



ICT-enhanced Innovative Pedagogy in TVET

in the Asia-Pacific



Beyond Access:

ICT-enhanced Innovative Pedagogy in TVET

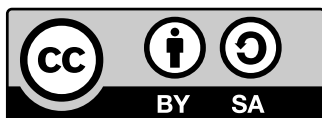
in the Asia-Pacific

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Foreword

We are living in a world experiencing rapid transformational changes, which are unfolding in our society, the environment, and economy. The drivers of these changes vary from the exponential growth of information and technology, to climate change and increased scarcity of natural resources, to rapid and wide urbanization, and to the shift of demographics towards either youth bulge or ageing societies among countries.

Industries have changed the way that they operate in response to these factors, and are preparing for more future disruptions to come. Consequently, job markets have been significantly impacted. According to the International Labour Organization (ILO), the global youth-to-adult unemployment ratio has reached a historical high. Youth in South Asia, Southeast Asia, and the Pacific are between four to six times more likely to be unemployed than their adult counterparts.¹ More strikingly, the research indicates that the cause for high unemployment in the region is not due to a shortage of jobs in the economy, but mainly due to a shortage of relevant skills.

The Education 2030 agenda clearly shows the need for rethinking of technical and vocational education and training (TVET) and skills development. Among the ten education goals, two are TVET-related targets: 1) to ensure equal access to affordable and quality TVET for all (SDG4.3) and 2) to increase the number of youth and adults with relevant skills for employment, decent work and entrepreneurship (SDG4.4).

Another distinctive feature of the Education 2030 agenda is the recognition of information and communications technology (ICT) as an essential tool for strengthening education systems and enhancing quality and effective learning. Notably, there is potential for ICT to create transformative changes in skills development and TVET, going beyond the traditional view of ICT for increasing access to education.

Such new possibilities enabled by ICT include flexible lifelong learning, enhanced knowledge sharing and social learning between peers and experts, and authentic learning experiences facilitated through simulations and virtual reality. Monitoring of learning can also be improved while personalized feedback can help to keep students on track. When its potentials are carefully considered and fully realized, ICT can bring learning experiences to a new level in TVET.

The potential for ICT in TVET has been recognized by several other declarations. The “Shanghai Consensus”² from the 3rd International Congress on Technical and Vocational Education and Training (TVET) recommended further integration of ICT in TVET in order “to reflect the transformations taking place in the workplace and in society at large”. Recently in May 2017, education ministers from across the Asia Pacific region collectively endorsed the “Regional Strategy for Using ICT to Facilitate the Achievement of Education 2030”, where TVET was identified as a top priority area for ICT to be used in reaching the Education 2030 goals.

¹ International Labour Organization. 2014. *Global employment trends 2014: Risk of a jobless recovery?* Geneva, ILO.

² UNESCO. 2012. *Shanghai Consensus - Recommendations of the Third International Congress on Technical and Vocational Education and Training*. Shanghai: China.

However, the present reality of ICT in TVET is not as promising. In many countries, TVET is still a sub-priority in comparison to basic and general education, leading to low national investment in TVET. This has resulted in a lack of research and development in TVET and a weak knowledge base. Questions such as how integration of ICT in TVET can enhance learning and teaching, what factors mediate or hinder successful integration, to what extent and how teaching quality can be accounted for such integration, remain at large.

This publication is an attempt to respond to such knowledge gaps in ICT in TVET and to strengthen the knowledge base. The study entitled “Beyond Access: ICT-enhanced Innovative Pedagogy in TVET in Asia Pacific”, aims to document innovative practices for harnessing the potential of ICT in TVET, explore ways to improve the pedagogical relevance of TVET in meeting the changing skill demands of a digital society, and to provide policy recommendations for the innovative use of ICT and the ways to increase quality of teacher training in TVET. It includes a collection of nine cases from six countries, namely, Australia, Hong Kong SAR of China, New Zealand, Philippines, Republic of Korea and Singapore.

It is hoped that the study will facilitate a better understanding of the potential of ICT in promoting innovative pedagogies and highlight promising practices of ICT in TVET. Also, for readers to be able to use the findings from the study to guide their own transformation of teaching and learning in TVET, drawn on factors that facilitate/withhold ICT-supported innovative teaching and learning used in TVET.



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Executive summary

Rapidly advancing information and communication technology (ICT) and changes in the culture of work in the digital world require workers to acquire not only technological competencies but also many soft skills. This necessity provides opportunities for marginalized groups to access training and gain new skills, and the process of imparting these new skills offers the potential to introduce innovative pedagogies. Such empowerment is in line with plans proposed in the Education 2030 Framework for Action, including ensuring ‘inclusive and equitable quality education and lifelong learning opportunities for all’ (UNESCO et al., 2015).

In an effort to better understand the potential of ICT to facilitate innovative pedagogies and with the goal of highlighting promising practices in the use of ICT in TVET, UNESCO Bangkok conducted a study titled ‘Beyond Access: ICT-enhanced Innovative Pedagogy in TVET’.

In particular, the study aimed to:

- Review and document innovative practices for harnessing ICT in TVET in the Asia-Pacific region.
- Explore ways to improve the pedagogical relevance of ICT-enhanced TVET to meet the changing skill needs of a digital society.
- Provide policy recommendations for the innovative use of ICT in teaching and learning and ways to increase the quality of teacher training in TVET.

Six countries in the Asia-Pacific region, namely Australia, Hong Kong (China SAR), New Zealand, the Philippines, the Republic of Korea and Singapore, participated in the study and provided case studies. The nine cases provided by TVET organizations in the participating countries illustrate advanced applications of ICT in teaching and learning. Furthermore, the promising practices provide insights into how the pedagogical relevance of ICT-enhanced TVET can be improved, so as to equip learners with twenty-first century competences.

Analysis of the promising practices indicated that ICT can contribute to enhancing education and training in four areas:

- Ubiquitous lifelong learning
- Learning engagement and social learning
- Authentic and simulated learning
- Reflective learning and knowledge creation

It is expected that the lessons from these cases will help policy-makers in the Asia-Pacific region and beyond to be more strategic in their plans for using ICT in education and training.

The case studies were analysed with regard to the extent to which ICT was integrated, in four key domains:

- Leadership readiness
- Teacher readiness
- Student readiness
- Infrastructure readiness

Nearly all of the organizations described in the case studies were found to be at an advanced stage (innovative or transformative) of ICT integration in at least two of the four readiness domains. For this reason, these organizations were able to adopt innovative technologies and pedagogies and ensure their pervasive use among their teaching staff and students, in contrast to ad hoc, sporadic experimentations with ICT, confined to small groups of students.

Cross-case analysis revealed recurring themes regarding barriers to the integration of ICT into TVET, which have practical implications at the policy level. These barriers are:

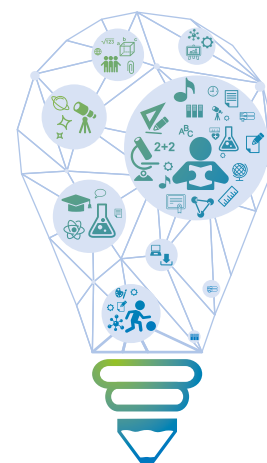
- Teachers' lack of ICT competencies
- The high cost of programme development
- Teachers' reluctance to change their roles and instruction styles
- Teachers' time constraints for ICT-enabled development and delivery

Analysis of the study findings resulted in the following policy recommendations:

- **Conduct a readiness assessment.** Training organizations should begin by conducting an honest assessment of their current readiness to integrate ICT into curriculum delivery.
- **Explore and employ various pedagogical approaches to improve outcomes.** Based on the findings from the readiness assessment, explore and employ TVET-relevant pedagogies, such as project-based and problem-based learning, to help students acquire technical, professional and soft skills.
- **Seek partnership with industry and employers.** To meet diverse learning needs, organizations should work with industry and employers to co-manage funding, curricula and assessment.
- **Review and redesign holistic curricula and assessment.** Organizations should review and redesign the curriculum towards more holistic assessment of student performance using e-Portfolio and learning analytics in order to support their career development.
- **Support teachers.** Teachers, who are central to teaching and learning, should be given systematic training that is developmental and is supported by adequate resources and communities of practitioners.
- **Select appropriate technology and pedagogy to ensure that graduates' skills are relevant.** Choose technologies that match the expectations of industries and use pedagogy that enables students to explore real-world projects.

