-reality-and-its-application-in-education/virtual-reality-a-tool-for-improving-the-teaching-and-learning-of-technology-education

[67] SA Forestry Online. (nd). Virtual Reality – the future of chainsaw training. Retrieved from https://saforestryonline.co.za/articles/sa-forestry-sector-makes-chainsaw-training-safer-with-vr/

[68] In a flipped classroom, students review required reading or multimedia before the class meets, and then class time is used for discussions, problem-solving, or other kinds of active learning that will help them actualize and assimilate this new knowledge. See https://educationaltechnology.net/flipped-classroom/

[69] Stone, R.T., Watts, K.P. and Zhong, P. (2011). Virtual Reality Integrated Welder Training. Industrial and Manufacturing Systems Engineering Publications. Retrieved from https://lib.dr.iastate.edu/imse_pubs/42/

[70] McLaurin, E.J. and Stone, R.T. (2012). Comparison of Virtual Reality Training vs. Integrated Training in the Development of Physical Skills. Sage Journals. Retrieved from https://journals.sagepub.com/doi/abs/10.1177/1071181312561526?journalCode=proe

[71] A VR platform that Google developed which consists of a fold-out cardboard viewer into which a user can insert a smartphone

enrolled in public technical and technological training centers.[72] These examples provide evidence for how students who experience various barriers to education can attain workplace experience and educational guidance from a skilled practitioner in spite of contextual challenges.

Mobile learning

Internationally, there are more than five billion mobile phone users, meaning that mobile connectivity is nearly universal in both developed and emerging markets. With the accelerating adoption of 5G since 2019,[73] mobile devices are becoming a core tool for delivering education and training. 5G networks can supply the same coverage as 4G LTE, but at significantly greater speeds, with improved stability.[74]

The rapid proliferation of mobile technology that enables internet access has opened opportunities for increasingly accessible personalized virtual learning and given rise to the phenomenon of mobile learning (m-learning). M-learning can be delivered to anyone in any location, provided they have a mobile device. Even an internet signal is no longer a prerequisite for m-learning as EdTech providers are increasingly designing applications that enable offline content. Providers also try to ensure that content is not too data-heavy to avoid accessibility issues. This is changing the way in which people learn.[75] Eneza Education launched Shupavu291 in 2012, which is a SMS-based EdTech solution that one can access on feature phones[76]. Students can access lessons and quizzes on any mobile phone via SMS or USSD daily, weekly or monthly. Shupavu291 also has an "Ask-A-Teacher" feature, where students can interact with teachers and ask questions in real time. The solution was developed by local teachers and aligned with the national curriculum. Shupavu291 achieved operational success in Kenya, and Eneza then expanded to Ghana in 2018, followed by Côte d'Ivoire in 2019. Following the onset of the pandemic, Eneza partnered with Safaricom, a mobile operator, to offer Shupavu291 and Shupavu Web free to students for 60 days. As of 15 May 2020, Shupavu291 had over a million subscribers, with 200,000 active students on the platform a day, who ask an average of 19,000 questions to teachers. Eneza reports that students experienced a 23 percent improvement in academic performance on average after using the platform for nine months.[77] Though not an example from the TVET sector, Eneza's platform demonstrates the power of mobile technology for improving access to education.

M-learning is particularly relevant to TVET because of the practical nature of TVET teaching and learning. When learning happens in various locations including classrooms, workplaces, and laboratories, having easy access to study materials can prove invaluable. Mobile phones can also be used to record activities, which creates opportunities for more remote support from teachers/trainers. M-learning also promotes use of a flipped classroom environment as well as

[72] United Nations Children's Fund. (2021). Unlocking the Power of Digital Technologies to Support `Learning to Earning' for Displaced Youth. Retrieved from https://www.unicef.org/media/105686/file/Learning%20to%20earning%E2%80%99%20for%20displaced%20youth.pdf

[73] In 2019, 4G overtook 3G as the dominant mobile technology globally and is expected to account for 60 per cent of all connections by 2023. Meanwhile, 5G is gaining pace and is expected to account for 20 per cent of global connections by 2025. As a result, 90% of the population in LMICs are covered by mobile broadband.

[74] Makala, B., Schmitt, M. and Caballero, A. (2021). EM Compass Note 97: How Artificial Intelligence Can Help Advance Post-Secondary Learning in Emerging Markets. World Bank Group. Retrieved from https://www.ifc.org/wps/wcm/connect/ab1ede3d-3694-4260-b209-d12e4fab13de/EMCompass_Note_97-Jan-21-web.pdf?MOD=AJPERES&CVID=nrdwfyL

[75] UNESCO-UNEVOC. (2019). Trends Mapping Innovation in TVET. Retrieved from https://unevoc.unesco.org/pub/tm_innovation.pdf

[76] A mobile phone with basic features such as small non-touch display, internet access and media storage, but which lacks the advanced functionality of a smartphone.

[77] Chebib, K. (2020). Education For All in the Time of COVID-19: How EdTech can be Part of the Solution. GSMA. Retrieved from https://www.gsma.com/mobilefordevelopment/wp-content/uploads/2020/09/EdTech-Final-WEB.pdf

enabling learning at any time that is most convenient for the student.[78] Thus, m-learning allows people to apply mobile technology to supplement learning in both theoretical and practical aspects of a variety of TVET competencies.[79]

Using social media to enable better course delivery

Because learning is increasingly occurring outside of formal learning environments, social media offers a range of opportunities for program and course delivery. Students can access expert advice, interact with peers and teachers/trainers, share their thoughts online and problematize knowledge in ways that they may not have been able to a decade ago. Recent research on the use of social media in TVET courses in Australia demonstrates that students appeared to be more willing to ask questions online than in a face-to-face setting. Many institutions around the world also create ad-hoc groups on platforms such as Facebook and WhatsApp, which provide access to educational resources and allow people to ask questions.

In Sri Lanka, recent research showed that between 60% and 70% of TVET courses continued throughout the pandemic, with 92% of institutions who participated in the survey providing at least one online TVET course. Online training was delivered predominantly through low-tech solutions such as social media and email. Both trainers and students used WhatsApp to share learning content, such as lecture notes and to submit assignments, because of its ubiquity and the fact that it was free.[80] Although the use of social media is promising in its ability to democratize access to knowledge and create an enabling environment for discussion and interactions, a key concern is the 'darker' side of social media which includes privacy concerns, fake news, inaccurate information, and biased commentary.[81]

Using partnerships to facilitate educational delivery through EdTech

Partnerships are an essential element of effective EdTech development and implementation. There is evidence of increased partnerships[82] and cooperation between TVET institutions and schools, telecommunication operators, technology providers and governments – particularly since the beginning of the COVID-19 pandemic. For instance, some partnerships with telecommunications companies have resulted in the provision of digital equipment to teachers/trainers and disadvantaged students. Such equipment included tablet devices, the free use of certain communication tools and platforms and free internet access or additional bandwidth.[83] In Turkey, Palestine, and Morocco, telecommunications operators and internet service providers in Palestine and Morocco are providing free internet access students.[84] In South Africa, mobile network operators agreed to zero-rate access

[78] Vosloo, S. (2017). Mobile learning and TVET for greater inclusion. UNESCO-UNEVOC. Retrieved from https://unevoc.unesco.org/home/Mobile+learning+and+TVET+for+greater+inclusion

[79] Pavlova, M. (2020). A Framework for Success: A regional overview of the ICT-enhanced practices in TVET. Anticipating and Preparing for Emerging Skills and Jobs. Retrieved from https://link.springer.com/chapter/10.1007/978-981-15-7018-6_24

[80] Hayashi, R., Jayasundara, H.D.S.A., Garcia, M., Balasuriya, A, and Hirokawa, T. (2021). COVID-19 Impact on Technical and Vocational Education and Training in Sri Lanka. ADB Briefs, March 2021. Retrieved from https://www.adb.org/publications/covid-19-impact-tvet-training-sri-lanka

[81] Brolpito, A. (2018). Digital skills and competence, and digital and online learning. European Training Foundation. Retrieved from https://www.etf.europa.eu/sites/default/files/2018-10/DSC%20and%20DOL.pdf

[82] See International Labour Organization, World Bank, UNESCO. (2021). Skills development in the time of COVID-19: Taking stock of the initial responses in technical and vocational education and training. Retrieved from https://www.ilo.org/skills/areas/skills-training-for-poverty-reduction/WCMS_766557/lang--en/index.htm

[83] International Labour Organisation, World Bank, UNESCO. (2021). Skills development in the time of COVID-19: Taking stock of the initial responses in technical and vocational education and training. Retrieved from https://www.ilo.org/skills/areas/skills-training-for-poverty-reduction/WCMS_766557/lang--en/index.htm

[84] ETF (2020). Mapping education and training responses to the health crisis in ETF partner countries. Retrieved from https://www.etf.europa.eu/en/news-and-events/news/eu-neighbours-coping-covid-19-education-and-training

to a range of educational and public service resources online.[85] In a third example, Megacom, a telecom operator in Kyrgyzstan, provided free SIM cards to all students and teachers/trainers, to improve access, as well as support the creation of an e-learning platform. In Kazakhstan, the government has also encouraged cooperation with the private sector and telecom operators to facilitate connectivity and procure and distribute equipment for teachers and trainers as well as students.[86]

Evidence from sectors and countries external to TVET in LMICs demonstrate that EdTech is accelerating opportunities for closer partnerships between employers and training providers (note that there is a dearth of evidence from the TVET sector in LMICs). Collaborative arrangements between training providers and employers have proven to be a promising approach for course delivery using EdTech. Many of these partnerships came to the fore amid the COVID-19 outbreak. For example, Coursera, which has 80 million registered users worldwide, sought to respond to the dual disruption of COVID-19 and automation by curating specific courses to meet these challenges. Coursera became aware that retraining needed to happen to equip students – from those just entering the job market to those reassessing their career paths – but was not well-funded. Coursera thus partnered with Google to start introducing entry level professional certificates, which do not have any prerequisites and are designed to prepare students with the core skills for an entry-level role in under six months.[87] This kind of partnership is particularly innovative because it maintains close links between companies and the job market, ensuring that skills development remains relevant and accessible to those who want to explore careers in the digital economy. Such arrangements mean that training providers are better able to use data on skills needs to work with employers to design content that directly meets the needs of industry and keep pace with changing skill requirements, particularly in ICT roles.

Another means of collaboration is between training institutions. In 2010, Zhejiang Technical Institute of Economics (ZJTIE) in China initiated a collaboration with the Management Development Institute of Singapore, followed by Malaysia and Uzbekistan, on a tertiary qualification in international trade and hospitality management. The participating institutions co-developed and shared courses on Web-based International-National Educational Resources Sharing (WINERS), a website platform. WINERS houses curriculum resources, including criteria, syllabi, authentic cases, media, and assessment tools. Approximately 40,000 students and 2,600 teachers benefitted from the program and the collaboration fostered knowledge transfer of online learning materials between for Asian countries. In addition, the arrangement promotes student engagement, access and self-learning as well as aligning with a flexible approach to course delivery.[88] This demonstrates the potential of EdTech to alleviate geographic constraints. This kind of flexible learning could allow people with work or family responsibilities to seek education.

There is also evidence of effective Public-Private Partnerships (PPPs) in TVET. In Egypt, the government is working with the private sector to provide training opportunities for TVET students via Applied Technology Schools that connects the education system with the tech industry in order to provide specialized educational opportunities in the field of technology.[89] Introduced in 2018 using a PPP

[85] Goldstuck, A. (2021). Educational technology booms in SA. Retrieved from https://www.businesslive.co.za/bt/business-and-economy/2021-01-24-educational-technology-booms-in-sa/

[86] European Training Foundation. (2020). Coping with COVID-19: Mapping education and training responses to the health crisis in ETF partner countries. Retrieved from https://www.etf.europa.eu/sites/default/files/2020-05/mapping_covid_180520.pdf

[87] Maggioncalda, J. (2021). Google launches three new entry-level Professional Certificates on Coursera. CourseraBlog. Retrieved from https://blog.coursera.org/google-launches-three-new-entry-level-professional-certificates-on-coursera/

[88] Pavlova, M. (2018). A framework for success - A regional overview of the ICT-enhanced practices in TVET. Retrieved from https://www.taylorfrancis.com/chapters/edit/10.4324/9781315694382-63/framework-success-margarita-pavlova

[89] Egypt Independent. (2019). Egypt cooperates with IBM to launch the country's first IT school. Retrieved from https://egyptindependent.com/egypt-cooperates-with-imb-to-launch-its-first-it-school/

model, private sector companies are responsible for funding upgrading school facilities, educational resources and equipment, as well as for funding the running costs of the schools (including bonuses and incentives for the existing teaching staff, and salaries for new teaching personnel). Companies have three agreement options depending on the level of responsibility they can and/or want to undertake: Full Partnership Agreement, Consortium Partnership, and Associate Partnership. Full Partnership is suitable for large and labor-intensive companies as well as with mega national projects, Consortium Partnership, is suitable for medium size enterprises, and Associate Partnership, allows small and micro enterprises to participate in the apprenticeship programs.[90] IBM is partnering with Egypt's Ministry of Education to establish Egypt's first IT school operating on the P-Tech model system to provide specialized educational opportunities in the field of technology.[91]

Following the theme of partnerships between the private and public sectors, in South Africa, Huawei and the South African College Principals Organization (SACPO) partnered to cultivate ICT talent in 23 TVET colleges across South Africa's nine provinces. This is a non-profit partnership program that allows colleges to deliver Huawei certification courses to their students with the aim of building a 'talent ecosystem for the ICT industry'. The partnership also involves training more than 200 teachers/trainers to offer Huawei-accredited courses. It feeds into the government vision of building links between post-school education and the world of work, to ensure young people have better opportunities and that the system produces the skills required by the economy.[92] In India, Betterplace is working with the National Skills Development Corporation on SkillConnect, which is a platform that aims to bridge the gap between demand and supply of vocational skills. They have developed a taxonomy of jobs and skills needed based on very detailed roles, across 37 sectors. This has resulted in 700 job roles, each of which has a QR labor code. About 500 or so are being used.[93]

The evidence above demonstrates that greater collaboration and strategic partnerships can lead to the faster adoption of vocational EdTech in the TVET sector. This results in wider integration of EdTech into TVET course and program delivery, thereby improving access to and relevance of training (by creating links between training provision and labour market demand).

Devotra's provision of smart classrooms for TVET in Kenya

In Kenya, a few TVET institutions have been fitted with smart classrooms that are helping to improve the quality of teaching. In 2015, a smart classroom concept for TVET was rolled-out in ten colleges as part of a bilateral TVET project between Kenya and the Netherlands. Students were provided with computers and digital library resources, and trainers were provided with over 1,000 interactive presentations covering vocational, technical and life skills. Devotra introduced a number of smart classrooms at TVET colleges in Kenya. They have trained teachers and they have various digital fabrication machines such as 3D printers as well as online science lab simulation. The impact of this initiative has yet to be made available.