- **Identify the issues before deciding which ICT to use.** Organizations should identify the problems and challenges, and examine the costs and benefits before deciding on the ICT solutions.
- **Employ phased approaches.** Long-term commitment by management is critical for successful rollout of ICT-enhanced learning initiatives, especially when they are large-scale and enterprise-wide. Wherever possible, organizations should adopt a change management plan, with phased approaches and clear milestones.

These policy recommendations can guide organizations to avoid known pitfalls and to step up their implementations with a greater chance of success. Future studies can leverage this research to assess the degree of ICT integration in less sophisticated TVET systems, at both the practice and policy level, thus providing a more complete picture of the state of ICT-enabled teaching practices across the countries of the Asia-Pacific region.



1. Introduction

The Incheon Declaration, adopted on 21 May 2015, announced the Education 2030 Framework for Action (UNESCO et al., 2015), which proposed action plans and indicators ‘to ensure inclusive and equitable quality education and lifelong learning opportunities for all’. One of the areas that has received renewed attention in the Education 2030 agenda is technical and vocational education and training (TVET) and skills development. Considering that TVET was not explicitly mentioned in the Dakar Framework for Action (UNESCO, 2000), this renewed attention is welcome; it recognizes that TVET plays a critical role in preparing people for employment, in alleviating poverty and in ensuring decent livelihoods.

The Member States of the Asia-Pacific region are aware, however, that there is a need to transform the existing TVET model and to increase access to TVET, while also improving quality. Indeed, the third International Congress on Transforming TVET, held in Shanghai, China, in 2012, concluded with an exhortation to all countries to expand access to TVET to those in need of skills training and to ensure that TVET is relevant to the needs of modern society and workplaces (UNESCO, 2012). The ensuing UNESCO Asia Pacific Conference on Education and Training in Malaysia in 2015 resulted in the Kuala Lumpur Declaration (UNESCO, 2015c), which outlines several recommendations to help Member States to overcome challenges relating to improving access to TVET and to improving the quality of such education and training. One of the recommendations highlights the importance of information and communication technology (ICT), noting that, ‘in addition to providing wider access to TVET, ICT has enormous potential to enable innovative pedagogy that makes teaching and learning experiences more authentic and relevant to workplace needs. Hence, appropriate policies, strategies and affordable solutions should be put in place to improve ICT facilities in TVET institutions’ (UNESCO, 2015c, p. 3).

Integration of ICT into TVET is no longer a good-to-have initiative; rather, it is an integral component that enables graduates to be adaptable and ready to ‘produce new ideas, to transform old ones, to combine and codify information into intellectual property and to incorporate it into new products and processes’ (Park and Kim, 2009, p. 1915).

The *Regional Strategy for Using ICT to Facilitate the Achievement of Education 2030*, adopted in May 2017, is evidence that most governments in the Asia-Pacific region recognize the need to promote the integration of ICT into TVET curricula and programme delivery. According to the results of a survey of 26 Member States in the region, TVET and tertiary education are the top priority areas in which ICT should be used towards achieving the SDG4 goals (UNESCO, 2017).

In reality, however, many countries in the Asia-Pacific have yet to integrate ICT into TVET and thus transform this sector. The barriers to integrating ICT include the global and national focus on providing general basic education, underinvestment in TVET, poor technical and institutional capacity and a weak analytical knowledge base (UNESCO, 2015a). In addition, countries of the region lack good models for integrating ICT into TVET and skills development. To this end, UNESCO Bangkok conducted a study to identify promising practices in the use of ICT in TVET and skills development in the Asia-Pacific region.

In particular, the study aimed to:

- Review and document innovative applications and purposeful uses of ICT in TVET in the Asia-Pacific region.
- Explore ways to improve the pedagogical relevance of ICT-enhanced TVET to meet the changing skill needs of a digital society.
- Provide policy recommendations for the innovative use of ICT in teaching and learning and ways to increase the quality of teacher training in TVET.

The study involved compiling and analysing case studies from nine TVET institutions in six countries in the region: Australia, Hong Kong (China, SAR), New Zealand, the Philippines, the Republic of Korea and Singapore. The promising practices described in the nine case studies provide insights into how to use ICT to equip learners with twenty-first century competencies. Highlighting promising practices from high performing TVET institutions in the region is likely to enable other TVET organizations³ to identify key success factors and incorporate such factors in their own programmes. The lessons learned from the cases also offer policy-makers in the Asia-Pacific region and beyond models and ideas for how to improve the systematic integration of ICT into TVET.

This study is limited by the self-reporting nature of the data collection. Another limitation is the small number of participating organizations per country; thus the results obtained are not representative of the TVET organizations and institutions in those countries.

While the case study approach yields a good range of innovative ICT-enhanced pedagogies, readers must contextualize the findings. This research has presented useful information on what types of ICT work in the context of the type of TVET programmes offered to learners of particular profiles. For example, the mode of e-learning delivery, pedagogy, content and applications for institution-based learners is different for workplace-based learners. Therefore, before embarking on a particular ICT initiative, policy-makers must first appraise their current readiness and evaluate the challenges of meeting the needs of specific student target groups.

³ See Appendix 5 for a glossary of terms.

2.1 Socio-economic context

Figure 1: National income levels, by sub-region (2015)



In most sub-regions of the Asia-Pacific,⁴ young people aged 10 to 24 constitute around 25 per cent of the population. South Asia and Central Asia have a 'youth bulge' and countries in these sub-regions face challenges of educating a huge number of youth and providing them with jobs. In East Asia, in contrast, where the fertility rate dropped from 5.5 births per woman in 1960 to 1.7 births per woman in 2014 (World Bank, 2015), the economic and social burden for the state is lower, but the relatively small number of youths in the countries of this sub-region must support a large population of aging citizens.

Youth in South Asia, South-East Asia and the Pacific are between four and six times more likely than adults to be unemployed (ILO, 2014), which is of grave concern to their governments. The Asia-Pacific region is home to a large number of unemployed youth. Of the 358 million youth globally who are not in school, training or employment, 220 million are in the Asia-Pacific, and 101 million of these youth live in South Asia (UNDP, 2016). Research indicates that the high youth unemployment level in the region is mainly due to a shortage of relevant skills rather than a shortage of jobs in the economy (Dawes and Marom, 2013). This finding is consistent with feedback from employers on the difficulty of recruiting workers with the required skills (Manpower Group, 2015). The skills gap indicates a need for a rethink of TVET and skills development, to ensure that such training is not only more accessible but also more relevant to the current labour market.

Rapid advances in technology make it difficult to predict what kinds of skills will be required by the time the children and youth of today leave school. Emerging technologies, such as 3D printing, machine learning, artificial intelligence and biotechnology are likely to transform some industries, and the World Economic Forum predicts that seven million jobs in the administrative, manufacturing and construction job families will disappear by 2020 (World Economic Forum, 2016). The ILO (2016) foresees that in 20 years robots will replace the jobs of 137 million people (56 per cent of the current employees) in five countries in South-East Asia (Cambodia, Indonesia, Philippines, Thailand and Viet Nam).

Although it is not possible to predict exactly which technical skills will be required, a great deal of recent research indicates that all graduates will need certain core competencies. According to Luksha and Peskov (2014), for example, competencies that are already critical today such as professional skills, soft skills and meta-skills will remain essential. More specifically, professional skills in the 21st century requires ability to adapt to multi-disciplinary work and multi-cultural, multi-lingual, and ICT enhanced environments while soft skills include problem and opportunity oriented thinking, entrepreneurial skills, creativity, collaboration skills, empathy, ethics of responsibility. Meta-skills, on the other hand, would require the ability to manage the self (including concentration and attention management), flexible thinking, resilience, personal health skills, mental management and a disposition for lifelong learning. The core competencies identified by the World Economic Forum (2016) are similar. These include critical and analytical thinking, social and collaboration skills, computational thinking and respect for diversity.

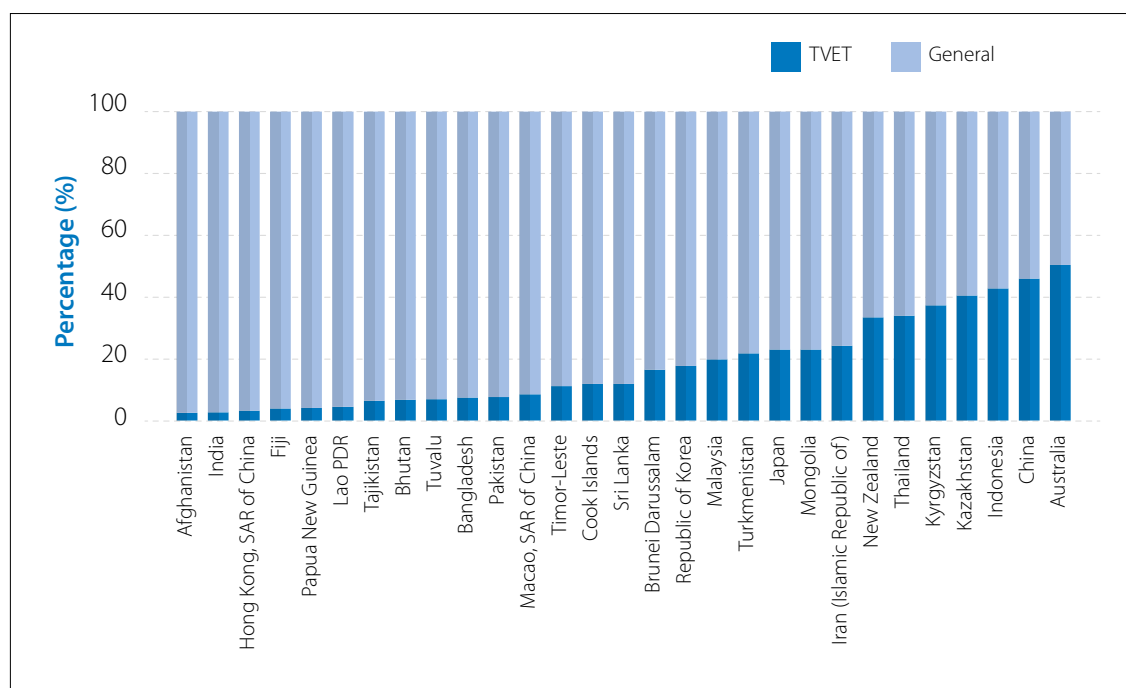
4 The exception is East Asia.

While these competencies (known as ‘transversal competencies’) are today expected of graduates of institutions of higher learning, they are not always expected from graduates of TVET institutions, so most such institutions do not currently promote these competencies. However, employers in Asia-Pacific countries have sought graduates with these competencies (UNESCO, 2016; UNESCO 2015d). Inadequate consideration of transversal competencies in designing and implementing education and training systems will therefore fail to prepare learners for employment and will undermine social and economic development.

2.2 Trends and issues in TVET

TVET is seen as a means of overcoming a myriad economic and social challenges, including poverty, inequality and unemployment, especially among youth and women, but participation in TVET is still very low in some countries. As shown in Figure 2, the percentage of students in upper secondary schools enrolled in TVET is as low as 3 per cent in Afghanistan and India, and less than 10 per cent in many countries.

Figure 2: Percentage of students in upper secondary education enrolled in TVET, selected countries (2013 or latest)



Source: UNESCO Institute for Statistics database

UNESCO (2015b) identified seven common obstacles to the development of TVET and to greater participation by learners in TVET:

- A global focus on general basic education and hence underinvestment in TVET.
- Poor technical and institutional capacity of formal TVET systems, including teachers.
- The low social status of TVET.
- Weak analytical knowledge base, as a result of a lack of investment in research.
- Lack of collaboration and communication among key stakeholders (e.g. between employers and schools).
- A tendency for policy responses to be a 'patchwork' rather than long-term strategic reforms.
- A tendency to import policy without adequate contextualization.

In view of these obstacles, UNESCO recommended a reconceptualization of the TVET system as a nation's overall lifelong learning system. Accordingly, steps need to be taken to support the development of the TVET sector, including by expanding and diversifying access to TVET, expanding work-based learning and cooperation with employers, and enhancing the quality and relevance of TVET curricula and outputs.

In the past, TVET curricula were delivered through didactic teaching of theories, and workshop demonstrations, followed by hands-on practice. However, under such learning conditions students often had difficulty relating theory to practice, since theoretical knowledge was imparted without an authentic context. This led to poor knowledge retention and a lack of understanding of the principles behind how things work. Moreover, rote learning by students were required in the past because assessments were limited to recall tests for procedural types of knowledge and skills. This reinforced the notion that there is only one right answer to a given problem or one correct way to do a given task.

The inadequate delivery of TVET curricula is in part due to the low quality of many TVET teachers and trainers (ILO, 2010). 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 continuous professional learning for practicing teachers. Moreover, it is essential to update TVET teachers' pedagogical skills and to introduce ICT tools for teaching and learning. Tools such as simulations, 3D immersive virtual reality, videos, collaboration software and mobile devices (including smartphones), can make training much more engaging than conventional modes of delivery (Kotsik, Tokareva and Chinien, 2009). These technologies support different learning styles and, when used appropriately, these tools can assist teachers to inculcate positive attitudes towards learning and build transversal competencies (Zuallkernan, 2006).

2.3 ICT in TVET: Potential and challenges

The potential

The core premise of Education 2030 is to go beyond basic education and initiate a comprehensive rethink of the education sector to build a lifelong learning society. It seeks a simultaneous renewal of all levels and areas of education, from early childhood care and education through K-12 to TVET and tertiary education and emphasizes the need for equality in access to high quality and relevant learning, wherever and whenever a learner wants, throughout one's life.

The Education 2030 Framework for Action, which outlines how to translate the global commitment into practice (UNESCO et al., 2015), recognizes the immense potential of ICT in achieving lifelong learning for all. It highlights the need for ICT to 'be harnessed to strengthen education systems' and to assist in increasing knowledge dissemination, expanding access to information, improving the quality and effectiveness of learning, and in providing more effective services' (UNESCO et al., 2015, p. 8). The Education 2030 vision was affirmed by the Qingdao Declaration (UNESCO, 2015d), articulated at the International Conference on ICT and post-2015 education, which noted that ICT can improve access to education and inclusion, support open education resources and solutions, support quality learning, facilitate lifelong learning pathways, enable online learning and improve mechanisms for quality assurance and recognition of learning.

ICT is a powerful means to increase access to quality and lifelong TVET and enhance the relevance and authenticity of learning, and it enables workplaces to be brought into learning. Although hands-on practical training cannot be replaced by technologies, modern technologies are able to enhance the acquisition of practical skills, under a fundamental assumption that learning is essentially a social phenomenon (Cox, 2013; Haddad and Draxler, 2002; Valentine, 2011; Wenger, 1998). ICT, with the power to innovate pedagogical approaches can also improve the employability of workers.

ICT-enhanced pedagogies can support learning in four ways:

- ICT can promote flexible lifelong learning

ICT offers those who had to drop out of basic education or who wish to gain further skills ubiquitous formal and informal learning opportunities. In addition, use of ICT can enable greater flexibility in learning arrangements, for example through the use of cloud-based file storage, browser-based software that is device-independent, online collaborative workspaces and social networking tools. Learning analytics, on the other hand, process student log data generated by learning management systems, allowing the institution to customize learning paths that are unique to students' learning needs, style, strengths and weaknesses, rather than forcing students to go through a standard curriculum and path.

- ICT can enhance learning engagement and social learning

With blended learning and 'flipped classroom'⁵ techniques, ICT can enable learners to prepare at home for classroom discussions and activities to exchange ideas and deepen knowledge. In addition, online social networks enable just-in-time learning from peers and a wider network of experts.

5 This is a teaching and learning approach that "flips" conventional learning delivery, such that content is delivered outside of the classroom, often online, while activities that might have once been considered homework (e.g. group projects) are moved into the classroom. See the Glossary in Appendix 5.

- ICT can provide authentic and simulated learning

Serious games and simulations are increasingly used in education to provide learners more opportunities to practice techniques and manipulate different parameters. Serious games using augmented reality and virtual reality technologies, for example, allow students to apply theory to practice in a realistic, safe and controlled way. It was found in one study that nursing trainees were able to transfer knowledge and skills from the simulation training to apply them on real patients during their practicum (Rush et al., 2010). Such technologies create close to realistic learning environments that were not previously possible.