Sources:

- Devotra. (nd). Smart classrooms for introducing new technologies for TVET in Kenya. Retrieved from https://www.devotra.nl/wp-content/uploads/2015/06/Folder-Smart-Classrooms-for-TIVET-improvement-in-Kenya.pdf
- World Bank Group. (2019). Kenya Digital Economy Assessment. Background paper series: Digital Skills. Washington, DC: World Bank. License: Creative Commons Attribution CC BY 3.0 IGO. Retrieved from https://thedocs.worldbank.org/en/doc/345341601590631958-

[90] European Training Foundation. (2020). Torino Process 2018–2020 – Egypt National Report. Retrieved from https://openspace.etf.europa.eu/sites/default/files/2020-04/TRPreport_2020_Egypt_EN.pdf

[91] Egypt Independent. (2019). Egypt cooperates with IBM to launch the country's first IT school. Retrieved from https://egyptindependent.com/egypt-cooperates-with-imb-to-launch-its-first-it-school/

[92] Mzekandaba, S. (2020). Huawei ICT Academy attracts 23 local TVET colleges Retrieved from https://www.itweb.co.za/content/P3gQ2MGxGbOqnRD1

[93] Sabharwal, M. (2018). BetterPlace launches SkillConnect, aims to synergize hiring in blue-collar workspace. Retrieved from https://yourstory.com/smbstory/betterplace-launches-skillconnect-aims-to-synergize-hiring-in-blue-collar-workspace

Work-based learning

Work-based learning (WBL) is learning that happens in a work environment, through participation in work practice and process and it is integral to TVET.[94] It refers to learning that occurs when people do real work that leads to actual production of goods and services.[95] Programs vary in length, structure, and whether they are formalized, compulsory, or voluntary. WBL includes the provision of apprenticeships, learnerships, or traineeships, work placements, work experience, cooperatives (or co-ops), internships, and on-the-job training to give practical experience of work while learning. The terminology varies across countries and what constitutes such a program is understood differently in different countries.[96] Nevertheless, WBL generally combines elements of learning in the workplace with classroom-based learning.[97] They can include simulations, practice firms, or virtual firms. This allows students to achieve employment-related competencies and provides them with knowledge and skills that help them connect school experiences to real-life work activities.[98] There are generally standard elements of this process, such as communication between training providers and employers, tracking and measuring student performance, and so on, but a key emerging trend involves the use of technology to provide WBL experiences when there are insufficient workplace placements available for trainees, a growing problem in LMICs.

Around the world, countries have prioritized work-based learning programs as a way to train their workers. WBL is a priority for 27 European Union Member States, the five EU Candidate Countries and the three European Economic Area countries. Morocco, Kazakhstan, Switzerland, and Turkey are also implementing WBL schemes for students.[99] However, because of a lack of available workplace placements, many TVET systems around the world remain predominantly school-based, offering minimal workplace experience to their students. This is not always due to a lack of effort. For example, some governments seek to emulate Germany's dual-system model by introducing apprenticeships that are managed by firms. Other countries like Latvia adopt a more measured approach by implementing WBL while sustaining a mostly school-managed TVET system.[100] Despite efforts like these, finding WBL placements can often be difficult.

The 4IR has accelerated the use of software by staff at all levels across all industry sectors. Most of these software packages require customized training that is aligned with the requirements of specific industry segments. Because it is often considerably more cost-effective to train students on these technologies in workplaces, virtual apprenticeships or virtual internships provide a promising approach to meet this demand at scale.

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[94] Atkinson, G. (nd). Work-based learning and work-integrated learning: fostering engagement with employers. National Centre for Vocational Education Research. Retrieved from https://files.eric.ed.gov/fulltext/ED568154.pdf

[95] Sweet, R. (2014). Work-based learning: A handbook for policy makers and social partners in ETF partner countries. European Training Foundation. Retrieved from https://www.etf.europa.eu/en/publications-and-resources/publications/work-based-learning-handbook-policy-makers-and-social

[96] Comyn, P. (2020). TVET and skills development in the time of Covid-19. World Education Blog. Retrieved from https://gemreportunesco.wordpress.com/2020/04/28/tvet-and-skills-development-in-the-time-of-covid-19/

[97] The Interagency Group on Technical and Vocational Education and Training (IAG-TVET). (2017). Investing in Work-Based Learning. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---ifp_skills/documents/publication/wcms_565923.pdf

[98] UNESCO-UNEVOC. (nd). Work-based learning. Retrieved from https://unevoc.unesco.org/home/TVETipedia+Glossary/filt=all/id=463

[99] Development Asia. (2018). Work-Based Learning for Skills Development. Retrieved from https://development.asia/explainer/work-based-learning-skills-development

[100] Hoftijzer, M. (2018). Making work-based learning work. World Bank Bogs. Retrieved from https://blogs.worldbank.org/education/making-work-based-learning-work

Virtual apprenticeships are conducted remotely while students interact with mentors and collaborate with their teams through digital communication channels.[101] They generally adopt a fully online or blended approach that balances between 'remote learning' and 'physical workplace practice', depending on the occupation or role requirements. The remote learning aspect may include the following elements, with WhatsApp, YouTube, and Zoom calls often being used to supplement the curriculum:

- Online Curricula;
- Downloadable Training Videos;
- Courseware;
- Webinars;
- Demonstrations;
- Knowledge Sharing forums; and
- Apprenticeship Management Training Systems.

Following the online aspects, students may shadow a mentor or trainer in the real industry setting to complete the on-the-job training and apprenticeship program.[102] Another option is conducting this aspect online through various means. There are several examples of this, such as virtual industry tours that allow students, parents and job-seekers to experience Nebraska-based industries without having to visit them in person.[103] These videos provide a comprehensive tour of different businesses and industries in sixteen Career Clusters in the Nebraska Model. They also contain interviews with employees and managers discussing work requirements, education levels, salary, and job prospects.[104]

The virtual nature of purely online or blended apprenticeships have become particularly valuable during the COVID-19 pandemic where the closure of businesses has prevented students from carrying out practical training – a critical aspect for TVET.[105] Digital tools have been a useful mechanism of circumventing these challenges – to an extent. For example, teachers/trainers in Chile reported that they are planning to use the Padlet tool[106] to evaluate the results of students' work through video recordings when performing skills, and, where possible, to also use digital simulators. Moreover, a TVET provider in Chile indicated that the institution was using e-learning for WBL components of the curriculum, although this excluded low-skilled and more vulnerable workers who did not have a computer or internet connection. In Lebanon, respondents used workshop videos prepared by the teachers/trainers as well as curating existing videos from YouTube based on targeted competencies and shared with students. The main barrier to implementation, however, was how quickly the pandemic had spread, giving institutions little time to prepare contingency plans for WBL programs. An additional key obstacle is in industries such as construction and manufacturing, where because the type of work is highly practical, it is difficult to rely solely on virtual apprenticeships.[107]

Virtual apprenticeships have been conceptualized differently around the world, one way being with 'e-apprenticeships.' The e-Apprenticeship model aims to deliver formal learning opportunities while

[101] International Labour Organization and Unesco. (2020). The Digitization of TVET and Skills Systems - Geneva: ILO. Retrieved from https://www.ilo.org/skills/areas/skills-policies-and-systems/WCMS_752213/lang--en/index.htm
[102] On-the-Job Training. (nd). Virtual Apprenticeships. Retrieved from https://ojt.com/virtual-apprenticeships-covid-19/
[103]Nebraska Career Clusters. (nd). Homepage. Retrieved from https://www.nebraskacareerclusters.com
[104] Simmons, B.K. and Stoehr, M.J. (2020). Employment Preparation and Work Based Learning Experiences in a Virtual World. Retrieved from https://transitioncoalition.org/wp-content/uploads/2020/04/Participant-Version-Employment-Preparation-and-WBLE-in-a-Virutal-World-April-7-2020-Webinar.pdf
[105] International Labour Organization, UNESCO, and World Bank Group. (2020). ILO-UNESCO-WBG Joint Survey on Technical and Vocational Education Training (TVET) and Skills Development Training during the time of COVID-19. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/genericdocument/wcms_742817.pdf
[106] See https://padlet.com
[107] Adecco. (2020). The Advantages And Disadvantages Of Virtual Apprenticeships. Retrieved from https://www.adecco.ca/en-ca/blog/the-advantages-and-disadvantages-of-virtual-apprenticeships/

apprentices are participating in WBL. This serves the purpose of alleviating the time and opportunity costs normally associated with the formal learning components of expansive apprenticeships. E-Apprenticeships integrate pedagogy (through the formal education components) and heutagogy[108] (through WBL), giving students the opportunity to integrate theory into practice. This model has been piloted in the Canadian TVET system to decrease direct and opportunity costs to students and employers, while simultaneously improving student outcomes.

Red River College in Manitoba used this model to roll out the E-Apprenticeship Alternate Delivery Design Initiative (EADDI), which sought to use alternative modes of delivery to increase the capacity of the technical training system to meet the projected need for skilled tradespeople. An evaluation of the initiative found that ICT-based instruction lowered the cost of study and allowed students to stay in their communities and earn an income while working, thus improving the accessibility of apprenticeships.[109] However, the roll-out faced some issues, including that scheduling of the programs was not optimal and that students were not used to online learning. Nevertheless, a key takeaway was that 'there needed to be pre-testing of online students to gauge who was comfortable with online self-study and who needed support or other accommodations in their studies.' Teachers/trainers also felt ill-equipped to handle online teaching, with insufficient technological, instructional and communication skills in some cases. Thus, although there is a dearth of evidence from LMICs, e-apprenticeships present a promising approach to scalable WBL in LMICs, provided that sufficient support mechanisms are in place to ensure that students are equipped to learn effectively and teachers/trainers to teach effectively.[110] The example presented above also reiterates how online learning might bend the educational cost curve without adversely affecting quality by lowering the marginal costs of education provision.

WBL is becoming a more prominent area for EdTech companies to focus on. As such, the sector has seen increasing development of solutions that address key needs. For example, aXcelerate – based in Australia – is a cloud-based student management system that offers a variety of solutions including those focused on short courses, VET in schools, Assessment and WBL. The system manages all aspects of running an Australian training organization and ensures that users comply with government standards. aXcelerate also integrates with common education and financial applications to provide a seamless, flexible, and customizable solution.[111] The soon-to-be-launched aXcelerate WBL solution is mobile-friendly, allowing students to use their mobile devices to capture WBL evidence through IOS and Android apps. It also offers offline capabilities, allowing students to record and create log entries, regardless of whether they are connected to the internet. Students can also access learning resources such as eLearning, assessments, and any other course related information directly from the Student App.[112]

EdTech has also demonstrated the capability of enabling the remote assessment of skills in LMICs. In Malaysia, students can demonstrate mastery of practical knowledge and skills by uploading evidence of workplace competence (including videos or audio) onto a MOOC platform, or they can be assessed in real-time remotely. Uploaded videos allow the teachers/trainers and other users to access them

[108] Also referred to as self-determined learning, heutagogy is a student-centered instructional strategy that emphasizes the development of autonomy, capacity, and capability in students.
[109] Little, P. (2017). Canada: E-Apprenticeships. In C. Latchem (Ed.), Using ICTs and blended learning in transforming TVET, pp. 169–184. Paris, France and Vancouver, Canada: UNESCO and Commonwealth of Learning. Retrieved from https://en.unesco.org/sites/default/files/247495eng.pdf
[110] Kanwar, A., Balasubramanian, K. and Carr, A. (2019). Changing the TVET paradigm: new models for lifelong learning. Retrieved from https://www.tandfonline.com/doi/pdf/10.1080/14480220.2019.1629722
[111] eduWorks resources. (2017). Everything your RTO needs – in one system. Retrieved from https://www.eduworks.com.au/axcelerate/
[112] aXcelerate. (nd). Work-based Learning. Retrieved from https://www.axcelerate.com.au/work-based-learning

easily. This also means employers can see the skills which are most sought-after first-hand and are not simply reliant on a third party to assure them that the skills exist.[113]

In countries where there is minimal history of employer involvement in education and training, virtual tools offer a way for students to develop vocational skills that they otherwise may not have access to.[114] New technologies, such as simulators and extended reality, can support the provision of practical training outside of workplaces. These technologies are particularly valuable because of their scalability, flexibility, and safety. As such, they have the potential to significantly support teaching and learning in TVET systems.

COVID-19 appears to have accelerated the adoption of distance learning approaches and technologies in TVET – around 15% of TVET providers participating in the ILO-UNESCO-World Bank survey reported that no online or offline distance learning was offered at the time of the survey, approximately 66% indicated that training was provided completely remotely and a further 12% of TVET providers reported that training was provided partially remotely and partially face-to-face. To this end, some respondents indicated that they were using simulation software such as STR, Opera and Amadeus for practical components of training.[115] Although these technologies remain out of reach for many TVET institutions in LMICs because of their cost, they remain promising. As the technology becomes more advanced and there is accelerated demand driven by COVID-19, increasingly affordable accessibility in LMICs should become a reality.

Credentialing and Recognition of Prior Learning (RPL)

With rapidly changing economic structures and processes, the skills required by industry are changing. As disruptive technology forces emerging markets to change their economic development paths, new skills are constantly required to adapt to a changing environment. Increasingly workers will require continuous learning and ability to augment their current skillsets to stay relevant in the face of both new technologies and digitization of current tasks. This will most likely generate greater demand both for more modular learning to facilitate more flexible acquisition of skills and recognition of micro-credentials to enable workers to signal gained skills. It also demands greater access to upskilling and reskilling opportunities for those who are left behind by structural change or improved resilience to cyclical fluctuations via skill diversification. Micro-credentialing holds much potential in LMICs to support more flexible modes of delivery.

A micro-credential is a stand-alone educational award formally recognizing student accomplishment. Micro-credentials are outcomes-based, clearly identifying and specifying what knowledge, competence, and skill the student has mastered. They focus on modules of learning much smaller than those covered in conventional qualifications, which often allow students to complete the requisite work over a shorter period. They are designed to validate actual learning outcomes achieved and the granularity of the learning undertaken. They allow students to accurately display and articulate their specific competencies and transport their credentials between institutions, registration agencies, and the workplace. Micro-credentials focus on defined learning outcomes and on how these are applied.

[113] Azwar Mazin, K., Norman, H., Nordin, N. and Ibrahim, R. (2020). Student Self-Recording Videos for TVET Competency in MOOCs. Journal of Physics: Conference Series. Retrieved from https://iopscience.iop.org/article/10.1088/1742-6596/1529/4/042061/pdf

[114] Sweet, R. (2014). Work-based Learning: A handbook for policymakers and social partners in ETF partner countries. https://www.etf.europa.eu/sites/default/files/m/8EFD210012D6B04EC1257CE60042AB7E_Work-based%20learning_Handbook.pdf

[115] International Labour Organization, UNESCO, and World Bank Group. (2020). ILO-UNESCO-WBG Joint Survey on Technical and Vocational Education Training (TVET) and Skills Development Training during the time of COVID-19. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/genericdocument/wcms_742817.pdf

The fragmented nature of the credentials means they can be delivered in multiple modes, within flexible timeframes, to a wide variety of students.[116] Micro-credentials can be obtained for learning delivered in various ways (face-to-face, online, blended, hybrid). They usually include a formal assessment of the student's demonstrable competence of that specific skill. This can take the form of a badge, certificate, nano-degree, professional certificate, or recorded in a digital wallet or e-portfolio.[117] Micro-credentials have been created by companies such as Google and IBM, professional bodies or associations, non-profit organizations, colleges, universities (for example, MicroMasters at Massachusetts Institute of Technology[118]) or training organizations or combinations of these organizations, as well as MOOC providers such as Coursera, EdX, Udacity and FutureLearn, often in partnership with prominent universities.[119]

The COVID-19 pandemic has provided impetus for rapid implementation of micro-credentials by governments. Whilst several countries and agencies are focusing their attention on micro-credentials, there is a dearth of evidence on its use and adoption in TVET in LMICs. In the United States, several states are incorporating micro-credentials into their professional development programs for teachers. Likewise, the State University of New York has introduced micro-credentials as a part of its suite of credentials or qualifications. International government organizations such as UNESCO and the OECD are focusing on micro-credentials. In addition, the European MOOC Consortium launched a Common Micro-Credential Framework to create portable credentials for lifelong long learners.[120]

Various platforms that support online learning can be used to support the design, development, and delivery of micro-credentials, whether in blended or fully online modes. Competency-based assessment technologies that make use of video-based assessment or other direct evidence of demonstrable skills and competencies. The leading platforms in North America – Canvas, Sakai, Moodle, Blackboard, Brightspace – are all being used to offer micro-credentials.[121]

Depending on how they are structured, authorized, and quality assured, micro-credentials may include badges. Digital badges are visual tokens of competency and achievement to capture and communicate what a student knows and can demonstrate. Their emergence has been facilitated by the development of digital platforms that can safely record, store, and transmit these micro-units of learning between institutions. Through these means, micro-credentials can be authenticated as being issued by an authoritative source, then added and 'stacked' to make different combinations of qualifications to form a larger or macro-credential.[122]

Essentially, badges are granular (pinpointing where skills and competencies have been demonstrated), stackable (added to credential repositories, mapped to qualifications frameworks, and more easily be understood in terms of eligibility for credits in other credential systems), evidentiary (directs readers

[116] Clayton, J. (2019). Micro-credentials in professional and technical vocational education and training: A cultural self-approach, Positional Paper, Awanuiārangi Press, Whakatane, New Zealand. Retrieved from https://www.researchgate.net/publication/335337091_Micro-credentials_in_professional_and_technical_vocational_education_and_training_A_cultural_self-approach_Positional_Paper_Awanuiarangi_Press_Whakatane_New_Zealand/link/5d5f455545851521025a1573/download

[117] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis

[118] The MicroMasters program credential from MIT Open Learning is a professional and academic credential for online learners from anywhere in the world who seek focused, accelerated advancement.