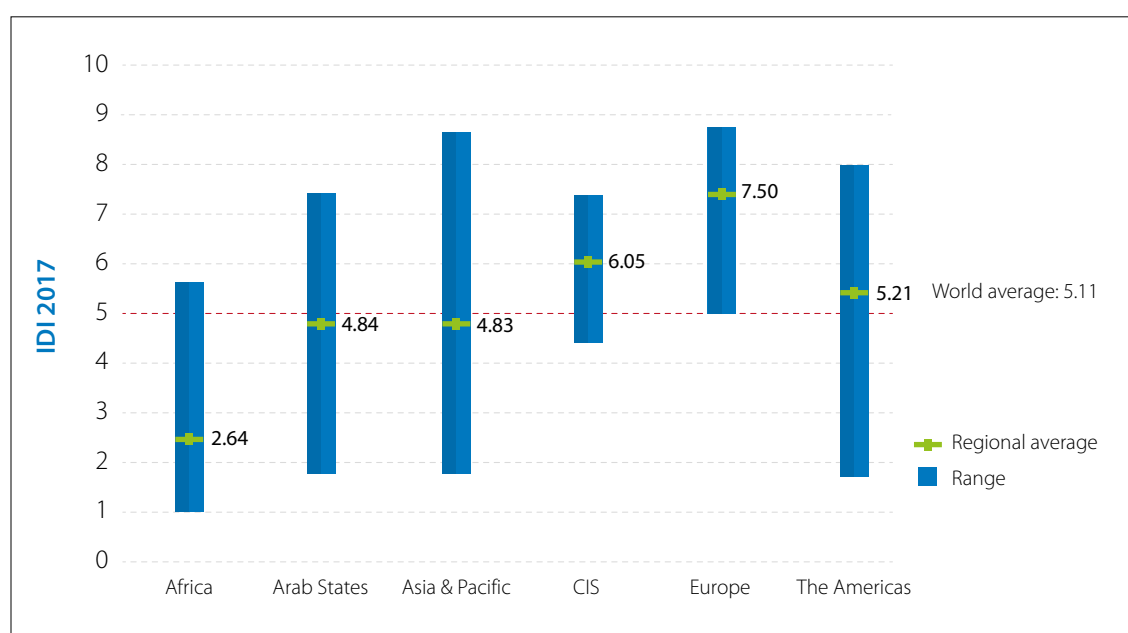
- ICT can promote reflective learning and knowledge creation

Project-based learning using ICT and e-portfolios enable evidence-based practice in workplace contexts in which knowledge and skills are used and new knowledge is created. Use of ICT in such contexts, along with interactions with peers and industry experts reinforces learning and enables students to develop their reflective capacity. E-portfolio and project-based learning encourage students to be knowledge producers rather than knowledge consumers and can change the way students respond to holistic and process-driven assessments.

The challenges

The potential benefits that new ICT can bring in terms of transforming skills development and TVET are enormous, but actual benefits in TVET institutions have yet to be seen in many cases. This is partly due to the lack of access to ICT and the under-development of ICT in many countries of the Asia-Pacific region. There is therefore great disparity in levels of ICT development between the countries of the region. As shown in Figure 3, the Asia-Pacific region has the largest range of ICT development index (IDI) values in the world.

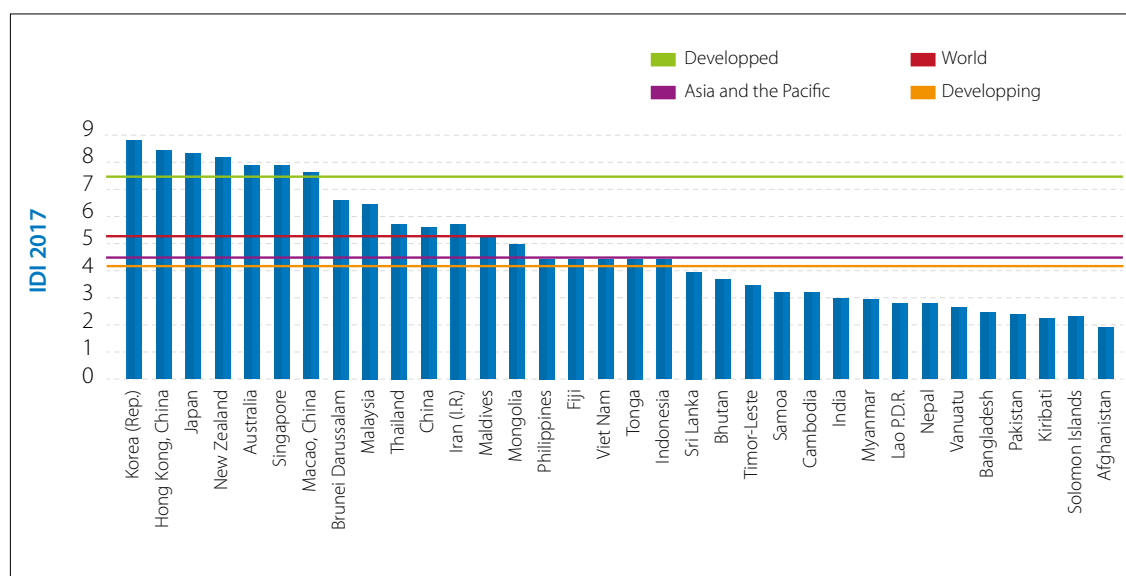
Figure 3: ICT Development Index, by region (2017)



Source: International Telecommunication Union, 2017

While the Asia-Pacific region is home to three of the ten most ICT-developed countries (South Korea, Hong Kong and Japan), it is also home to some of the least ICT-developed nations (Afghanistan, Bangladesh and Pakistan) (Figure 4).

Figure 4: ICT Development Index values in the Asia-Pacific region (2017)



Source: International Telecommunication Union, 2017

Data on internet connectivity likewise indicates a wide disparity in the region in terms of access to ICT. For example, while all learners in Singapore, Korea and Hong Kong have broadband internet connectivity at the secondary school level, fewer than 10 per cent of schools in Bangladesh and Nepal have internet connection, as illustrated in Figure 5.

Figure 5: Proportion of schools with internet access (2012 or latest year available)



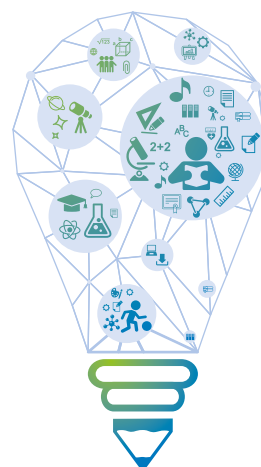
Source: UNESCO Institute for Statistics, 2014

The key reasons for this disparity are the hefty costs of establishing ICT infrastructure and providing training for staff, and the high recurrent costs of system maintenance and upgrades, along with the costs of staff skills upgrades. Geographical factors also inhibit the establishment of ICT infrastructure. For example, ICT infrastructure development in most Pacific countries requires laying expensive undersea fibre optic cables. In rural mountainous areas of other Asia-Pacific countries, the cost of installing cables is also very high (PRIF, 2015). Another factor hampering greater access to ICT is poor electrical infrastructure in some countries.

Thus, while most high income and upper-middle income countries have well-established telecommunications systems and infrastructure, and have used ICT in TVET for some time, many low and lower-middle income countries in the region have only just begun.

A factor that prevents ICT from being used in TVET is a lack of understanding of the dynamics between ICT and pedagogy for TVET. There remains much confusion regarding what triggers the deployment of ICT in the first place, whether and how integration of ICT into TVET can enhance learning and teaching, what factors contribute to successful integration, and to what extent teaching quality is affected by such integration.

In line with Recommendation 4 of the Shanghai Consensus (UNESCO, 2012), ‘improving the evidence base’, UNESCO’s study, described here, is an attempt to create a knowledge base to understand how ICT can overcome some of the obstacles to developing TVET and skills learning.



3. Research method

The study aimed to identify promising practices in the use of ICT in TVET and skills development so as to obtain a better understanding of the potential of ICT to enhance access to TVET and to improve the relevance of TVET.

3.1 Key research questions

To gain the required information, the following research questions were formulated:

- In what ways are the current practices of integrating ICT into curriculum delivery in countries in the Asia-Pacific region innovative, and pedagogically relevant to TVET?
- How will the pedagogical approaches to integrating ICT into TVET delivery be able to meet the changing skill needs of a digital society?
- What are the policy recommendations to encourage innovative and pervasive use of ICT in TVET?
- What are the promising practices in TVET teacher training that can equip teachers with the ICT competencies required to deliver ICT-enhanced teaching?

3.2 Data collection

The researchers adopted the case study approach and took the TVET organization as the unit of analysis (Gerring, 2007). The case study method was adopted because it enables the study of contemporary issues that have not been investigated extensively in previous studies (Yin, 2003). With its open-ended mode of exploration, the case study method allowed the researchers to investigate the multi-faceted phenomenon of integrating ICT into TVET, in view of the diverse range of technologies used, the variety of pedagogies and the distinct skill-sets demanded of TVET graduates. The case study approach also enabled the researchers to elicit rich data on key considerations in ICT implementation, challenges encountered and the process of attaining the desired outcomes, and to identify concrete examples that illustrate these achievements.

The researchers sought cases studies from TVET organizations in the Asia-Pacific region that were sizable in terms of student enrolments and had implemented enterprise-level e-learning as well as staff professional development. The selection criteria intentionally sought organizations that were able to demonstrate strong ICT implementation strategies. In particular, the criteria were:

- TVET organizations with least 1,000 students enrolled as of January 2016.
- TVET organizations with enterprise e-learning solutions, guided by clear policies that had been implemented for all students in the organization for the previous three years.
- TVET organizations that made staff professional development available to all teaching staff.

The organization representative(s) invited to participate in this study were required to have the following knowledge and experience:

- At least two years of experience in implementing organization-wide ICT-supported learning initiatives.
- Is in a position to formulate and/or influence policies that are related to organization-wide ICT-supported learning.

The primary sources of data were case studies prepared by the representatives of the selected TVET organizations, while the main secondary sources were policy documents, information from the TVET organizations' websites and related journal publications.

The researchers distributed a questionnaire (see Appendix 1) and a case study template (see Appendix 4) to the selected representatives of the TVET organizations. These representatives completed the documents, elaborating in the case study document the specific innovative practices they had used to successfully integrate ICT into TVET delivery.

Five categories of information were collected, as follows:

- Section A: Information on the TVET organization (4 Questions)
- Section B: Level of ICT Integration into TVET (Matrix for rating in four domains)
- Section C: Barriers to ICT Integration into TVET (2 Questions)
- Section D: Promising and Innovative Examples (3 Questions)
- Section E: Case Study (Text entries using template)

Table 1 describes the two types of instruments (questionnaire and template) used for the data collection.

Table 1: Data collection instruments

Sections	Data collection instruments	Main Focus	Notes
Sections A to D	Online questionnaire titled 'TVET ICT Study on Innovative Practices in AP Countries'.	Besides collecting information on the participating organizations, the questionnaire required each organization to self-rate the level of ICT integration into the curriculum, and provide data on the barriers encountered in ICT integration as well as information about promising and innovative content and pedagogies adopted.	The link to the questionnaire was sent to each participant via an individual email.
Section E	Case study template	The case study data included details about a particular example that the organization wished to showcase in which ICT was used in TVET.	Case study information was submitted using the template and sent via email to the researcher.

The case study template collected the following information about the use of ICT in TVET:

- Organizational background
- Previous teaching practice
- The challenges
- Intended outcomes
- The learning environment
- The digital advantage
- Key points for effective practice
- Conclusions and recommendations

Although the representatives were encouraged to submit any reports they might have on the efficacy of their implementations, only a handful did so. Further details about the promising practices can be obtained by contacting the TVET organizations directly.

3.3 Participating organizations

A total of nine organizations from six countries in the Asia-Pacific region participated in this study. All of the organizations selected had at least 1,000 students enrolled as of January 2016. Two organizations (Informatics Holdings Philippines and the Online Lifelong Education Institute) offer specialized programmes for working adults who seek to upgrade their repertoire of skills (in information technology) or gain new skills (in engineering); the other seven organizations offer a comprehensive range of TVET courses. The TESDA Women's Center offers only traineeship and certification courses, while the other organizations cater to both full-time and part-time students, with six also catering to employees on work-based traineeship arrangements.

Information about the participating organizations is provided in Table 2.

Table 2: The participating organizations (in alphabetical order)

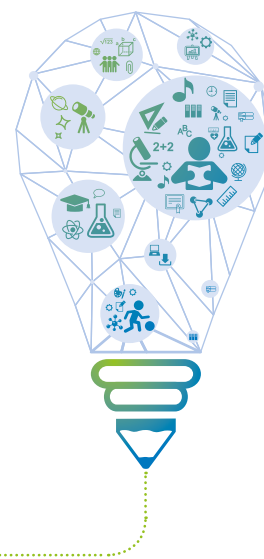
Code	Organization and country	Enrolment*	Type**	Programmes***	Management+
AUS-BHI	Box Hill Institute, Australia	Large	Comprehensive	FT, CET, TRN	Multiple-One
AUS-CIT	Challenger Institute of Technology, Australia	Very Large	Comprehensive	FT, CET, TRN	Multiple-One
HK-VTC	Vocational Training Council, Hong Kong	Very Large	Comprehensive	FT, CET, TRN	Multiple-One
NZ-UCOL	Universal College of Learning, New Zealand	Large	Comprehensive	FT, CET	Multiple-One
NZ-WIT	Waikato Institute of Technology, New Zealand	Large	Comprehensive	FT, CET, TRN	Multiple-One
PHI-IHP	Informatics Holdings Philippines	Medium	Specialized	FT, CET	Multiple-One
PHI-TWC	TESDA Women's Center, Philippines	Medium	Comprehensive	TRN, Cert	Single-One
RKO-OLEI	Online Lifelong Education Institute, Korea University of Technology and Education, Republic of Korea	Large	Specialized	CET, TRN	Single-One
SG-ITE	Institute of Technical Education, Singapore	Very Large	Comprehensive	FT, CET, TRN	Multiple-One
SG-SP	Singapore Polytechnic	Very Large	Comprehensive	FT, CET	Single-One

* Enrolment: Small: <1,000; Medium: 1,001-5,000; Large: 5,001-10,000; Very large: >10,000

** Organization type: Comprehensive: Comprehensive range of courses; Specialized: specialized niche courses

*** Programme type: FT: Full-time; CET: Continuing Education and Training; TRN: Apprenticeship/traineeship; CERT: Certificate

+ Management type: Multi-One: Multi-campus with one organization; Single-One: Single campus with one organization



4. Promising practices

Seven of the nine participating organizations submitted descriptive case studies highlighting their ICT-enabled teaching and learning strategies, with two organizations submitting more than one case study, making a total of nine case studies.⁶ The case studies are presented below in four categories: towards ubiquitous lifelong learning; enhancing learning engagement and social learning; authentic and simulated learning; and promoting reflective learning and knowledge creation.

4.1 Towards ubiquitous lifelong learning

4.1.1. Online learning for adults: Challenger Institute of Technology (Australia)

Institutional background

TVET in Australia is normally offered to adults as a post-school option (UNESCO-UNEVOC, 2015), but is sometimes also offered at senior secondary school level (typically from grades 10 to 12). In the latter case, students graduate with either a Senior Certificate of Education or a TVET qualification, after which they can qualify to enrol at a vocational training institution.

Most VET students are adults enrolled in continuing education programmes. Training is based in an institution and/or in the workplace. The majority receive training through apprenticeships or traineeships as part of their employment contracts. VET qualifications are provided by government institutions called technical and further education (TAFE) institutions, as well as by private institutions.

The Challenger Institute of Technology is a TAFE institution based in Fremantle, Western Australia. The institution offers over 140 career development programmes through a wide range of courses catering to various industry training areas. Unique training areas include oil and gas resource industry training at the Australian Centre for Energy and Process Training (ACEPT) and maritime training at the Australian Centre for Applied Aquaculture Research (ACAAR).

⁶ Apart from PHI-TWC and NZ-WIT.

On 11 April 2016, the Challenger Institute of Technology became South Metropolitan TAFE. South Metropolitan TAFE, now incorporating the former Challenger Institute of Technology, provides services to both urban and regional communities and admits over 17,000 students each year.

The Challenger Institute's programmes are provided through campuses across a number of South Metropolitan locations. These include:

- Applied Engineering (incorporating the Australian Centre for Energy and Process Training (ACEPT))
- Maritime (incorporating the Australian Centre for Applied Aquaculture Research (ACAAR))
- Automotive
- Building and Construction
- Community Services, Health and Lifestyle
- Business and Information Technology
- Hospitality and Tourism
- Foundation and Cultural Studies
- Science and the Environment

More than 23,000 students take part in more than 300 courses, on a full-time, part-time or short course basis. About 1,000 international students are enrolled at the institute, which has overseas training facilities in eight countries: Mauritius, Qatar, United Arab Emirates, India, China, Singapore, Sri Lanka and Indonesia.