[119] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis

[120] Wheelahan, L., and Moodie, G. (2021). Analysing micro-credentials in higher education: a Bernsteinian analysis. Journal of Curriculum Studies. Vol 53(2). Retrieved from https://www.tandfonline.com/doi/full/10.1080/00220272.2021.1887358

[121] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis

[122] Wheelahan, L., and Moodie, G. (2021). Analysing micro-credentials in higher education: a Bernsteinian analysis. Journal of Curriculum Studies. Vol 53(2). Retrieved from https://www.tandfonline.com/doi/full/10.1080/00220272.2021.1887358

to learning evidence created by the student), personalized (accurately representing each student's achievements and where skills or outcomes were achieved above the minimum standard); and machine-readable (if built using open technical standards, they enable rich analytics). Digital badges can play a significant role in learning: motivation, recognition of learning, signaling of achievements, capturing of learning paths, and the potential to contribute to student retention.[123] One example of this is ILO's International Training Centre (ITCILO), which recently switched to digital credentials for its certification. Whilst this is not a formal TVET example, it does provide learnings that can be useful for formal TVET. The initiative notes the benefits for students in that they are able to add badges to their LinkedIn profiles and personal webpages, able to share certificates with short posts on social media, and improve their professional reputation. For ITCILO staff, the move has reduced their administrative work, allowing them to focus on more interesting work. In addition, the move is more sustainable as it eliminates printing and mailing costs, reduces paper use, streamlines the logistical process, and enables a lifelong digital archive of all students.[124]

Blockchain technology[125], originally developed for cryptocurrencies, is also being explored for digital credential certification. This technology, which allows for the issuing of academic and professional micro-credentials, can improve data verifiability, availability, and reliability regarding evidence of learning. By using blockchain technology for digital credentials, it becomes possible to provide 'a single secure record of educational attainment, accessible and distributed across many institutions'[126]. Several countries are now exploring blockchain technology to support certification of qualifications. For example, Malta is conducting a country-level pilot, using the BLOCKCERTS standard developed by MIT to develop a 'learning wallet' which allows students to store their qualifications digitally. In Ethiopia, Cardano is working with the Ministry of Education to build a blockchain-based universal student credentialing system. [127] However, blockchain is still a relatively new technology and it will take time to establish its use widely and assess its impacts. It is also 'power-intensive' and thus has massive power requirements, which raises concerns regarding its environmental sustainability.[128]

An alternative to blockchain is storing credentials on multipurpose digital identity platforms. In 2015, the Government of India launched Digilocker – a Government-owned cloud based platform for storage, sharing and verification of documents and certificates. The aim is to minimize the use of physical documents and enable e-sharing of documents across different agencies. One of the features of the platform is that it has allowed State education and skills boards to make exam results available on Digilocker, with users able to link their results to their account. Digilocker integrates with the Central Board of Secondary Education to contain all examination-related material and with *Pradhan Mantri Kaushal Vikas Yojana* (PMKVY), the Government's skill certification scheme that supports

[123] Chakroun, B., and Keevy, J. (2018). Digital Credentialing - Implications for the recognition of learning across borders. Unesco. Retrieved from https://unevoc.unesco.org/home/Digital%20Cred%20Report
[124] ITCILO. (2020). Introducing the ITCILO's new digital credentials. Retrieved from https://www.itcilo.org/stories/introducing-itcilos-new-digital-credentials
[125] Builtin defines blockchain as 'decentralized, distributed ledger that records the provenance of a digital asset. By inherent design, the data on a blockchain is unable to be modified, which makes it a legitimate disruptor for industries like payments, cybersecurity and healthcare'. Retrieved from https://builtin.com/blockchain
[126] Sharples, M., and Domingue, J. (2016). The Blockchain and Kudos: A Distributed System for Educational Record, Reputation and Reward. In Verbert, K., Sharples, M., and Klobučar, T. (Eds). Adaptive and Adaptable Learning. 11th European Conference on Technology Enhanced Learning, EC-TEL 2016, Lyon, France, September 13-16, 2016, Proceedings. Retrieved from https://link.springer.com/chapter/10.1007/978-3-319-45153-4_48
[127] United Nations Children's Fund. (2021). Unlocking the Power of Digital Technologies to Support `Learning to Earning' for Displaced Youth. Retrieved from https://www.unicef.org/media/105686/file/Learning%20to%20earning%E2%80%99%20for%20displaced%20youth.pdf
[128] Chakroun, B., and Keevy, J. (2018). Digital Credentialing - Implications for the recognition of learning across borders. Unesco. Retrieved from https://unevoc.unesco.org/home/Digital%20Cred%20Report

Indian youth to participate in industry-relevant training. Data indicates that more than 13 million people have had Skill Enhancement or Skill Proficiency Certificates issued via the platform.[129]

There are several benefits of digital credentialing, and particularly micro-credentials, which directly influence the dimensions of access, quality, and relevance. For example, for students they enhance access to learning on demand, allowing them to reskill and upskill quickly, while encouraging and rewarding self-motivated learning. They provide professional development and lifelong learning opportunities for people working in the gig economy.[130] They are usually at a lower cost to students and provide the opportunity to 'earn while you learn'. It provides training institutions with new sources of revenue, new markets, and students; allows for the ability to experiment and take risks with models for teaching, learning, assessment and delivery; and creates stronger links with employers, community organizations and professional bodies. Employers can close skills gaps among existing employees, improve their recruitment strategies through competency-based hiring, and retain employees by rapidly deploying training linked to new technology, new business processes and new markets. Governments benefit through faster response to emerging social and economic needs for training/learning, and focused opportunities for reskilling in areas of high unemployment.[131]

For micro-credentialing to be effective, several issues need to be tackled:[132]

- Access to connectivity, equipment, and digital skills. A heavy reliance on technology for micro-credentialing creates a risk of perpetuating digital insiders and outsiders, while further excluding those already excluded from the labor market.
- Pathway visibility, or the ability to 'connect the atoms' so that work-seekers have can understand and are able to develop marketable portfolios of credentials that combine effectively into more meaningful qualifications over time.
- Quality assurance so that skills are portable and there is trust in the signal provided by the micro-credential. Systems are needed to help students and employers identify which learning opportunities and micro-credentials are valid and of quality.
- The risk that 'the whole is less than the sum of the parts', that learning becomes too fragmented; failing to result in a meaningful whole that is recognizable to employers.

Thus, TVET systems and credentialing authorities need to provide quality assurance and governance systems that are responsive to this changing landscape, to make credentialing information from multiple sources more accessible, to provide the methodologies for comparing credentials, and to understand how these combine meaningfully. Whilst the functionality must ultimately exist across the TVET system, the imperatives and pace of 4IR suggest that responses focused on specific economic sectors and/or disciplines can offer some of the agility that is needed in the short- to medium-term.

RPL

With new ways of learning, there is also a need to consider new ways of recognizing learning. There are mechanisms to recognize learning in a way that facilitates or leads to accreditation. One such mechanism is credit transfer, which refers to institutions granting credit to students who have taken courses at other institutions. Another, more commonly explored mechanism for accreditation is RPL.

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[129] United Nations Children's Fund. (2021). Unlocking the Power of Digital Technologies to Support `Learning to Earning' for Displaced Youth. Retrieved from https://www.unicef.org/media/105686/file/Learning%20to%20earning%E2%80%99%20for%20displaced%20youth.pdf

[130] A gig economy is a free market system in which organizations contract with independent workers for a short-term engagement. The term 'gig' is a slang word meaning 'a job for a specified period of time' and was used typically by musicians.

[131] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis

[132] Keevy, J. Rein, V. Chakroun, B. and Lori Foster, L. (2019) 'Credentialing in the 21st Century – beyond event horizon', in Oswald, F. Behrend, T. Foster, L. Workforce readiness and the future of work, Routledge, New York, p. 246.

This process allows students to demonstrate and obtain recognition for learning they have acquired within or outside a formal educational setting. RPL has been defined as:

> *The principles and processes through which the knowledge, skills and competences of a person are made visible, mediated and assessed for the purposes of certification, progression and professional standing (Keevy and Chakroun, 2015).*[133]

RPL is an assessment process that involves assessment of an individual's relevant prior learning (including formal, informal, and non-formal learning) to determine the credit outcomes of an individual application for credit.[134] Students who have obtained knowledge and skills through informal and non-formal learning and work experience can apply for RPL to obtain credit for admissions purposes into formal TVET. RPL is a means of formally certifying prior learning as per accreditation standards. Such certification allows students entry into the training course/program or could qualify them for a specific job. Making RPL possible and allowing students to gain credit for their current skills can improve their earnings and provide an entry point to learning pathways and progression. Research shows that, for RPL, the use of learning portfolios is fairly popular, followed by examinations that allow students to challenge-for-credit through assignments, examinations, interviews, courses, tutorials, demonstrations, self-assessment, external evaluations, essays, and face-to-face or online workshops. Whilst many RPL-supportive institutions have developed resources and structures that cover most aspects of accreditation and assessment, these RPL practices and policies differ widely between countries and institutions. They evaluate learning that has occurred outside a given degree-granting institution, but still in relatively strict accordance with the criteria of that institution.

EdTech plays an important role in RPL. Digital credentials can be recognized as part of RPL, and the online nature of digital credentialling can expedite the RPL process. Electronic Portfolio systems can help students build their e-Portfolios and align them with a competency framework. An e-Portfolio can be described as 'a student-driven collection of digital objects demonstrating experiences, achievements and evidence of learning'. Thus, e-Portfolios are an evidence-gathering tool that students can use to show their learning achievements and to document the competencies they have attained from training courses and work-based experiences (including apprenticeships and traineeships), thus allowing them to plan for RPL. One example of an e-Portfolio system is the Mahara e-Portfolio system, which enables students to capture evidence of their learning (see boxed example below).

[133] Chakroun, B., and Keevy, J. (2018). Digital Credentialing - Implications for the recognition of learning across borders. Unesco. Retrieved from https://unevoc.unesco.org/home/Digital%20Cred%20Report

[134] Australian Qualifications Framework. (2012). Recognition of Prior Learning: An Explanation. Retrieved from https://www.aqf.edu.au/sites/aqf/files/rpl-explanation.pdf

Mahara ePortfolio Management System

Mahara is a free and open-source web-based electronic portfolio management system written in PHP and distributed under the GNU Public License. The Mahara e-Portfolio system enables learners to capture evidence of their learning through a variety of media (e.g. video, audio, documents, blogs and plans) and to share with selected audiences. Mahara combines a range of social collaboration tools including blogs, comments, groups, forums and profile pages, and integrates the use of mobile devices. Mahara allows teachers to develop student-centered customized delivery and assessment strategies, and enables individualized and industry-contextualized assessment of learners.

One institution that uses Mahara is the Box Hill Institute of TAFE (BHI), which provides education and training across its campuses and licensed partners in Singapore, Macau, Kuwait, Tehran, Dubai, Abu Dhabi, Fiji, Samoa, PNG, Vanuatu, Vietnam, Malaysia and China. The BHI introduced the Mahara e-Portfolio system recognizing the need to assist students to secure a pathway for lifelong learning and to embed e-learning, while also supporting connection and communication between classroom-learning and workplace-learning.

Source:

- Yian, T.T.T. and Park, J. (2017). Beyond Access: ICT-enhanced Innovative Pedagogy in TVET in the Asia-Pacific. Retrieved from https://en.unesco.org/sites/default/files/ict-

Certif-ID (2019) notes that e-Portfolios were developed on the 'supply-side' of the labor market to gather evidence of competence, link it to standards which make up a qualifications, and then sign-off when a student has reached the required level of competence. Recent trends are of employers using eCredentialing platforms such as Credly, DigitalMe and Certif-ID.

> *Their most basic feature is secure and verifiable credentials which can be interrogated by employers or HE institutions on-line but, more interestingly, they can evolve into on-line labor marketplaces which free people from local networks of trust which usually dictate employment opportunities, and can allow direct contact between employers and students.*[135]

Developing a SkillPass for seafarers

Certif-ID joined forces with TÜV Rheinland Philippines and Multiple Government Agencies to support seafarers impacted by COVID-19. Alongside government partners, it launched an initiative to help unemployed seafarers create a digital community to find jobs. This involves using a SkillPass, which seafarers can use to showcase their skills, record and share online interviews and store all relevant information in a digital portfolio secured with blockchain technology.

Source:

TÜV Rheinland. (2020). Certif-ID Joins Forces with TÜV Rheinland Philippines and Multiple Government Agencies to Support Seafarers Impacted by COVID-19. Retrieved from https://insights.tuv.com/blog/certif-id-joins-forces-with-t%C3%BCv-rheinland-philippines-and-multiple-government-agencies-to-support-seafarers-impacted-by-covid-19

Digital credentials are becoming sufficiently substantive to be included in national qualifications frameworks, with some micro-credentials being credit-bearing if they are aligned with a specific qualification.[136] In some countries, micro-credentials can be 'stacked' to create a credit course, which is then transferable from the college system to the university system. For example, in Canada, micro-credentials can be recognized and transferred into a degree or diploma.[137] In Ontario, Canada, micro-credentials are 'transcriptable', meaning that they are qualifications or certificates that a college or university can include on a student's transcript.[138] All colleges and universities in Canada are partnering with Digitary[139] to create

[135] Certif-ID. (2019). Using technology to keep the promises of TVET. Retrieved from https://e-assessment-question.com/wp-content/uploads/2020/02/Mike-Dawe-paper.pdf

[136] Harris, L. (2019). Micro-credentials – measuring the value of soft skills. https://insights.navitas.com/micro-credentials-measuring-the-value-of-soft-skills/

[137] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis

[138] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis

[139] See https://www.digitary.net/

a national blockchain-enabled digital credentials service. This will allow students to access their digital credential wallet and add any credentials they earn to it. Where credentials are time-limited (the skill needs updating given new requirements or is automatically outdated due to changes in technology or new developments in that skill or competency), an existing credential can be revoked by the provider.