Challenges in teaching practice prior to innovation

One of the institute's post-school programmes for adults is the Certificate II in General Education for Adults. Students in this programme are from various backgrounds including:

- Mature age students returning to work/education
- Disadvantaged students
- Students with special needs
- Students with limited education background
- Students undertaking training as part of welfare programmes

Prior to the introduction of the pilot study, the Certificate II in General Education for Adults was offered as a traditional classroom-based programme, focusing primarily on mastering learning, but distance learning was possible. This consisted of paper-based resources mailed to students by the institute. Students were able to communicate with instructors via telephone and email.

The diversity within the student cohort meant that some students struggled with learning in a classroom setting. Furthermore, the varied learning needs of the cohort required a significant amount of guidance from teachers. Some classroom-based students prospered due to the social aspect of classroom learning, while others found it intimidating, non-productive and unsafe. Some distance learners struggled because they felt isolated. The challenge overall was to provide a better, more needs-driven service for students while maintaining strong care for them.

Project brief and intended outcome(s)

The institute initiated a pilot project to offer a fully online version of the Certificate II in General Education for Adults programme.

The pilot project aimed to:

- Provide a more individualized, student-focused learning experience, with strong supportive relationships between teachers and students.
- Offer a more productive, supportive learning environment for distance learners.
- Provide a more flexible, accessible learning environment for students.
- Produce a product that could be accessible for students from a far greater geographical distance.

In designing the online programme, the institution applied constructivist pedagogies as most of the learning activities were cognitive-driven, and ensured that learning outputs and products would be very individual. In delivery, a strong focus is placed on critical and reflective practices and students are required to develop a deep understanding of 'why' rather than simply recollecting facts. Instructors develop tasks and assessments based on the students' existing knowledge, previous experiences and personal interests.

Since the programme is for adult learners, who may be lacking in confidence, one of the main goals of the institute was to increase students' self-belief and nurture self-directed learning habits. Activities were designed accordingly, with the students gaining increasing autonomy, though always with a teacher's supporting presence. The institution recognizes the need for continuous improvement of programmes and therefore adjusts the programme in line with feedback gathered from students.

While the programme was designed to be fully deliverable online, students can opt for classroom delivery if they feel a need for face-to-face interaction with their teachers and peers.

Key points for effective practice

The provision of online learning provides the students with greater flexibility in accessing learning resources and learning support, so that the course becomes more suited to their needs. Geographical location is no longer an issue for students, which encourages lifelong learning. Such learning can be pursued anywhere and at any time. The course structure nurtures self-directed learning capacity and the students find the learning environment safe and more student-centred.

For the programme to be effective, the TVET organization requires time and commitment from the teachers. In addition, the teaching team has to be as committed to pastoral care as they are to the content.

One of the factors that contributed to the success of the project was the Australian government's policy of promoting flexible learning. The Australian Flexible Learning Framework (2008–2011) supports VET participants to gain skills through e-learning, and expands access to professional development opportunities, products, resources and support networks in an increasingly technology-driven learning environment. This framework is managed by the Flexible Learning Advisory Group (FLAG), a key policy advisory group on national directions and priorities for ICT in the TVET sector.

4.1.2. Learning analytics: Online Lifelong Education Institute (Republic of Korea)

Institutional background

Seeking to increase Korea's global competitiveness, the Korean government aims to build a workforce that is driven by competency rather than academic qualifications. Accordingly, the government launched the High School Diversification project in 2007, which addresses the demands of students and parents for tertiary education as well as the issue of surplus university graduates. An example of successful diversification was the establishment of employment-oriented specialized high schools and 'Meister' high schools to advance vocational education and to encourage an 'employment first university later' mind-set in society.

Korea's National Qualifications Framework (NQF) maps the amount of education, training and work experience required for each qualification in the various industry sectors. To manage the NQF, the Korean government developed the National Competency Standards (NCS), which defines the levels of knowledge, skills and attitudes expected of workers for particular tasks in the workplace. The implementation of the NCS in 2013 strengthened career-oriented vocational education in relation to academic qualifications. This policy initiative also enhanced specialization among the universities, junior colleges and the Meister high schools. Furthermore, NQF, coupled with NCS, was infused into the secondary vocational education curriculum and has helped nurture creative talents for new and emerging occupations. Demand-driven high school vocational curricula boosted the employment rates of graduates and improved the image of vocational education in Korean society.

The Online Lifelong Education Institute (OLEI), within the Korea University of Technology and Education, is a hub for online vocational training that specializes in the fields of technology and engineering. The institute mainly pursues interactive and experiential e-learning practices by incorporating new technologies into online learning environments.

Funded by the Korean Ministry of Employment and Labour, the OLEI has developed and offered more than 200 free online courses to industrial workers and job seekers in the subjects of mechanics, electronics, mechatronics, ICT, design, materials, architecture and chemistry. OLEI also provides job basics courses and core courses.

OLEI offers approximately 300 e-learning courses. Most of these online courses are six-week formal vocational training that result in certificates; they are offered once or twice a month. Some non-certificate courses for informal learning are available at all times, along with a few college-credit courses.

In April 2015, OLEI launched the portal website, e-koreatech (see www.e-koreatech.ac.kr) and that year enrolled 69,583 students. In April 2016, 8,100 students were enrolled in certificate courses; this was a significant increase from the monthly average enrolment in 2015, which was 5,798. In the first year of operation, the site had over 700,000 visitors.

Challenges in teaching practice prior to innovation

To gain information about the learners (mostly employed adult workers) and the learners' perceptions, OLEI conducted student surveys and interviews. However, the data collected this way was not always useful. OLEI recognized that advances in learning analytics technologies offered the capacity to analyse enrolled students' log data to learn about their learning styles, preferred study time and interactions with others. OLEI found that learning analytics was a more useful tool in supporting adult lifelong learning than surveys and interviews because it provides real-time analysis of automatically recorded data.

Project brief and intended outcomes

OLEI evaluated and redesigned its e-learning services and introduced learning analytics technology so as to be able to provide timely support to students, with the ultimate aims of improving the quality of e-learning services and enabling more students to complete their courses and achieve good results (thereby reducing drop-out rates).

The organization collects and analyses student log data (see Figure 6) over time with the aim of predicting each student's success in a course. Data from its learning system was collected and analysed with the learning analytics software, so that students' learning patterns over time helped predict their success at course completion. Data collected include the number of log-ins and log-outs, the percentage of visited content objects, the percentage of time spent on the content object, the number of assignments submitted, the number of messages posted followed by at least one reply, final exam scores and previous e-koreatech courses taken.

Based on the results of the data analysis, the system attempts to provide course recommendations adjusted to each individual learner. If students show signs of struggling, e.g. lagging behind on the course schedule, the online managers (mentors) will send messages to prompt them to keep studying and send them information on what level they have progressed to and how that compares to the expected level. OLEI's learning analytics system also provided course recommendations that were more suitable to the individual learner. Thus, learning analytics software helps students keep on track with their self-directed study. The feedback students receive on their progress also lessens any feelings of isolation they may have. This is especially important for working adults who have little time outside working hours to socialize with their course mates. The feedback about their learning behaviour also helps students to make informed choices about future courses. Furthermore, the data assists teachers in planning future courses.

Figure 6: Online feedback provided to students about their progress



Pedagogical approach

Timely feedback (from the analytics system) on student performance provides individual learners with useful information on what they should do to progress in their course of study. The analytics software automatically processes the data and displays the results visually in graphs or other images. The features of the system thus allow students to visualize the results of the data, and therefore enable them to easily understand what they should do. Apart from students, the users of the learning analytics system include e-learning managers who could use the data to improve e-learning services as well as instructors who could use the data to provide relevant support to students.

Key points for effective practice

There is no shortage of data when it comes to learning analytics or Big Data. Therefore, the key point for effective learning analytics was to find out what kinds of data should be collected and analysed. The type of data to be collected depends on the particular e-learning services being offered and the purpose of applying the analytics.

4.2 Enhancing learning engagement and social learning

4.2.1. Flipped classroom: Singapore Polytechnic

Institutional background

Singapore has five polytechnics, which offer a wide range of courses in diverse fields to equip graduates with practical knowledge and skills to meet the nation's personnel needs. Students at

polytechnics have opportunities to immerse themselves in the relevant industries via work attachments. These vary in duration: usually between six weeks and six months. The practice-based learning approach in the polytechnics helps students to not only gain the work skills they need but also to acquire valuable life skills and become creative problem solvers (Joint Polytechnic, 2016; MOE Singapore, 2015).