In some countries, the government's strategic response to economic recovery during the COVID-19 pandemic has been to invest in the rapid development and deployment of micro-credentials. For example, Australia has invested US$4.3 million to support the growth of micro-credentials and to create a marketplace for them.[140] A current review of the Australian Qualifications Framework (AQF) is considering the role of micro-credentials in Australia's formal credential architecture. It is understood that current thinking supports the role of micro-credentials in the broader Australian education landscape, but to minimize complexity, the mechanism for RPL (the AQF Qualifications Pathways Policy) needs to be elevated and reinvigorated. [141] In addition, the OpenCreds framework is the first cross-sector micro-credential framework for Australian education. OpenCreds is now available for Malaysia, drafted to align with the Malaysian Qualifications Framework (MQF) and the Guidelines to Good Practices: Micro-credentials (GGP: Micro-credentials) by the Malaysian Qualifications Agency (MQA).[142]

There are also several government efforts focusing on verification of qualifications. For example, the China Higher Education Student Information and Career Center (CHESICC)[143] (an authoritative institution directly under Chinese MoE) provides a qualification verification service. France and the United Kingdom also have digital databases for verification of qualifications.[144]

Governments are also working towards creating equity in the TVET system by allowing students to accumulate credits and apply them to credentials. This creates upward mobility in the sector, promotes access, and allows any student to compete on a level playing field (see boxed example on China's credit bank as an example).

[140] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis
[141] Harris, L. (2019). Micro-credentials – measuring the value of soft skills. https://insights.navitas.com/micro-credentials-measuring-the-value-of-soft-skills/
[142] openlearning. (nd). Introducing OpenCreds for Malaysia. Retrieved from https://solutions.openlearning.com/opencreds/opencreds-microcredentials-for-malaysia
[143] See https://www.chsi.com.cn/en/
[144] Chakroun, B., and Keevy, J. (2018). Digital Credentialing - Implications for the recognition of learning across borders. Unesco. Retrieved from https://unevoc.unesco.org/home/Digital%20Cred%20Report

China's Credit Bank

In China, in 2020 the government passed regulations for the construction of a National Credit Bank of Vocational Education. This included the recognition and accreditation of online skill learning achievements. It will record individual vocational education credits to enable the transfer and conversion of those credits towards other certifications. The National Credit Bank System (NACBS) is a central agency and mechanism through which credit can be accumulated and applied to credentials and provide students with greater access to, mobility and progression within education, and training and career paths, thus fostering a lifelong learning society.

The Open University network provides formal and non-formal higher education programs. Since 2012 it has started to research and design a model called "Credit Bank" for the accreditation, accumulation and transfer of formal and informal learning outcomes. The OUC (2017), under the guidance of the Ministry of Education, has organized 55 units, including relevant ministries and commissions, colleges and universities, vocational schools, open universities, training institutions and communities, to be engaged in a pilot. Between 2012 to 2016, more than 670 accreditation standards were developed. Partners established 67 Learning Outcome Accreditation Sub-Centers across China and 4.3 million personal learning accounts have been created. The OUC (2017) launched an online platform called "Online Credit Bank Platform" on November 10, 2017. It enables millions of students to study and transfer their learning outcomes, anywhere, anytime.

Sources:

- Wang, L. (2020). Policy Framework and Platform Development in China. Retrieved from: https://internationaleducation.gov.au/news/latest-news/Pages/China-announces-majer-reform-to-vocational-education-sector.aspx
- Zawacki-Richter, O. and Qayyum, A. (2019). Open and Distance Education in Asia, Africa and the Middle East. Retrieved from: https://www.researchgate.net/publication/331299194_Open_and_Distance_Education_in_Asia_Africa_and_the_Middle_East
- Zhou, M. (2019). Credit: Self-Growth, Dreaming of the Future—Exploration and Practice of Zhejiang Lifelong Education Credit Bank. *Open Access Library Journal*, **6**, 1-9. Retrieved from: https://www.scirp.org/journal/paperinformation.aspx?paperid=92194

Geographic mobility is an important element of social mobility. Credentials linked to international frameworks of competence can support economic migrants in finding jobs and experience abroad which may not be available at home, and gain credit for the skills they develop when they are there.[145] An example of this is the recent development of Sri Lanka's National Skills Passport, which provides recognition of skilled workmanship and the verified work experience through the central web-based online database (see boxed case study below).

[145] Certif-ID. (2019). Using technology to keep the promises of TVET. Retrieved from https://e-assessment-question.com/wp-content/uploads/2020/02/Mike-Dawe-paper.pdf

The National Skills Passport in Sri Lanka

Introduction

In Sri Lanka, the Tertiary and Vocational Education Commission (TVEC) is an apex body in the TVET sector whose primary responsibilities are policy formulation, planning, quality assurance, coordination, and development of tertiary and vocational education in the country. There are 1,300 active TVET centers including public and private sectors across the country. In 2014, the National Vocational Qualification (NVQ) was introduced, which is the current National Policy in Sri Lanka for vocational education.

One of the innovative practices by the Sri Lankan system, which aims to improve the TVET sector in the country, is the introduction of a Skills Passport. A skills passport is a digital smart space that allows students to record their skills, competences, and knowledge. In Sri Lanka, TVEC, together with The Employers' Federation of Ceylon (EFC) and the International Labour Organization (ILO) embarked on the Skills Passport initiative for the country.

> *The Skills Passport is a comprehensive portfolio of skills and qualifications of a worker, acquired informally, along with references. This enables both employers and workers of Sri Lanka to compare their skills with various skills assessment frameworks. It is essentially a "gateway" to finding a job and accessing further training for re-skilling and up-skilling.*[146]

Skill passports have been a growing phenomenon, particularly in contexts of highly homogeneous education and training systems, such as within the European Union (EU). In the EU for example, the "Euro Pass" confirms to which level of the European Qualification Framework the skills correspond, regardless of how they have been acquired and where.

This documentation system aims to ensure that students' skills, expertise, and experience is recorded in a methodical manner, both within and across sectors. It records the current competencies of a worker. It can be used in the formal sector to help employees create a comprehensive portfolio of skills and qualifications, along with their references and experience, ensuring compatibility with various skill assessment frameworks. The passport allows students to identify their experience under the national skills assessment systems, explore job opportunities, and further their training for re-skilling and up-skilling. In Sri Lanka, the National Skills Passport (NSP) serves as an extension of the NVQ qualification awarded by TVEC jointly with accredited training providers). The ultimate objective is to ensure that every citizen entering the workforce, at least by 2035, will be certified in their skills and registered in the database.

How it works

The NSP is a smart card issued to a skilled person who possesses a NVQ and at least one year of confirmed and verified related employment experience. This card is connected to a fully online system (www.nsp.gov.lk) which links different stakeholders such as employees, employers, qualification bodies, and labor market intermediaries by collating the passport holder's skills, expertise and experience. It provides recognition of skilled workmanship and the verified work experience through the central web-based online database. The NSP also carries a QR code for convenient online searching.

Figure 2 The Skills Passport

The following people can access the NSP:

- Students already holding a NVQ;
- Returning migrants;
- Workers who have been serving various industries with no formal paper qualifications; and
- Mature candidates (people with ten or more years of work/industry experience without formal qualification).

[146] National Skills Passport. (nd) Home Page. Retrieved from http://www.nsp.gov.lk/

NSP users are required to complete an online form indicating their qualifications and work history. The instructions in the database are provided in three languages (English, Sinhala, and Tamil).

The system also enables one to track employment y of the NVQ holders with an up-to-date database. Based on students' national identity number or passport number, the NSP database can access data from the NVQ student database to ascertain whether students have a NVQ.

Once the user form is submitted, employer credentials are verified by the EFC database or via manual verification of SMEs by regional bodies in the case where employers are not EFC members. The process usually involves NSP staff sending verification requests to the EFC, the EFC verifying the employer in their database, and then completing the required form which is sent to the NSP via email. The verification is then manually uploaded to the NSP database. In addition, the regional bodies also assist with the verification of SMEs or those that are self-employed.

Once all information is verified, users are informed via email and SMS to collect their Skills Passport, which is valid for a period of five years. Before expiry, users will be notified that they need to reapply for renewal of the Skills Passport.

Benefits

The NSP provides benefits to all stakeholders:

- **Workers** – allows their skills and experience that have been obtained informally to be assessed and certified. It creates opportunities for entrepreneurship and further learning, enabling upward mobility in employment, leading to better wages and working conditions. It can be used in the formal sector to help employees create a comprehensive portfolio of skills and qualifications, along with references and experiences, which ensures its comparability with various skills assessment frameworks. This provides the NSP holders a 'gateway' to find suitable jobs, accessing reskilling and upskilling opportunities locally and internationally.
- **Employers** – allows them to access skilled workers with international experience, and they are able to recruit the right person for the job with the specified skill set.

  > *Skills passport supports to formalize the informal skills and thereby employees get better opportunities and higher salaries so that they can retain in the jobs for longer duration.*[147]

  Further, it reduces time and costs associated with recruitment and allows employers to recruit workers with certified skills and authenticated experience. In this system, experience of a person is primarily authenticated by the EFC and their network of HR managers. Employers could eventually identify the upskilling and reskilling requirements of an employee. This will help career progression, labor mobility and the search for better employees through the system.
- **Government** – allows for the bridging of labor market gaps locally and internationally. It also supports the Government's long-term skills planning for the economy and facilitates easier matching of skills for future employment creation.

  > *The system will provide information for streamlining migrant workers by skill-type by bridging the gaps in the labor market both locally and overseas. Eventually, this will help attract migrant returnee workers to industries such as construction, which are currently facing a high demand, with inadequate local workers to bridge the gap.*[148]

Importantly the NSP provides pathways to employment. The NSP can be directly linked with the Recognition of Prior Learning (RPL) being a platform that helps recognize informally acquired knowledge, skills and competencies through formal assessments and certification. Whilst students who already have a NVQ can directly apply for a NSP, other workers need to first obtain a NVQ through the RPL pathway. The NSP can be a career guide for the workers if their RPL results and performance are documented as a starting point to provide evidence of their skill. This will help them move vertically or horizontally through job roles within the industry. Returning migrants need to obtain a NVQ through NAITA before applying for the NSP.

Such candidates are able to apply for related NVQs from a basket of around 500 National Competency Standards (NCS) listed on TVEC website (www.nvq.gov.lk) through the RPL pathway. When they obtain the NVQs they can then apply for the NSP through the TVEC online portal (www.nsp.gov.lk), allowing them to apply for better jobs locally or abroad for a better salary with recognized qualifications.

In addition, the NSP also serves the purpose of creating an online standard CV providing clear, concise and up-to-date information with current employment and educational information. The CV system in the NSP is benchmarked with the 'Euro Pass', an online CV tool for EU countries.

[147] Interview with Janaka Jayalath, Deputy Director General, Tertiary and Vocational Education Commission Sri Lanka, 23 July 2021

[148] Jayalath, J. (2020). Sri Lanka's National Skills Passport Launched on the World Youth Skills Day (WYSD). Retrieved from https://www.linkedin.com/pulse/sri-lankas-national-skills-passport-launched-world-youth-jayalath?art/icleId=6695591149031305216

In essence, the NSP is a system of e-documentation that shall ensure the skills, expertise and experience of a worker in a streamlined manner, providing the individual worker's history both within and across sectors. It also serves the purpose of creating online standard CV (curriculum vitae), a more detailed synopsis than a normal resume. It gives clear, concise and precise and up-to-date information with current employment and educational information. The CV system in the NSP is benchmarked with the "Euro Pass", an online CV tool for EU countries.[149]

Implementation

The roll-out of the initiative was delayed due to the COVID-19 pandemic, and hence the NSP is still in the early stages of implementation. Various worker organizations are working towards obtaining the skills passport for their membership. For example, the Plumbers Guild worked with the Construction Industry Sector Council (CISC) in calling for private plumbing manufacturers to sponsor a program to upskill 100 plumbers. Various development workshops were held to upgrade plumbers' skills, and plumbers were issued with the skills passport once they went through the training and a RPL process. In addition, the Hayley's Plantations Sector representing Talawakelle Tea Estates, Kelani Valley Plantations and Horana Plantations have supported 100 field workers to obtain their NSP in the plantations industry initially.

Individual students are also applying for a Skills Passport directly, via the website (despite the lack of active marketing). Thus far, 300 applications have been received, and approximately 100 cards have been issued, with 200 in the process of being issued.

The TVET network in Sri Lanka comprises more than 100 training centers nationwide, which provide career guidance. These centers are equipped with computers and trained staff who would be able to assist students should they require assistance in completing necessary documentation for the Skills Passport. At the time of writing, these centers were not fully operational due to COVID-19 restrictions.

Challenges

The employer verification process takes time. Once the NSP sends forms to the EFC or employers to complete, it can take up to two weeks or more for the forms to be completed and returned. NSP staff may need to make follow up calls to employers to get the forms.

Another challenge is the current number of staff. The NSP unit falls under the Information Systems (IS) Division of TVEC which has seven staff, and there is one contracted staff member dedicated to the NSP process. This staff member facilitates the employer verification process and assists users if they experience challenges with the website. Thus far, it has been sufficient to have one person fulfilling this role due to the COVID-19 pandemic restricting the marketing of the initiative because of travel restrictions and office closures. The aim is to expand the number of staff dedicated to NSP to three people once the marketing campaign commences in August 2021. In addition, TVEC has proposed that a dedicated call center be set up to address queries and questions from the public in three languages to allow users to access information in their local language. However, the process of recruiting staff for government services is tedious, requiring approvals from several institutions, including the education ministry and the treasury.

A further challenge is incomplete applications. The NSP staff member follows up with users to determine reasons for non-completion. Thus far, reasons for non-completion are due to users not having the required information on-hand. This can include not having reports/certificates providing work evidence from previous employers or not recalling dates of work. In other instances, users may experience difficulty in uploading the required documentation. Thus, for some users a related challenge may be digital skills, although to date this has not been specifically investigated. Once the project is rolled out more widely, surveys will be done to obtain information on further challenges.

TVEC also faces the challenge of ensuring ongoing stakeholder cooperation and collaboration. The Director General (DG) of the EFC has recently changed, and ILO and TVEC are working to convince the new DG to continue participating in the initiative.

The representative of employer federation changed. Now we are trying to convince the new DG. This is a recent challenge we are facing and we (myself and ILO) requested a separate meeting with new DG. It depends on leadership how they are interested in particular project – we will try our best.[150]

[149] Jayalath, J. (2020). Sri Lanka's National Skills Passport Launched on the World Youth Skills Day (WYSD). Retrieved from https://www.linkedin.com/pulse/sri-lankas-national-skills-passport-launched-world-youth-jayalath?art/icleId=6695591149031305216

[150] Interview with Janaka Jayalath, Deputy Director General, Tertiary and Vocational Education Commission Sri Lanka, 23 July 2021

Further, there is currently no government employment policy requiring specific skills for occupations, which poses a challenge to the initiative:

> *We need to have an employment policy on qualifications to get a job or recruit a person. They need valid qualifications. We want to impose this because this is imposed in the informal sector where [workers] can work without any qualification….This is not easy.*[151]

If there is no demand for formal qualifications, this means that the demand for the NSP will be limited. Thus, TVEC is lobbying government to put this kind of policy into practice to get the demand from industries – if there is no demand, workers will not apply to get their skills recognized.

Lessons learned

Stakeholder cooperation and collaboration is significant to ensure smooth rollout of the initiative. ILO was a funding partner from the onset of the initiative and continues to support the initiative as it is implemented. The role of the EFC is invaluable in handling the employer verification aspect. In continuing the implementation of the initiative, formal agreements between stakeholders are critical to ensuring that the initiative is sustainable.

There is still a need to promote the NSP amongst employers and its potential to address the challenge of not finding people with the required quality of skills.

> *Employers complain that people …don't have skills. Unskilled people take the job and quality is low. I think we can get rid of this kind of situation with the smart card. With the skills passport, employers can scan and see quality and experience, and the employer can be confident that can get the right person to the job. That is how we are going to promote it.*[152]

In addition, the NSP can serve as an important function is establishing and sustaining a National Skills Database.

Next steps

- TVEC is currently working towards introducing NCS for traditional Sri Lankan industries which do not fall within this NCS basket as a means of giving more 'muscle to the rural economy' by recognizing traditional Sri Lankan skills.
- There has not been an impact evaluation of the initiative thus far. As the project is implemented, TVEC wishes to conduct a study on how the NSP is being used, together with challenges users face in the application process. This will hopefully be incorporated into future project plans.
- With ILO support, TVEC is expanding the implementation to include returning migrants, and to increase participation in RPL processes.

  > *We are trying to get more stakeholders to get assessment in RPL mode. We are currently issuing 5,000 RPLs per year. We want to increase this to 50,000. We have already prepared a plan…and will follow up the process now.*[153]

- TVEC has galvanized its network of Skills Development Assistants, regional industrial forums, and District Coordinating Committees at District Secretariats. It is planning to promote and market the NSP in two ways: via social media to target youth, and via the official government network whereby printed posters will be displayed in every village office thereby attracting more mature workers from the public.

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[151] Ibid
[152] Ibid
[153] Ibid

- Interview with Janaka Jayalath, Deputy Director General, Tertiary and Vocational Education Commission Sri Lanka, 23 July 2021

Challenges and lessons learned

Uneven access to EdTech increases inequalities and runs the risk of leaving those behind in the digital divide. Infrastructure proves to be a major bottleneck for effective EdTech in TVET systems. Many examples of successful use of technology in TVET come from high- and middle-income countries that have the necessary infrastructure to support such efforts. Further, internet and mobile network access varies greatly in LMICs. For example, access to the internet is over 80% of the population in some Southeast Asian countries but is as low as 39% in Vietnam and some African countries. The use of EdTech also excludes large groups of disadvantaged students, such as those without infrastructure like electricity, or devices such as television or smartphones.[154] This challenge has been documented across several studies, for example in Sri Lanka it was noted that delivering lectures during the pandemic was not possible due to limited access to the internet and devices.[155] In addition, a 2017 study investigating the use of ICT in TVET teacher training institutions in Uganda found that that was no electronic learning infrastructure in the institution.[156] The COVID-19 pandemic and the corresponding attempt to conduct training and teaching online has again accentuated the large infrastructure gaps in TVET systems in many LMICs,[157] with these gaps deepening inequality in access, a gap seen across countries and between income brackets within countries.[158] Thus, low-income and vulnerable populations may be unable to benefit from EdTech due to lack of electricity or technical limitations in connectivity and equipment, accentuating the digital skills gap that already exists.

[154] Raluca, D., Pellini, A., Jordan, K., Phillips, T. (2020). Education during the COVID-19 crisis - Opportunities and constraints of using EdTech in low-income countries.
[155] Hayashi, R., Jayasundara, H.D.S.A., Garcia, M., Balasuriya, A, and Hirokawa, T. (2021) COVID-19 Impact on Technical and Vocational Education and Training in Sri Lanka. ADB Briefs, March 2021. Retrieved from https://www.adb.org/publications/covid-19-impact-tvet-training-sri-lanka
[156] Bagumisiriza, R. (2017). ICT Adoption in Teaching and Learning in TVET Teacher Institutions in Uganda: The Case of National Instructors' College Abilonino. Africa Journal of Technical and Vocational Education and Training, 2(1), 115-121. Retrieved from https://afritvet.org/index.php/Afritvet/article/view/42
[157] International Labour Organization, UNESCO, and World Bank Group. (2020). ILO-UNESCO-WBG Joint Survey on Technical and Vocational Education Training (TVET) and Skills Development Training during the time of COVID-19. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/genericdocument/wcms_742817.pdf.
[158] Li, C., and Lalani, F. (2020). The COVID-19 pandemic has changed education forever. This is how. World Economic Forum. Retrieved from https://www.weforum.org/agenda/2020/04/coronavirus-education-global-covid19-online-digital-learning/

The WBG Digital Economy for Africa (DE4A) Initiative

The World Bank's DE4A initiative, launched in 2018, aims to ensure that every individual, business, and government in Africa will be digitally enabled by 2030 in support of the African Union "Digital Transformation Strategy for Africa". It is a coordinated, pan-African initiative that seeks to enable all countries on the continent to work together with development partners and the private sector to set up relevant government programs and measures that will act as a catalyst for Africa's digital transformation.

The DE4A initiative is based on five principles:

- ***Comprehensive*** *– taking an ecosystem approach that looks at supply and demand and defies a narrow silo approach in defining the requisite elements and foundations for digital economy.*
- ***Transformative*** *– aiming at a very different scale of ambition beyond incremental 'islands' of success.*
- ***Inclusive*** *– digital economy for 'everyone, in every place, and at all times' creating equal access to opportunities and dealing with risks of exclusions.*
- ***Homegrown*** *– based on Africa's realities and unleashing the African spirit of enterprise to have more homegrown digital content and solution, while embracing what is good and relevant from outside the continent.*
- ***Collaborative*** *– dealing with the digital economy requires a different flexible 'mindset' requiring different type of collaboration among countries, among sectors and among public and private players, facilitation, retooling, and encouraging risk taking.*[1]

In addition, five key "building blocks" are required to implement the initiative: digital infrastructure, digital platforms, digital financial services, digital entrepreneurship, and digital know-how. These building blocks are conditional on a strong regulatory, pro-competition framework.

The initiative highlights the key policy reforms and investments needed at the national and regional level for the continent to achieve its digital development ambitions. The WBG commitment to the initiative has been accompanied by a call for African countries to increase their spending on digital economy and to prioritize critical reforms. The DE4A initiative involves developing Digital Skills Country Action Plans for higher education and TVET, focusing on the rapid development of digital skills among students through coordinated strategies. This includes establish enabling policies and developing a digital skills framework, reforming digital skills programs in TVET and higher education, enhancing the use of technologies in teaching and learning, connecting higher education and TVET institutions to affordable high-speed broadband, and building capacity building and re-engineering business process re-engineering in Ministries and relevant higher education/TVET authorities.

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Thus, infrastructure is a key area where socio-economic stratifications are either entrenched or diminished in relation to EdTech. EdTech has potential to accentuate the already significant and growing digital divide within education, conferring benefit on those with access, and further marginalizing those without such access. However, while the provision of hardware has been an essential focus of debates on the digital divide, it is now seen as only one of a range of factors that must be tackled to increase participation in the 4IR, including provision of basic services such as stable electricity connections, and access to broadband (high-speed) Internet connections. While the digital divide continues to widen, it must be recognized that the divide is not binary and there is no single

Developing digital skills

There have been several initiatives to develop digital skills in LMICs, for example:

- The African Development Bank, the government of Nigeria and Microsoft launched the Digital Nigeria eLearning Platform, to provide marketable digital skills to the country's youth.
- In South Africa, The Council for Scientific and Industrial Research (CSIR) and Siemens South Africa entered into a partnership to empower the country's TVET students with digital skills.
- Microsoft and the National Skills Development Council (NSDC) in India have a partnership focused on enhancing women's workforce participation by equipping underserved young women from rural communities with the skills required to thrive in a digital economy.

Sources:

- African Development Bank. (2020). Nigeria: African Development Bank partners with government and Microsoft to launch Digital Nigeria eLearning Platform. Retrieved from: https://www.afdb.org/en/news-and-events/press-releases/nigeria-african-development-bank-partners-government-and-microsoft-launch-digital-nigeria-elearning-platform-38060
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- Microsoft News Centre India. (2020). Microsoft and NSDC collaborate to empower 1 lakh underserved young women across India with digital skills. Retrieved from: https://news.microsoft.com/en-in/microsoft-and-nsdc-collaborate-to-empower-1-lakh-underserved-young-women-across-india-with-digital-skills/

overriding factor for determining such a divide. Factors that require consideration include access to hardware (including devices for students) and affordable/reliable Internet connections, digital literacy, extent of integration of ICT into the social fabric of everyday life, provision of technical and training support, and access to applications and content. Most importantly, though, unless there is a concerted effort to ensure that steps are taken to integrate marginalized students into EdTech-enriched TVET environments, widening of the digital divide and deepening of social inequities, both within and between countries, is inevitable. There have been several efforts to develop digital skills within LMICs (refer to the box on digital skills which provides some examples of such initiatives).

There have also been efforts to use low-tech approaches to facilitate learning, but these have not always had the desired outcome. For example, in Sri Lanka, teachers/trainers made notable efforts to keep students learning during the COVID-19 pandemic, with more than a third of major TVET courses continuing using low-tech solutions like social media. However, they struggled to deliver online lectures (in contrast to higher education institutions in Sri Lanka where use of online collaboration tools such as Zoom significantly accelerated during the pandemic). Teachers/trainers provided lecture notes and assignments through social media such as WhatsApp. However, because not all students could access digital learning during the lockdown, the TVET teachers/trainers had to repeat lectures once face-to-face training resumed.[159]

In TVET, teachers/trainers lack necessary, industry-based technological skills.[160] This is compounded when looking at **teachers/trainers' lack of preparedness to leverage technology for teaching and learning**. There may be insufficient focus on training TVET teachers/trainers on how to assist students in using digital technologies as tools for learning, communication and collaboration.[161] Data from the Philippines indicate that many teachers/trainers are not comfortable with online learning tasks.[162]

[159] Hayashi, R., Jayasundara, H.D.S.A., Garcia, M., Balasuriya, A, and Hirokawa, T. (2021) COVID-19 Impact on Technical and Vocational Education and Training in Sri Lanka. ADB Briefs, March 2021. Retrieved from https://www.adb.org/publications/covid-19-impact-tvet-training-sri-lanka

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[161] Subrahmanyam.B., and Law, B. (2020). UNESCO-UNEVOC study on the trends shaping 'The future of TVET teaching. UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training. Retrieved from https://www.nepad.org/file-download/download/public/126905

[162] Organisation for Economic Co-operation and Development. (2021). Economic Outlook for Southeast Asia, China and India Volume 2021 Issue 1. Retrieved from https://www.oecd.org/dev/economic-outlook-for-southeast-asia-china-and-india-23101113.htm

A further compounding challenge to effective use of EdTech within TVET institutions is teacher/trainer attitudes and resistance to change. This is largely due to lack of EdTech skills that may have not been covered within the TVET teacher training curriculum or if covered it was shallow and not in-depth since most of the new technologies were not available at that time.[163] In some contexts, even promoting digital tools is difficult. For example, in Ghana, there are difficulties in promoting the use of digital tools amongst teachers/trainers.[164] Negative attitudes of teachers/trainers towards using e-learning applications in TVET courses was also reported in a study in Jordan.[165] The challenge of motivation is not limited to LMICs or teachers/trainers since during the COVID-19 pandemic, several countries reported that students lacked motivation to engage in online learning. Teachers/trainers also required motivation to engage in online learning, particularly if it was a new way of working. For example, in Kyrgyzstan, the adoption of different distance learning tools meant that teachers faced a heavy workload with new teaching methodologies and increased messages and questions from students at all hours.[166] Students may also lack digital skills to access and manage their learning using EdTech. Thus, low levels of existing digital capability and awareness of EdTech opportunities could hinder take-up and ability to directly connect with current EdTech offerings. This is a key consideration for the access dimension, as it highlights the complexities around ensuring effective adoption of technologies.

Thus, a key priority in efforts to increase the quality and relevance of TVET is the reform of pre-service teacher training and the provision of CPD for practicing teachers/trainers. This includes updating pedagogical and EdTech skills for teaching and learning. It also involves ensuring that teacher training institutes have the required ICT infrastructure. In a 2020 ILO-UNESCO study, 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 EdTech training in TVET. There is thus a clear need to widen the pools of expertise within TVET, and to better train teachers to work in a digital-first, student-centered educational environment.[167]

Reaching scale through teacher trainings, for example, typically requires a large investment in time and resources, and can be limited by geography, politics, government policies, and financial constraints. Such trainings could be bolstered by technology,[168] for example, through the provision of MOOCs. There is also the potential to expand the reach of in-service training for hard-to-reach teachers using low tech. For example, TVET Academy[169] equipped eight vocational training centers across Cambodia with a bank of video recordings of TVET teachers/trainers explaining theory and

[163] Obwoge, E., and Kwamboke, O.S.. (2016). E-Learning in TVET: An Opportunity for Developing Countries. IRA International Journal of Education and Multidisciplinary Studies (ISSN 2455–2526), 3(3). Retrieved from https://www.researchgate.net/publication/304496725_E-Learning_in_TVET_An_Opportunity_for_Developing_Countries/link/59c0b6560f7e9b48a29db651/download

[164] Abdullah, A. (2021). NVTI pushes for policies to encourage use of digital tools in TVET institutions. Modern Ghana. Retrieved from https://www.modernghana.com/news/1082079/nvti-pushes-for-policies-to-encourage-use-of-digit.html

[165] Shdaifat, S.A.K., Shdaifat, N.A.K., and Khateeb, L.A. (2020). The Reality of Using E-Learning Applications in Vocational Education Courses During COVID 19 Crisis from the Vocational Education Teachers' Perceptive in Jordan. International Education Studies; Vol. 13, No. 10; 2020. Canadian Center of Science and Education.

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[167] International Labour Organization and UNESCO. (2020). The Digitization of TVET and Skills Systems - Geneva: ILO. Retrieved from https://www.ilo.org/skills/areas/skills-policies-and-systems/WCMS_752213/lang--en/index.htm

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[169] TVET Academy. (nd). Home Page. Retrieved from http://www.tvetacademy.org/en/

practice in their native language. This initiative occurred in partnership with the Ministry of Education. This is an example of how problems related to access to in-service training and access to materials for teachers in remote areas, can be overcome using low-tech solutions and local expertise.[170] In more developed country contexts, there have been efforts to build the capacity to use more high-level technology (see boxed example below which describes the Shenzhen Polytechnic's effort to build the capacity of teachers/trainers to conduct AI-aided teaching.

Shenzhen Polytechnic (SZPT) building the capacity of TVET teaching staff to conduct AI-aided teaching

Shenzhen Polytechnic (SZPT) in China is building the capacity of TVET teaching staff to conduct AI-aided teaching as part of the Chinese Ministry of Education's Artificial Intelligence Action Program for Higher Education Institutions. The initiative involves creating AI resources and tools for education, and is premised on the idea that mutual interaction and collaboration between teachers/trainers and students is the core of AI education. The aim is to transform the way that training is delivered from an individualized mode to one involving structured, hierarchical, team-based cooperation. Teaching methods will be aligned with research findings regarding effective models for integrating AI into education and training, with the focus on developing teachers' and students' cross-occupational competences. The initiative also involves building an AI classroom to support teachers/trainers in making the shift to new forms of teaching and learning. Both pre-service and in-service teachers will receive training in AI and other new technologies.