Singapore Polytechnic, established in 1954, was the first polytechnic in the nation. Singapore Polytechnic's vision is to prepare learners to be life ready, work ready and world ready. Its mission is to produce a caring community of inspired learners who are committed to serve with mastery. The institution is committed to the delivery of consistently high quality curricula that are robust, relevant and innovative, so as to meet students and industry requirements and expectations. Singapore Polytechnic is also committed to caring for the environment and fostering sustainability, and has consequently adopted green initiatives around the campus.

As of 2016, Singapore Polytechnic offers 47 full-time diploma courses and 32 part-time courses through ten academic schools. Besides core trade modules, Singapore Polytechnic offers elective modules that are designed to foster character development and critical reasoning skills and has introduced a 'Social Innovation' programme and an internship programme. The organization prepares its students for both work and university, and as of 2016 had about 16,000 students enrolled (full-time and part-time).

The institution works closely with a key stakeholder: industry practitioners (employers). Each school within Singapore Polytechnic has an advisory committee consisting of industry representatives to advise the TVET organization on industry trends, the latest industry developments and needs, and the implications of these for the curricula.

Singapore Polytechnic's Department of Educational Development offers its lecturers support in the implementation of innovative teaching methods, such as the 'Conceive-Design-Implement-Operate' (CDIO) and 'Design Thinking' approaches. Through professional development courses and learning journeys, lecturers are equipped with competencies to experiment with creative approaches of instruction, including the use of interactive technologies in the classroom. The department has provided the organization with e-learning systems that are designed to enhance course and module delivery and assessment, along with physical resources and infrastructural support, including media rooms, training rooms and a Centre for Interactive and Learning Technologies (Singapore Polytechnic, 2016).

Challenges in teaching practice prior to innovation

Until recently, teaching practices at Singapore Polytechnic consisted mainly of traditional face-to-face lectures and tutorials, with a strong emphasis on practice and projects. Today, the pedagogical approaches are generally workplace oriented and inquiry based, and they emphasize active and experiential learning and collaborative learning.

Singapore Polytechnic recognized the need to harness technology in support of efforts to imbue a lifelong learning mind-set in students and to encourage them to be independent, self-directed learners adept at using technology to discover and use information appropriately. This was a challenge, however, particularly when students lacked motivation to learn.

Project brief and intended outcomes

In 2014, the School of Electrical and Electronic Engineering implemented a three-phase flipped classroom⁷ (pre-class, in-class and post-class) pilot project among first year students studying Digital Electronics.

The three phases of the flipped classroom are as follows:

1. Pre-class, students watch short video clips on a particular topic at home.
2. In class, lecturers use short quizzes to check students' understanding of the material covered in the video clips, evaluate student readiness for more difficult topics, and identify topics that need more elaboration during class.
3. At the end of every lesson, students do another quiz, the results of which enable lecturers to evaluate the effectiveness of the learning experience and to identify areas that students have not fully understood.

Each phase has particular benefits. The pre-class phase helps students to familiarize themselves with the basic concepts and key facts at a convenient time for them and at their own pace. The face-to-face classroom phase allows lecturers to identify the students' specific learning needs and adapt instructional strategies accordingly. In the classroom, if students have not understood a topic, lecturers can conduct mini lectures on those topics. The classroom phase also offers an opportunity for real world applications of content to solve problems as well as a setting for collaborative problem solving, peer discussion and assessment. In the classroom, lecturers can also provide students with feedback on areas where improvement is required and can provide extra learning support for low-scoring students. To address difficult topics identified by students and clarify complex concepts, lecturers created a 'Question and Answer' video.

The lecturers use the following software to develop lesson packages: Camtasia, Screencast-o-matic and Softchalk, and use the organization's learning management system to deliver these lesson packages to the students. For quizzes, the lecturers use quiz tools such as Socrative and Kahoot.

All students are required to bring their own laptop computers (notebooks) to class, so as to access the learning resources and online activities. Throughout the semester, an online communication tool (a mobile phone application), Whatsapp, is used to inform students of new resources and quiz deadlines. This app is also used to maintain two-way communication and ensure timely feedback with students.

At the end of the initial pilot project in 2014, the polytechnic conducted a student survey to assess the students' experience of the pilot, how they felt about the various aspects of the programme and its impact on their learning. Most students found that the pre-class learning materials were useful in preparing them for the face-to-face sessions. In the classroom, students enjoyed the use of tools like Kahoot as well as the learning activities such as class discussions. The final quiz was seen as useful in clarifying areas in which they needed further work and students saw it as a useful means of providing feedback to their lecturers. Overall, most students preferred the flipped

⁷ This is a teaching and learning approach that "flips" conventional learning delivery, such that content is delivered outside of the classroom, often online, while activities that might have once been considered homework (e.g. group projects) are moved into the classroom.

teaching and learning method to the conventional method, but they were concerned that it could potentially increase their workload.

The performance of the students who participated in the flipped classroom pilot was analysed and compared to that of students in classes using conventional methods. The pilot class outperformed the cohort and the outperformance was significantly larger when compared against students of similar academic backgrounds.

In 2015, four other schools within the polytechnic adopted the approach: the School of Mathematics and Science, the School of Communications and Social Sciences, the School of Business and the School of Chemical and Life Sciences. In October 2016, the remaining schools began implementing the flipped classroom initiative.

Pedagogical approach

The pedagogical approach emphasizes teaching methods such as provision of regular feedback, and encourages problem solving and peer instruction. Students are encouraged to learn independently, search for new information and collaborate online, thus learning with and through technology to create knowledge.

With the flipped learning resources available online, students are able to learn at their own pace and go through the material repeatedly if required. The quizzes are useful to students in enabling them to check their understanding.

Since lecturers do not have to present the material during the face-to-face sessions, they therefore have more time to focus on difficult topics and help less competent students. The Whatsapp tool allows lecturers to give an individual feedback to students in a timely manner, while the Kahoot tool introduces interactive games into learning, making it more engaging for the students. The flipped learning approach also provided the institution with more flexibility in lesson timetabling.

Key points for effective practice

For the flipped classroom method to be effective, it is important that lecturers have the professional discipline to not simply re-teach the material imparted via the video-clips or repeat the material if students did not do their preparation. It is also important that teachers plan appropriate in-class activities that build on students' home learning. Furthermore, teachers need to conduct regular formative assessments of student understanding and address difficulties encountered by their students before introducing more difficult topics.

Finding a successful combination of high effect teaching methods and supporting ICT (educational web tools) is essential. In the pilot phase, the combination was reviewed frequently and was modified based on student and staff feedback. This iterative process is important in ensuring the ICT tools are being used effectively to enhance students' learning experiences.

Another important factor in ensuring success is to ensure contact and communication between the lecturers and the students so that the students receive learning support throughout the three phases.

4.2.2. Blended learning: Vocational Training Council (Hong Kong)

Institutional background

The Vocational Training Council (VTC), established in 1982, is the largest vocational and professional education and training provider in Hong Kong. The VTC provides publicly-funded courses at nine campuses of the Hong Kong Institute of Vocational Education (IVE) and the Hong Kong Design Institute (HKDI) and at 18 training centres. VTC's 13 member institutions provide many pre-employment and in-service programmes, covering multiple industries and catering to students from various backgrounds and abilities, equipping a quarter of a million students with valuable credentials and the qualifications they need to reach their potential.

The qualifications offered by the VTC include master's degrees, bachelor's degrees, higher diplomas, a Diploma of Foundation Studies, a Diploma of Vocational Education, certificates and a Yi Jin Diploma. The VTC offers applied learning courses, part-time day and evening programmes, and programmes for non-local students.

The VTC draws strength from its large number of member institutions, its breadth of programmes and its variety of accredited qualifications. The organization champions a teaching and learning approach that is practical, hands-on and outcome-based. The VTC desires its graduates not only to possess good understanding of the subject areas, but also to gain strong capability in practical skills, team management skills, personal management skills and inter-cultural networking skills. The VTC students tend to prefer visuals rather than text, learning by doing, multi-tasking and learning through social interactions.

Challenges in teaching practice prior to innovation

Because of the nature of TVET, in the past most lessons at the VTC were delivered via traditional face-to-face contact, which is a uni-directional way of teaching and learning that is not always suitable for students with different learning styles (e.g. auditory, visual and kinesthetic). As mentioned above, some students have preference for visuals rather than text while some have a short attention span and like multi-tasks. Face-to-face learning was time-consuming, and it was difficult for teachers to deliver the teaching content and also allow time for hands-on practice, especially with large class sizes.