Source:
Subrahmanyam.B., and Law, B. (2020). UNESCO-UNEVOC study on the trends shaping 'The future of TVET teaching. UNESCO-UNEVOC International Centre for Technical and Vocational Education and Training. Retrieved from https://www.nepad.org/file-download/download/public/126905

Managers in TVET systems and institutions may have insufficient capacity to make decisions around promoting and adopting EdTech within institutions – for example, considering appropriate teaching and learning platforms to facilitate learning for all students, and developing appropriate guidelines and relevant policies on how to approach EdTech in TVET.[171]

In addition, EdTech brings new kinds of support challenges. This introduces the importance of ensuring that technologies adhere to common open standards to facilitate integration and inter-operability. Each new technology introduced brings its own requirements for support, while the support needs of established technologies remain. Introducing new technologies can also create backlash from those expected to change how they work.

There is limited access to online educational resources within TVET systems in LMICs.[172] The uptake of EdTech solutions such as OER, e-books and e-textbooks has been limited in TVET in LMICs but is particularly urgent because of the rising cost of copyrighted and printed materials and a need for high quality resources. Adding to the complexity of this challenge is a requirement for resources with a good instructional foundation to make materials more engaging, digestible, and effective for students. Technology tools are making cheap digital content creation increasingly easy, but sometimes at the expense of proper instructional design, relevance and educational quality of the end product.[173]

[170] Veal, K., and Dunbar, M. (2017). Preparing TVET for the Digital Age. Development Asia. Retrieved from https://development.asia/explainer/preparing-tvet-digital-age
[171] International Labour Organization, UNESCO, and World Bank Group. (2020). ILO-UNESCO-WBG Joint Survey on Technical and Vocational Education Training (TVET) and Skills Development Training during the time of COVID-19. Retrieved from https://www.ilo.org/wcmsp5/groups/public/---ed_emp/---emp_ent/documents/genericdocument/wcms_742817.pdf.
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[173] Tosh, K., Woo, A. and Doan, S. (2021). Did Experience with Digital Instructional Materials Help Teachers Implement Remote Learning During the COVID-19 Pandemic? Rand Corporation. Retrieved from https://www.rand.org/pubs/research_reports/RRA134-8.html

Moreover, the COVID-19 pandemic spurred an influx of cheaply available teaching and learning materials online, as both the demand and supply of these materials increased. However, the pandemic severely impacted students' ability to engage with educational materials, particularly because several programs require practical components in workshops and laboratories, meaning that the need to resort to more theoretical or passive methods of engaging with content, such as reading, videoconferencing, watching demonstrations and videos fell short of achieving the desired engagement.[174] Collaboration among teachers/trainers could greatly assist in increasing the repository of instructionally sound digital materials available for different training fields in TVET.

There is limited evidence that EdTech solutions such as MOOCs have a greater positive impact on learning outcomes in comparison to in-classroom alternatives. But by virtue of being more cost-effective and scalable, they can provide access to lower income segments and populations that otherwise would not have access. However, the challenge to MOOC adoption is that from a student perspective, MOOCs need to provide a good learning experience (one that is not more likely to lead to disengagement and dropout due to poor instructional design). In addition they should be equally or more valued by employers as a comparable alternative to in-person education. There is scant evidence of MOOC completion rates in TVET in particular, but as it stands, MOOC completion rates have been found to be as low as 15%.[175] An assessment of edX, a MOOC platform run by Harvard University and the Massachusetts Institute of Technology (MIT), analyzed its performance over six years based on 12.7 million course registrations of 5.6 million students.[176] The authors found that completion rates have consistently declined since inception of the platform. In 2017-18, the last year of the analysis, only 3.1 percent of enrollees completed their course. Among the subset of those who purchased 'verified' certificates for their course, 46 percent completed their classes. Consequently, there is a need for more robust data on reasons for non-completion.

MOOC use in TVET is less common, but the little evidence that exists points to slightly higher completion rates amongst those courses. An assessment of the Australian MOOC ecosystem compared a sample of 263 national university, 27 transnational, and 72 TVET MOOCs.[177] The completion rates of the TVET MOOCs, both unconditional and conditioned on the subgroup having completed at least one significant piece of work, were comparatively higher and the difference was statistically significant. A potential reason for this difference might have been the differing cognitive intensity of the workload.[178] Insufficient foundational skills[179] and demanding workloads[180] have been

[174] International Labour Organization, World Bank, UNESCO. (2021). Skills development in the time of COVID-19: Taking stock of the initial responses in technical and vocational education and training. Retrieved from https://www.ilo.org/skills/areas/skills-training-for-poverty-reduction/WCMS_766557/lang--en/index.htm

[175] Ahearn, A. (2019). Moving From 5% to 85% Completion Rates for Online Courses. EdSurge. Retrieved from https://www.edsurge.com/news/2019-06-06-moving-from-5-to-85-completion-rates-for-online-courses

[176] Reich and Ruipérez-Valiente, "The MOOC Pivot." For evaluations based on Coursera MOOCs see for instance Freitas, Morgan, and Gibson, "Will MOOCs Transform Learning and Teaching in Higher Education?"; Greene, Oswald, and Pomerantz, "Predictors of Retention and Achievement in a Massive Open Online Course"; Khalil and Ebner, "MOOCs Completion Rates and Possible Methods to Improve Retention - A Literature Review."

[177] Paton, R. M., Scanlan, J.D., and Fluck. A.E. (2018). A Performance Profile of Learner Completion and Retention in Australian VET MOOCs. Journal of Vocational Education & Training 70, no. 4 (October 2, 2018): 581–99.

[178] Paton, R. M., Scanlan, J.D., and Fluck. A.E. (2018). A Performance Profile of Learner Completion and Retention in Australian VET MOOCs. Journal of Vocational Education & Training 70, no. 4 (October 2, 2018): 581–99.

[179] Khalil, H, and M Ebner. (2014). MOOCs Completion Rates and Possible Methods to Improve Retention - A Literature Review. In Proceedings of EdMedia 2014--World Conference on Educational Media and Technology, edited by J Viteli and M Leikomaa, 1305–13. Tampere, Finland: Association for the Advancement of Computing in Education (AACE), 2014. Retrieved from https://www.learntechlib.org/primary/p/147656/

[180] Hew, K.F. (2016). Promoting Engagement in Online Courses: What Strategies Can We Learn from Three Highly Rated MOOCS: Engagement: Lessons from MOOCs. British Journal of Educational Technology 47, no. 2 (March 2016): 320–41. Retrieved from https://www.researchgate.net/publication/269936923_Promoting_engagement_in_online_courses_What_strategies_can_we_learn_from_three_highly_rated_MOOCS_Engagement_lessons_from_MOOCs

found to adversely affect retention, which might make courses focused on practical skills more amenable to online learning. A caveat though is that the TVET MOOCs assessed were provided by reputable university institutions under a certification program. This additional incentive might have played a role in improving retention.

An underlying challenge is the lack of adequate funding for EdTech in LMICs. This includes inadequate funding to procure ICT infrastructure, develop effective digital learning resources and associated online learning tools and platforms, and train teachers/trainers and support staff in EdTech implementation and application.

> *Insufficient funding from the government budget is a challenge for training schools that must cover high costs associated with infrastructure, equipment, teacher training, and qualification, among other things. Indeed, TVET provision can be very expensive, particularly due to the constant need to upgrade equipment as technology changes. To fill the investment gaps, training institutions are encouraged to seek additional funds from private companies, NGOs, and donors, and to generate their own revenue in the market.*[181]

Many EdTech products and services are also expensive to develop, compounding the challenge of limited finances. Some EdTech products or services can cost millions of dollars to develop, which puts pressure on the developer to recover the investment by selling the product at scale. Because a lot of EdTech procurement is localized and fragmented, this makes it difficult to promoting access to the right kinds of EdTech. Countries like the United Kingdom, however, are testing regional buying hubs and pre-negotiating buying deals to mitigate these risks.[182] Additional challenges related to this are:

- There is no formal way to assess student and teacher/trainer needs. This results in products being purchased that do not directly meet the needs of teachers/trainers or students, which in turn means that valuable resources are used inefficiently and ineffectively.
- The EdTech market is already large and continues to grow rapidly so identifying new suitable EdTech products can be difficult and time-consuming.
- EdTech products are not always evaluated effectively. This can most likely be attributed to time constraints in product development and a lack of measurable outcome. This is compounded by the fact that buyers are often not the end-users of the products.
- Procurement practices are not always appropriate for the digital age. Many public institutions still use outdated procurement practices based on textbook adoption models, which have not been adapted to suit shifting EdTech market trends.[183]

There has been an explosion in cloud-based content creation services, but this introduces problems of vendor lock-in in the business model, as most content formats in these systems are not yet standardized. This makes TVET institutions dependent (i.e. locked-in) on a single cloud provider technology implementation and cannot easily move in the future to a different vendor without substantial costs, legal constraints, or technical incompatibilities.[184] This can negatively impact TVET institutions in several ways:

- If a vendor's quality of service declines, the TVET institution may be stuck with it.
- The vendor may change its product offerings in such a way that they no longer meet an institutions' need.

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[181] International Labour Organization. (2016). Compilation of assessment studies on technical vocational education and training (TVET) Lao People's Democratic Republic, Mongolia, the Philippines, Thailand and Viet Nam. Retrieved from https://www.ilo.org/asia/publications/WCMS_458131/lang--en/index.htm

[182] Atlantis Group. (nd). Buying and selling EdTech is complicated, and costly. Retrieved from https://www.varkeyfoundation.org/what-we-do/atlantis-group/system-failure/edtech-today

[183] Smith, A.J. (2019). Guest Post: Challenges and Possible Solutions for Edtech Procurement: Part 1. Digital Promise. Retrieved from https://digitalpromise.org/2019/05/07/challenges-and-possible-solutions-for-edtech-procurement-part-1/

[184] Opara-Martins, J., Sahandi, R., and Tian, F. (2016). Critical analysis of vendor lock-in and its impact on cloud computing migration: a business perspective. Journal of Cloud Computing volume 5(4). Retrieved from https://journalofcloudcomputing.springeropen.com/articles/10.1186/s13677-016-0054-z

- A vendor may go out of business altogether.
- A vendor may impose massive price increases for the service, knowing that the institution is locked in.

Thus, handing a foundational, business-critical technology to an external vendor is not easy for any institution and it requires a large degree of trust in the vendor.[185] Facilitating the development of OER across multiple platforms offers a potential mechanism to address this.

TVET skill development is often less theoretical and more practical in nature. It has been argued that, due to the practical nature of TVET programs, they do not easily lend themselves to online learning.[186,187] Practical skills are often acquired through learning-by-doing, which occurs in school-based workshops and laboratories or through gaining hands-on experience in work environments. Despite this, it is possible to shift theoretical aspects of courses online (as was illustrated in the Kenya Blended Learning case study). This provides an opportunity for the development of more flexible learning solutions.[188]

Anyone can provide micro-credentials, raining challenges of monitoring and assuring quality:

> *New providers — large companies, industry associations, licensing bodies — will begin to offer these credentials as the market-place expands. Faster and smarter course design, new models of assessment and new ways of forging courses through partnership all pose challenges and require agile institutions to respond rapidly to market demand and emerging opportunities.*[189]

Growth in a plethora of providers raises challenges of monitoring and assuring quality, highlighting the importance of defining quality requirements of the providers of micro-credentials and possibly accreditation.[190] Other challenges that have been raised relate to the portability and transferability of micro-credentials, verification of the identity of students, and the need for employers to be much more directly involved in defining the credential's scope, required competencies and capabilities and assessment strategy. Further, 'stacking' may be flexible so may not lead to a coherent qualification, resulting in acquisition of credential that may be in combinations that do not hold together logically (thereby limiting employability).[191]

Finally, the **TVET landscape is complex and the nature of TVET systems and the way in which vocational skills are developed, organized, and regulated differs substantially across countries and regions**.[192] Many TVET systems are fragmented and have a proliferation of qualifications. In many countries, TVET does not receive as much priority as basic and general education, resulting in low national investment in TVET. This has resulted in a lack of research and development in TVET and a

[185] CloudFlare.(nd). What is vendor lock-in? | Vendor lock-in and cloud computing. Retrieved from https://www.cloudflare.com/learning/cloud/what-is-vendor-lock-in/

[186] Comyn, P. (2020). TVET and skills development in the time of Covid-19. World Education Blog. Retrieved from https://gemreportunesco.wordpress.com/2020/04/28/tvet-and-skills-development-in-the-time-of-covid-19/

[187] Hayashi, R., Jayasundara, H.D.S.A., Garcia, M., Balasuriya, A, and Hirokawa, T. (2021). COVID-19 Impact on Technical and Vocational Education and Training in Sri Lanka. ADB Briefs, March 2021. Retrieved from https://www.adb.org/publications/covid-19-impact-tvet-training-sri-lanka

[188] Comyn, P. (2020). TVET and skills development in the time of Covid-19. World Education Blog. Retrieved from https://gemreportunesco.wordpress.com/2020/04/28/tvet-and-skills-development-in-the-time-of-covid-19/

[189] Jean-Loius, M. (2020). Micro-credentials and the Skills Agenda. Retrieved from https://www.linkedin.com/pulse/micro-credentials-skills-agenda-maxim-jean-louis

[190] European Trade Union Committee for Education. (2020). Joint ETUC – ETUCE Position on Micro-credentials in VET and tertiary education (July 2020). Retrieved from https://www.csee-etuce.org/en/resources/statements/3908-joint-etuc-etuce-position-on-micro-credentials-in-vet-and-tertiary-education-june-2020

[191] Chakroun, B., and Keevy, J. (2018). Digital Credentialing - Implications for the recognition of learning across borders. Unesco. Retrieved from https://unevoc.unesco.org/home/Digital%20Cred%20Report

[192] Allais, S., and Wedekind, V. (2020). Chapter 15 Targets, TVET and Transformation. In Wulff, A. (ed). Grading Goal Four - Tensions, Threats, and Opportunities in the Sustainable Development Goal on Quality Education. Brill. Retrieved from https://brill.com/view/book/edcoll/9789004430365/BP000023.xml

weak knowledge base,[193] with very little emphasis on EdTech. EdTech in TVET is typically offered in both formal and informal environments and is covered by a host of different policies and regulatory frameworks. It is usually not a single area of government strategy: no single ministry or body is usually responsible for taking ownership of the implementation of an EdTech in TVET strategy. The linkages between TVET and skills systems and digitization policies are, at best, inferred. In most cases, they are weak. Sometimes, they are contradictory.[194] The lack of a single entity with the responsibility for digital TVET and skills policy often 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.

This is further complicated by the reality that, **whilst TVET systems are national, they are influenced by providers and structures that extend beyond national and regional borders**, as demonstrated in the TVET system framework. There are an increasing number of multinational companies operating in this space, capitalizing on the ease of deploying online learning across national borders. For example, online platforms like Coursera and online coding bootcamps like Springboard allow students to access international standard platforms and programs. This means that people are not bound to the institutional infrastructure (or lack of) and are able to develop internationally recognized skills development, and in some cases, supporting mentorship. The increasing ability to digitize content is also expanding the boundary of the type of learning that can be offered online, as well as its reach. Facilitated by connectivity platforms such as Zoom, online offerings can also support virtual live interaction between student and trainer, regardless of physical location.

In many countries, TVET-based qualifications and careers are still poorly perceived and recognized in the workplace due to the fragmented landscape, calling for a need to create better articulation pathways between vocational and general education. Formal TVET systems and credentialing authorities need to provide quality assurance and governance systems that are responsive to this changing landscape, to make credentialing information from multiple sources more accessible, to provide the methodologies for comparing credentials, and to understand how these combine meaningfully. A credit transfer system is also important to facilitate mobility between institutes; in the recognition of different types of qualifications from various institutes offering vocational training; and the evaluation of prior learning and work experience from within the formal, non-formal, and informal sectors.[195]

Singapore's Skills Future

Singapore's Skills Future initiative demonstrates a multi-pronged approach to skilling using technology and provides financial incentives to encourage individuals to take ownership of their skills development and lifelong learning.

Policymakers in Singapore are addressing skills imbalances and the impact of technological change on labor markets, by pioneering an approach to its education system to focus on lifelong skills and career training. They regard their approach as an 'investment in people' rather than simply 'financing'. The SkillsFuture scheme's dual focus on developmental and social policy goals can be explained as having four key thrusts:

- Help individuals make well-informed choices in education, training and careers.
- Develop an integrated high-quality system of education and training that responds to constantly evolving needs.
- Promote employer recognition and career development based on skills and mastery.
- Foster a culture that supports and celebrates lifelong learning.

Source:
My SkillsFuture. (nd). Homepage. Retrieved from https://www.myskillsfuture.gov.sg/content/portal/en/index.html

[193] Yian, T.T.T., and Park, J. (2017). Beyond Access: ICT-enhanced Innovative Pedagogy in TVET in the Asia-Pacific. Unesco. Retrieved from https://en.unesco.org/sites/default/files/ict-enhanced_innovative_pedagogy_in_tvet_in_the_asia_pacific.pdf
[194] International Labour Organization and Unesco. (2020). The Digitization of TVET and Skills Systems - Geneva: ILO. Retrieved from https://www.ilo.org/skills/areas/skills-policies-and-systems/WCMS_752213/lang--en/index.htm
[195] International Labour Organization. (2016). Compilation of assessment studies on technical vocational education and training (TVET) Lao People's Democratic Republic, Mongolia, the Philippines, Thailand and Viet Nam. Retrieved from https://www.ilo.org/asia/publications/WCMS_458131/lang--en/index.htm

There is little evidence of fundamental systems reforms in using technology in TVET in LMICs. There is more evidence of this in high income countries, for example, Singapore (see boxed example above) and South Korea. In LMICs technology initiatives tend to be discrete projects that are not well-integrated into formal TVET systems. Data also suggests continued donor funded initiatives, denoting increasing reliance of LMIC governments on donors.

Formal TVET can play an important role in supporting lifelong learning. Given the loss of jobs during the pandemic, particularly in professions that cannot be conducted at home, workers will need to acquire skills in different sectors when seeking employment. TVET systems can thus play a vital role in recovery but will need to adapt its offerings to allow for continuous skilling programs [196] For example, adopting a 'plug-and-play' approach whereby different skills units are bundled in different configurations for different stakeholders and different purposes.

Scaling the current system and meeting expenditure and capacity requirements will likely be difficult given capacity constraints under traditional TVET models. EdTech provides an immense growth opportunity – it is important to overhaul formal TVET systems so that LMICs are the beneficiaries of technology trends and contribute to promoting access, equity, quality and relevance in TVET.

Increasing global connectivity means that substantial content can be made available through digital channels and offer more flexible solutions – particularly to support access challenges amplified by COVID-19. However, for this to make an impact on enhancing student outcomes, there needs to be a focus on materials with a good instructional foundation as well as attempts to promote access by investing in low-tech solutions such as mainstreaming the use of e-textbooks and e-books. Lessons from the higher education sector will be central to this.

Conclusion and recommendations

EdTech has great potential to improve access, quality, equity, and relevance in formal TVET. But the historical relative neglect of the TVET sector means that limited attention has been afforded to issues of technology in TVET systems. LMICs are lagging in this regard, primarily due to lack of political will, infrastructure, digital literacy, and human resource constraints. This report has highlighted these 'critical dependencies', without which successful use of EdTech cannot be achieved. Thus, formal TVET systems in LMICs have not really yet begun to leverage EdTech's full potential, although there is clear evidence of pockets of use and innovation. Most efforts to use EdTech tend to focus on relatively traditional deployment of online and blended learning, which has grown somewhat as part of recent responses to the COVID-19 pandemic. Fewer initiatives focus on high-tech like VR, and, where these have been used, they tend to be relatively small-scale pilot or donor-funded initiatives and are thus not integral parts of TVET offerings and systems.

Sadly, the challenges facing EdTech in TVET in LMICs remain largely unresolved, despite having been well documented over the past ten years or more. Infrastructure, teacher/trainer capacity, governance, digital skills, and related constraints have been repeatedly highlighted across several reports and studies over the last decade,[197] but – with some variations between countries – remain

[196] Organisation for Economic Co-operation and Development. (2021). Economic Outlook for Southeast Asia, China and India Volume 2021 Issue 1. Retrieved from https://www.oecd.org/dev/economic-outlook-for-southeast-asia-china-and-india-23101113.htm

[197] See for example, Veal, K., and Dunbar, M. (2017). Preparing TVET for the Digital Age. Development Asia. Retrieved from https://development.asia/explainer/preparing-tvet-digital-age; Abubaker, B. and Hashim, M.H.M. (2014). Imperatives and the Challenges to Effective Integration of ICTs in Nigerian TVET Institutions toward Instructional Delivery. Retrieved from https://www.researchgate.net/figure/Challenges-to-successful-ICT-integration-in-TVET_fig2_300813044 ; Pavlova, M.

key constraints today. There are several underlying reasons for this, key among which is a lack of research on what kind of EdTech is most and least educationally effective, and why. Related to this is that existing evidence is difficult to act on, so critical policy interventions are not always successful in mainstreaming EdTech use. Finally, stakeholders within the TVET EdTech system – be they EdTech providers, governments, donors, teachers/trainers or educational institutions – are often disconnected from one another, making it difficult to undertake coherent planning and implementation efforts and creating silos of activity that do not tackle systemic problems in a coordinated fashion.[198] In addition, the TVET system is unlike other education sectors. The fact that TVET requires significant practical components means that new ways of leveraging EdTech need to be considered in skills provision, relative, say, to higher education or traditional secondary education. The COVID-19 pandemic has spurred some countries and institutions to consider some of these innovations, though many have simply used EdTech to attempt to replicate face-to-face pedagogies, with very little success. Hopefully, the momentum gained in harnessing EdTech in the last 18 months might ultimately serve to stimulate more thoughtful EdTech use within TVET from both the supply and demand side.

Importantly, within the challenges facing TVET lies an opportunity to improve societies and economies in ways that are just, equitable, inclusive, and sustainable. Those marginalized by their ethnicity, gender, geographical location, physical ability, or socio-economic status tend to be left behind in participating in digital societies and EdTech opportunities. To seize this opportunity, it is necessary to reinvent formal TVET systems so they can fulfil their true potential as a vehicle for social and economic development. This cannot be achieved through slow, incremental change, as the relentless pace of technological development and innovation precipitated by the 4IR means that formal TVET systems must respond in kind, with purpose and pace. Failure to do so runs the risk of worsening inequalities within and between countries, as those unable to adjust swiftly will run the risk of falling behind, widening the disconnect between the demand for and supply of skills and potentially exacerbating economic inequalities.

To change will require a willingness to reconsider many of the core principles and operational models on which TVET systems are currently based. Holistic approaches, encompassing policy, implementation, funding, and partnership, are critical to ensure that all students have opportunities to access and cultivate necessary and relevant skills. This may require change management processes to leverage EdTech, and to consider innovative solutions by providers, governments, start-ups, and donors.

Although it is tempting to seek to classify recommendations in reports of this nature by country type (for example, by income level), this kind of grouping is unhelpful as it masks important contextual differences between individual countries and does not recognize that some supposedly less developed countries may be significantly more advanced in EdTech implementation in TVET than their more developed counterparts. For example, in considering partnerships, it is not possible to differentiate between LICs and MICs as this depends on many factors including the legislative and political environment. Similarly, in considering teacher training, an understanding of country context is vital to determine where training needs would focus – for example, Lebanon is technically a MIC but, based on the case study interview, has had no EdTech in TVET initiatives so could be placed at a base level for teacher training. By contrast, Afghanistan, an LIC, has had some engagement/attempt at EdTech

(2018). A framework for success - A regional overview of the ICT-enhanced practices in TVET. Retrieved from https://www.taylorfrancis.com/chapters/edit/10.4324/9781315694382-63/framework-success-margarita-pavlova

[198]Dr Björn Haßler. (nd). The global stakes of digitalization in education. EdTech Hub. Retrieved from https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=&cad=rja&uact=8&ved=2ahUKEwjFhN_kl4jyAhVZwuYKHYR6AyIQFjAARegQIFxAD&url=https%3A%2F%2Fzenodo.org%2Frecord%2F4888604%2Ffiles%2FHa%25C3%259Fler_2021_The%2520global%2520stakes%2520of%2520digitalization%2520in%2520education.pdf&usg=AOvVaw2xmEuaQ8Eo6E9yY_9bo558

in TVET at a national level but is also considered to be at a base level for teacher training. Likewise, the notion of phasing recommendations (creating steps of what should come first, then next) is problematic as it assumes a linear sequence of steps and prior knowledge of what progress a country has made in EdTech implementation, which one cannot know without first analyzing the specific country context. Thus, efforts to deploy EdTech in TVET within countries cannot assume a cookie cutter approach to EdTech implementation and should preferably commence with investigation of the specific context before proposing any interventions.

Given this, several recommendations are offered for consideration to governments, donors, and inter-governmental organizations (IGOs), keeping in mind that some countries may be at early stages of implementing EdTech, whilst others may be further along in the process. Following these recommendations, we present a summary matrix of the recommendations that targets countries at different levels of advancement of EdTech implementation in TVET.

Create an enabling environment for effective EdTech use in TVET

It is already widely recognized that the growing digital divide means that there is an imperative to ensure that investments in ICT infrastructure for the TVET system are made on an inclusive basis that provides equitable opportunities to those currently excluded both from TVET and from the broader economy. However, many governments have done little to ensure good ICT access for teachers/trainers and students, and there is thus still an imperative for continued efforts to improve access to ICT. This requires a strong focus on creating an enabling policy environment for EdTech in TVET to flourish, accompanied by the mobilization of funds as a priority.

A prerequisite for effective use of EdTech in TVET is adequate infrastructure to support teaching, learning, assessment, and administration in TVET institutions. It is thus recommended that governments focus on the following:

- Develop an integrated ICT plan for the TVET system that includes provision of affordable ICT devices and connectivity to all TVET students to ensure equitable access to learning opportunities made possible through the affordances of the 4IR.
- Support TVET institutions with expertise to develop, manage and maintain institutional ICT infrastructure.

Governance systems play an important role in generating and guiding the relevance, access and participation, and quality/innovation components for effective EdTech delivery. In ensuring that the governance and legislative environment supports EdTech in the TVET system, governments can focus on the following:

- Establish governance structures and strategies to coordinate the work of different governmental entities (at national, regional, and institutional levels), as well as the public and private sectors. This can include identifying a lead agency or ministry to coordinate implementation, with clearly defined responsibilities; and having clear implementation plans at multiple levels (national, regional, and institutional).
- Develop/align TVET policy frameworks and regulations with broader and linked government policies.
  - Legislative frameworks, particularly those that have advocated and succeeded in enforcing e-rates for social services from telecommunications and technology companies, are useful for governments looking at ways of reducing costs associated with accessing the Internet.
  - Within TVET, Ministries of Education can approach telecommunication companies to zero rate educational content.
- Align institutional ICT policies and plans with national policies, with appropriate financing and implementation strategies.

- Strengthen systems of RPL, including a review of relevant policies and address articulation gaps where they exist.
  - Create systems related to micro-credentials for TVET, including stackable credentials and digital badges.
- Identify a key institution/agency responsible for monitoring and evaluation of progress and goal attainment.

A key component of an enabling environment for EdTech in TVET is ensuring the requisite funding, and thus it is also imperative to ensure the ongoing mobilization of funds. The following is thus recommended for governments to consider:

- Develop reliable and regular funding mechanisms (at institutional and national levels) to source, develop, maintain, and upgrade existing infrastructure, and equipment. This can include:
  - Considering PPPs as a procurement option, particularly for large-scale infrastructure projects.
  - Creating enabling regulations for importing devices and necessary digital infrastructure.
- Incentivize innovative practices in EdTech and innovative solutions through, for example, tax incentives for PPPs. This encourages innovation at scale, impacting on sector competitiveness by encouraging all players in the EdTech field to innovate and improve their offerings.
- Allocate/make readily available funds to TVET institutions to enable them to purchase and maintain the necessary infrastructure needed for effective teaching and learning in TVET. This includes ensuring a stable power supply at institutions. The available budget should cover the purchase, repair and updating of equipment as technology changes in the marketplace.
- Allocate funding for training institutions to regularly review and upgrade their curricula, materials, and equipment to reflect new technologies and learning methods.
- Establish/direct skills development funds to support EdTech related training.

Donors and IGOs can support this process in the following ways:

- Support policy review processes drawing on experiences and best practice data from other countries.
- Provide guidance to governments drawing on successful examples where countries have zero rated access to educational content.
- Encourage pooling of resources to create necessary infrastructure that several training institutions can benefit from.
- Continue with the provision of infrastructure to support innovative EdTech projects within training institutions.
- Conduct feasibility studies for EdTech implementation to ensure that funding is used efficiently and to prioritize quality and equity in funding provision.
- Promote skills frameworks that include digital skills which donors/IGOs have developed (for example, the ILO Core skills framework).

Develop the capacity of teachers/trainers and TVET managers to support systemic changes

As this report has illustrated, EdTech is now an essential component of creating an effective teaching and learning environment in TVET.[199] In many respects, teachers/trainers in LMICs may not be equipped with the kinds of skills and competences needed to implement EdTech to teach effectively and will thus need access to CPD to enable them to adjust to changing requirements. To keep pace with EdTech trends and changes precipitated by 4IR, it is important to develop and implement flexible programs of professional development support, making these widely available to institutions,

[199] Aerts, C. (2018). Time for an EdTech rethink. Retrieved from https://www.globaleducationseries.org/media/4494/alliance-edtech-rethink.pdf

educational staff, support staff, and quality council staff to enable ongoing reskilling. This might include improving access to learning materials, short courses and workshops, online courses (including access to MOOCs), and mentoring support during course development, amongst others. This also includes developing change management capacity to drive adoption and engagement, to use technology efficiently, and to leverage technology to enhance learning processes. The focus of this professional development should be on:

1) Improving curriculum and program design skills, with particular focus on designing meaningful learning outcomes, formative and summative assessment tasks, and structured, blended teaching and learning pathways, and effective implementation of RPL.
2) Gaining mastery over the tools of production for ICT and online learning to enable teachers/trainers to work directly within digital and online learning environments.
3) Understanding the pedagogical strengths and weaknesses of a wide spectrum of teaching and learning options in blended learning environments, as well as the skills to deliver successful blended learning experiences.
4) Developing skills in providing effective online support services to students.

Governments can focus on the following to ensure that teacher/trainer capacity in EdTech is developed:

- Develop a digital skills and competency framework to define important EdTech skills for teachers/trainers.
- Embed digital skills and EdTech use in pre-service training ensuring that new teachers/trainers have the requisite competencies and capacity to use EdTech effectively.
  - Include industry experience or industry exposure to allow teachers/trainers to be familiar with practical skills and technology used to prepare students for the workplace.
- Strengthen teachers/trainers skills via in-service training. This can include:
  - promoting exchange/return to industry programs to ensure a supply of teachers/trainers who have developed digital skills in a work-based context.
  - providing training opportunities related to the design and delivery of tech-supported lessons.
- Provide incentive schemes for teachers/trainers to encourage digital-skill uptake. Incentive structures may also reward collaborative activity and innovative applications of technology.
- Review change management practices across institutions and ensure that institutional management is equipped to develop clear implementation plans for new EdTech.
- Conduct regular monitoring and evaluation on the effectiveness of EdTech solutions in practice, and implement these findings in teacher/trainer skill development training.

Donors and IGOs can support government by focusing on the following:

- Support and fund initiatives that facilitate capacity building of teachers/trainers and managers.
- Foster the development and support of online professional learning communities and across countries.
- Direct teachers/trainers to online courses/MOOCs where they can access relevant courses.
- Include capacity building of stakeholders as part of all donor-funded initiatives to develop EdTech in TVET.
- Share innovative capacity building solutions from other countries at relevant fora.

Encourage partnerships

Partnerships underpin the implementation of EdTech at multiple levels, and well-functioning partnerships and networks can accelerate innovation and help deliver EdTech solutions across all the levels. As a recent ILO-World Bank-UNESCO (2021) publication highlighted:

The reinforcement of partnerships between public administrations, learning providers, telecommunication companies, software developers and ICT hardware producers is an important step towards making universal access to digital learning a reality.[200]

Within EdTech, there can be a range of different types of partnerships at different levels of the education system (local or national) – for example, there can be PPPs between private sector and government, partnerships between industry and training institutions, between governments and donors/NGOs, and between government and companies.

Governments can consider the following in facilitating partnerships:

- Develop partnerships with EdTech companies to support and facilitate EdTech investment. EdTech models cannot flourish if the digital infrastructure that underpins them does not support the necessary connectivity. This is particularly the case to ensure low-income and vulnerable populations can access EdTech products, otherwise it will constrain the ability of these products to reach underserved populations and potentially expand the digital divide.
- Governments and training providers may also enter into agreements with private sector companies and technology service providers to fulfil specific services related to EdTech. Companies may offer discrete solutions or a more complete package including an online learning platform, learning resources, interaction, and assessment mechanisms. Governments can collaborate with experts in this area to benefit from existing knowledge and work being carried out by private initiatives in their country.
  - Establish clear policy directives that steer the processes of procurement and solicitation that are needed to put the partnerships in place.
  - Ensure that there are Memoranda of Understandings or Memoranda of Agreements between partners in the planning phases of initiatives to enhance sustainability of initiatives.
- Create a bigger role for employers and employer organizations in supporting skills development.
  - Partnerships and collaboration can improve the ability to offer employer recognized micro-credentials and employers to participate more directly in designing training. However, this requires adequate infrastructure and alignment and recognition of employer-led or micro-credentialled training initiatives within the national formal TVET system and their transferability between jobs/countries.
  - Facilitate cooperation and collaboration between training institutions in program design and delivery, for example by offering guest workshops (online, across radio channels, or sharing short videos via WhatsApp).
- Pool resources across private and public stakeholders, particularly in developing blended learning solutions and approaches that require considerable investment in equipment, content development, bandwidth, and training of teachers/trainers (for example, in the applications of AR and VR).

Donors and IGOs can focus on the following:

- Establish collaborative taskforce teams which include training providers, industry players, and EdTech providers to enhance the development and provision of curricula and programs.

Foster the use of OER and open licensing

OER provide considerable opportunities to promote access, relevance, and quality in the TVET system. Important to note is that 'for EdTech to become an enabler and augment teaching and learning, it

[200] International Labour Organization, World Bank, UNESCO. (2021). Skills development in the time of COVID-19: Taking stock of the initial responses in technical and vocational education and training. Retrieved from https://www.ilo.org/skills/areas/skills-training-for-poverty-reduction/WCMS_766557/lang--en/index.htm

needs to be scaffolded to and driven by appropriate learner-centric design, pedagogies and recognize the importance of context.'[201] OER and open licensing offer a promising foundation in achieving this.

It is important to tackle the digital divide at all levels by ensuring that technologies employed in TVET systems adhere to common open standards. There is also potential to harness OER and open licensing in TVET systems both to increase access to TVET learning opportunities, align those opportunities more closely with the needs of the labor market and help to drive growth in employment amongst those currently most adversely affected by the 4IR, and improve the quality of educational courses and programs.

The following recommendations are made to governments:

- Provide an integrated mechanism for expanding access to high-quality TVET programs and short courses in key areas of national need.
  - Flexible entry and exit points into programs and short courses can be created through developing RPL systems for those programs/courses.
  - This can be combined with increased opportunities for self-study to reduce the financial and time burden of study.
- Invest in digital learning platforms to provide support for students and teachers/trainers, coupled with training to use them effectively.
  - Scale up digital skills training to prepare students to be proficient in increasingly digital workplaces.
  - Coordinate public agencies and leverage multi-stakeholder partnerships and collaborative teams to develop digital skills.
- Promote online educational content platforms (including virtual training content) and the use of open licenses for educational resources.
  - Create policies on using open licenses for educational content and resources that facilitates the reuse of content to ensure scaling.
  - Make available clear, reliable, and relevant public sector data that is open and in a non-proprietary machine-readable format.
- Training institutions should have policies on intellectual property rights and copyright detailing the respective rights of the institution and its employees, students, and sub-contractors regarding intellectual capital.
  - Institutions may enhance their reputations and gain market advantage by making intellectual capital easily accessible under open licenses.
  - Government can define open educational content standards to which institutions need to adhere.

Open content lends itself to cross-national initiatives in TVET, and donors and IGOs can coordinate online educational content platforms to facilitate the sharing of high-quality open resources in multiple languages.

Encourage innovation and pilots, with the option of scaling

New models of education are bringing unprecedented competition to the traditional models of formal TVET education. As new platforms and models – such as MOOCs – emerge, there is a need to evaluate them and determine how to best support collaboration, interaction, and assessment.

To facilitate this process, governments can focus on the following:

[201] Aerts, C. (2018). Time for an EdTech rethink. Retrieved from https://www.globaleducationseries.org/media/4494/alliance-edtech-rethink.pdf

- Pilot test EdTech initiatives to assess what works within the country context and to learn from their implementation. This can include:
  - Examining initiatives within the private sector and informal TVET sector to draw evidence/gain inspiration on implementing EdTech in TVET.
  - Implementing rigorous evaluation to assess EdTech evidence of impact, taking in to consideration issues of sustainability (through policy measures and project implementation plans, for example).
- Encourage institutional management to keep abreast of technological developments so that they are open to change.
- Consider data-driven procurement processes that provide insight into the use and usefulness of EdTech solutions. This can enhance the value-add of the final product and creates opportunities for the private sector to measure the impact of EdTech solutions before they are rolled out at scale.
- Promote transparency between the private and public sectors to promote investor confidence and innovation in the sector.
  - Avoid being too prescriptive in tender specifications. Finding a balance between defining essential functionality and removing excessive details will enable greater innovation and creativity for a product or service instead of restricting it.

Donors and IGOs can support this by:

- Share findings of in-country initiatives' evaluations to facilitate South-South learning and cooperation.
- Facilitate regional fora such as education summits, conferences, webinars and virtual awards to showcase innovative practices and share findings.

Remaining areas for future research and analysis

Given the difficulty in locating relevant research – particularly for LMICs – there is significant scope for additional research on this topic, particularly regarding the implications of EdTech implementation, and how to instill within TVET systems the four themes addressed in this report. Potential areas for future research are outlined below.

- The scarce body of existing research (particularly in LMICs) comes together as a patchwork of differing technologies applied in very different educational and occupational fields in different geographic and institutional contexts. Further research is needed to consolidate these findings into a coherent set of lessons that LMICs can use in practice.
- More evidence-based research on how technology improves learning, skills acquisition and labor market outcomes of students over time.
- Greater exploration of how EdTech has been used innovatively in resource-scarce contexts with limited access to internet connectivity to bridge the digital divide.

Summary

The following section provides a summary of recommendations based on levels of country progress with implementing EdTech in TVET. It describes the three levels of country EdTech advancement and progress, and then segment the recommendations per level. These recommendations are indicative, and although a country may largely fall into one level, recommendations from other levels may also be relevant, depending on the aspect of the EdTech ecosystem.

Descriptions of levels of EdTech Advancement

- **Latent**: Countries at this level have poor EdTech infrastructure to support teaching, learning, assessment, and administration in TVET institutions. There are no or few EdTech in TVET initiatives. There are no/poor governance structures and strategies to coordinate EdTech, and no/limited funding mechanisms (at institutional and national levels) for EdTech in TVET. Consequently, there is no or limited focus on EdTech in pre-service and in-service teacher training.
- **Emerging**: Countries at this level have infrastructure to support teaching, learning, assessment, and administration, but these are only available in some institutions and are not equitably distributed (i.e. there is unreliable access to teachers/trainers and students). There are governance structures and strategies to coordinate the work of different governmental entities (at national, regional, and institutional levels), as well as the public and private sectors. There are some pre-service and in-service training opportunities dedicated to EdTech in TVET. Whilst there are some EdTech initiatives, these are few and tend to be pilots which are primarily funded by donors.
- **Established**: Countries at this level have good infrastructure, allowing equitable and reliable ICT access for teachers/trainers and students. There are clear governance structures and strategies to coordinate the work of different governmental entities (at national, regional, and institutional levels), as well as the public and private sectors. These countries have many EdTech initiatives in TVET, and there may have a lead agency or ministry to coordinate implementation of EdTech in TVET. The government is able to mobilize ongoing funds and has reliable and regular funding mechanisms (at institutional and national levels) to source, develop, maintain, and upgrade existing infrastructure, and equipment. Countries have made extensive progress in developing digital skills and EdTech use is embedded in pre-service training, and teachers/trainers skills are strengthened via in-service training. Countries at this level also tackle the digital divide at all levels and there also well-functioning partnerships and networks to accelerate innovation and help deliver EdTech solutions across all the levels.

Table 2 Summary Matrix: Recommendations for effective implementation of EdTech in TVET

Focus Area	Level of EdTech Advancement		
	Latent	**Emerging**	**Established**
Infrastructure	• Develop an integrated ICT plan for the TVET system to provide affordable ICT devices and connectivity to all TVET students.	• Implement an integrated ICT plan for the TVET system to provide affordable ICT devices and connectivity to all TVET students. • Support TVET institutions with expertise to develop, manage and maintain institutional ICT infrastructure.	
Governance	• Identify a lead agency or ministry to coordinate EdTech in TVET implementation, with clearly defined responsibilities; and clear implementation plans at multiple levels (national, regional, and institutional).	• Develop and align TVET policy frameworks and regulations with broader and linked government policies, for example, enforcing e-rates for social services from telecommunications and technology companies to reduce costs associated with accessing the Internet or to zero-rate educational content. • Develop and align institutional ICT policies and plans with national policies, with appropriate financing and implementation strategies.	• Identify a key institution/agency responsible for monitoring and evaluation of progress and goal attainment and conduct regular monitoring and evaluation on the effectiveness of EdTech solutions in practice. • Strengthen systems of RPL, including a review of relevant policies and address articulation gaps where they exist. This can include creating systems related to micro-credentials for TVET, including stackable credentials and digital badges.
Funding	• Develop reliable and regular funding mechanisms (at institutional and national levels) to source, develop, maintain, and upgrade existing infrastructure, and equipment. This can include PPPs for large-scale infrastructure projects, as well as creating enabling regulations for importing devices and digital infrastructure.	• Incentivize innovative practices in EdTech and innovative solutions through, for example, tax incentives for PPPs to encourage innovation at scale. • Allocate funds to TVET institutions to enable them to purchase, maintain, and update the necessary infrastructure needed for effective teaching and learning in TVET.	• Allocate funding for training institutions to regularly review and upgrade their curricula, materials, and equipment to reflect new technologies and learning methods. • Establish/direct skills development funds to support EdTech related training.
Capacity	• Develop a digital skills and competency framework to define	• Strengthen teachers/trainers skills via in-service training, and embed digital skills and EdTech use in pre-service training to	• Provide incentive schemes for teachers/trainers to encourage digital skill uptake, and to reward

Focus Area	Level of EdTech Advancement		
	Latent	**Emerging**	**Established**
	important EdTech skills for teachers/trainers.	ensure that teachers/trainers have the requisite competencies and capacity to use EdTech effectively.	collaborative activity and innovative applications of technology. • Review change management practices across institutions and ensure that institutional management is equipped to develop clear implementation plans for new EdTech. • Implement findings from monitoring and evaluation efforts in teacher/trainer skill development training.
Partnerships		• Develop partnerships with EdTech companies to support and facilitate EdTech investment. • Enter into agreements with private sector companies and technology service providers to fulfil specific services related to EdTech. • Establish clear policy directives that steer the processes of procurement and solicitation that are needed to put the partnerships in place. • Ensure that there are Memoranda of Understandings or Memoranda of Agreements between partners in the planning phases of initiatives to enhance sustainability of initiatives	• Create a bigger role for employers and employer organizations in supporting skills development, as partnerships and collaboration can improve the ability to offer employer recognized micro-credentials and employers to participate more directly in designing training. • Facilitate cooperation and collaboration between training institutions in program design and delivery, for example by offering guest workshops (online, across radio channels, or sharing short videos via WhatsApp). • Pool resources across private and public stakeholders, particularly in developing blended learning solutions and approaches that require considerable investment in equipment, content development, bandwidth, and training of teachers/trainers (for example, in the applications of AR and VR).
Open content and licensing		• Invest in digital learning platforms and promote online educational content platforms, combined with use of open licenses for educational resources, to provide support for students and teachers/trainers, coupled with training to use these effectively. • Promote online educational content platforms (including virtual training	• Create policies on using open licenses for educational content and resources that facilitates the reuse of content to ensure scaling. • Define open educational content standards to which institutions need to adhere. Ensure that training institutions have policies on intellectual property rights and copyright detailing the respective rights of the institution and its employees, students, and sub-contractors regarding intellectual capital.

Focus Area	Level of EdTech Advancement		
	Latent	Emerging	Established
		content) and the use of open licenses for educational resources.	• Make available clear, reliable, and relevant public sector data that is open and in a non-proprietary machine-readable format. • Provide an integrated mechanism for expanding access to high-quality TVET programs and short courses in key areas of national need, including flexible entry and exit points into programs and short courses through developing RPL systems for those programs/courses, and increasing opportunities for self-study.
Innovation and pilots		• Pilot test EdTech initiatives to assess what works within the country context and to learn from their implementation. • Examine initiatives within the private sector and informal TVET sector to draw evidence/gain inspiration on implementing EdTech in TVET. • Encourage institutional management to keep abreast of technological developments so that they are open to change.	• Evaluate new platforms and models as they emerge to determine how to best support collaboration, interaction, and assessment. • Implement rigorous evaluation of pilots to assess EdTech evidence of impact, taking into consideration issues of sustainability. • Promote transparency between the private and public sectors to nurture investor confidence and innovation in the sector. One way of spurring innovation can be to avoid being too prescriptive in tender specifications, thus encouraging providers to seek out new solutions to existing problems. • Consider data-driven procurement processes that provide insight into the use and usefulness of EdTech solutions. This can enhance the value-add of the final product and creates opportunities for the private sector to measure the impact of EdTech solutions before they are rolled out at scale.

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