Project brief and intended outcomes

The VTC decided to adopt various forms of ICT and systems that would support curriculum delivery, improve course management, enhance learning and teaching, and improve communication between students and teachers. Thus, in 1999, the VTC introduced a Web Course Tool (WebCT) as a course management system and adopted a blended mode of learning in which e-learning resources were used to enhance classroom teaching.

In 2012, the VTC switched to 'Moodle' as its learning management platform. In response to teachers' needs and requests, the VTC developed useful applications, including an anti-plagiarism software plugin and mobile applications, and integrated them into the platform. With these easy-to-use applications, teachers became able to design and facilitate lessons using various media-rich resources, and to assess students' learning using time-saving ICT tools, such as online assignment submission and forums for discussion and communication. Teachers were also able to access and use a rich repository of online videos and e-materials to aid them in their explanations and demonstrations. The animations, visuals and graphs on the platform are useful in explaining difficult concepts and, in some cases can be used to demonstrate practical skills.

Moodle enables students to view the learning content anywhere and at any time. Students can acquire an initial understanding of the topic at home and therefore be more prepared to participate in classroom discussions and practical training. Teachers leverage this to encourage self-directed learning and to implement flipped classroom. The platform also enables teachers to interact with students online in a secure environment and supports the development of a global learning community. Using ICT tools, teachers can video record seminars and practical sessions for students to revisit and review regardless of time and location. With more time in class for discussions and forums, students now have an opportunity to interact more with one another in engaging activities, thus making learning more interesting and increasing students' motivation to learn.

Teachers use online modules to complement and supplement face-to-face teaching:

- Complementary modules: In this case, the online modules are an integral part of a course, so students must participate in all e-learning activities and study the content materials provided.
- Supplementary modules: In this case, the online activities and resources offer extended learning opportunities, and give students further exposure to the subject. Students can preview the uploaded teaching materials and review them after class.

The philosophy behind the VTC's blended learning approach is social constructivism. Training workshops and seminars for teachers promoted the use of ICT in teaching and demonstrated how it could benefit students. Teachers are encouraged to make the most of the learning management platform in their teaching.

Guided by their teachers, students can work together in small groups using the platform. For example, they can refer to the online materials on the platform, create glossaries inside their course, post messages in the discussion forum, submit group assignments and group projects online and conduct peer evaluations. Students can also conduct experiments and use their real-world problem solving skills to construct new knowledge.

Key points for effective practice

The VTC overcame several barriers to e-learning. The barriers are described below along with how they were overcome:

- Teachers had the conventional role of providing information, rather than guiding learning, and were using conventional instruction styles, rather than learner-centred approaches.

The VTC encouraged teachers to adopt modern pedagogical approaches, such as problem-based learning, project-based learning, case-based learning, blended learning and flipped classroom. An incentive award scheme was in place to promote teaching excellence.

- The institution had lacked relevant and well-designed digital content that was suitable for TVET.

To overcome this, the institution's staff were encouraged to attend training and conferences on new pedagogical approaches using ICT, including the use of open education resources and applications in TVET. Content now available for learning include audio clips, videos, animations, augmented reality, lab simulations and 3D immersive virtual reality. Teachers received extra resources for customisation of their courses in Moodle and they shared how their customized modules could support innovative teaching delivery.

Some teachers needed further skills development in using online tools to create online courses, so were given extra guidance. Self-help resources were also provided e.g. guidelines on how to create an online course and e-tutorials. A help-desk, email and hotline were also made available, which were essential in providing just-in-time support.

- Teachers had limited competency in ICT. Although teachers were skilled in industry-specific technologies, they lacked ICT skills.

Teachers were encouraged to attend seminars on current ICT approaches and applications in education and to attend workshops that gave them practical, hands-on experience in using ICT in teaching. As a result, teachers are now using the following tools pervasively: online quizzes, online assignment submissions, social media tools and mobile applications.

4.3 Authentic and simulated learning

4.3.1. Online practice lab for programming: Online Lifelong Education Institute (Republic of Korea)

Challenges in teaching practice prior to the innovation

The conventional learning environment for computer programming courses was not learner-friendly and did not allow sufficient student-teacher interaction. Normally learning took place in a physical computer lab where students practiced programming on their own, then printed out the results. If learning took place online, students had to use their own computers and had to find and install a compiler or an interpreter, which was difficult for those who had just begun to learn a programming language. Moreover, the conventional e-learning method used video lectures, which meant that students often learned on their own and were not able to interact with instructors while learning and get timely feedback. To get feedback, students had to send their work files to the instructor via e-mail or the assignment submission system and wait some time for a response.

Project brief and intended outcomes

The e-koreatech Online Practice Lab (OPL) is an interactive web-based system for teaching programming languages. The OPL offers various commonly-used language compilers and language interpreters, and learners choose the one that is appropriate for the programming language that they are learning. The students can change the editor setting if they want to and, using the editor, they can get instant feedback as they work on a programme. The OPL is connected to a bank of programming problems, which enables students to select a problem and work on it as many times as they want (see Figure 7 and Figure 8 for examples). Thus, a problem-based learning approach is used. Once students have acquired basic knowledge about a programming language, they apply what they have learned by solving problems randomly selected from the bank of problems. Also, using the OPL, students can access a programming editor any time and practice various types of programming as many times as they want. They can also see the results immediately in the same window. The instructors can see what their students have done and can provide immediate feedback.

Using the OPL, students can do all the coursework on mobile devices. This means that students do not have to go to a computer lab or even set up their home computers to learn a programming language. They can learn at anytime and anywhere.

As of 2016, e-koreatech was using the OPL to teach college-credit courses and informal e-learning courses on C, C++, Python, JAVA, and HTML.

Figure 7: A practice exercise for learning the C programming language

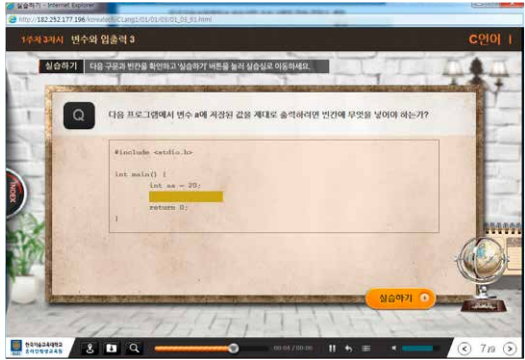
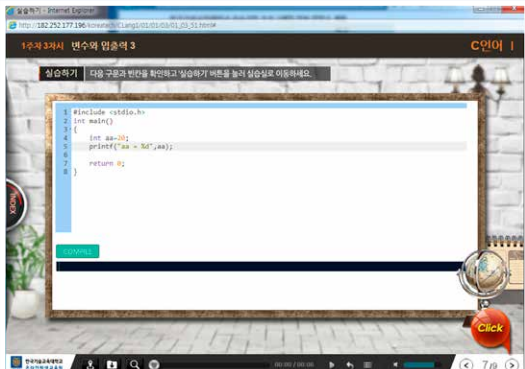
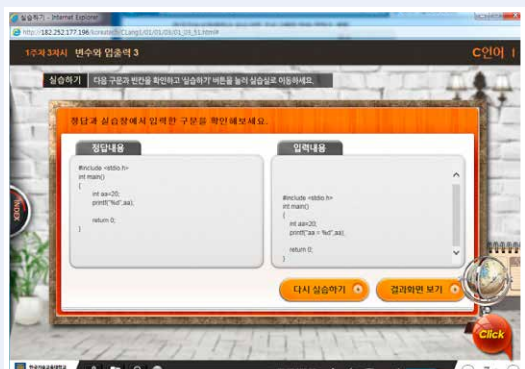
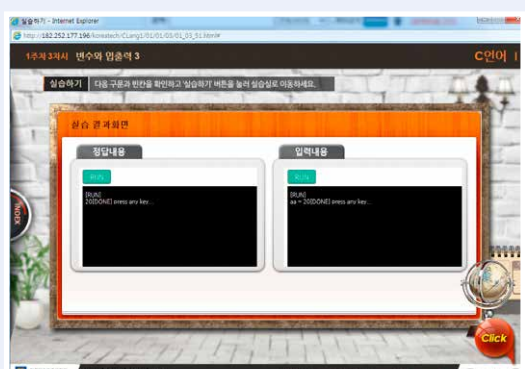
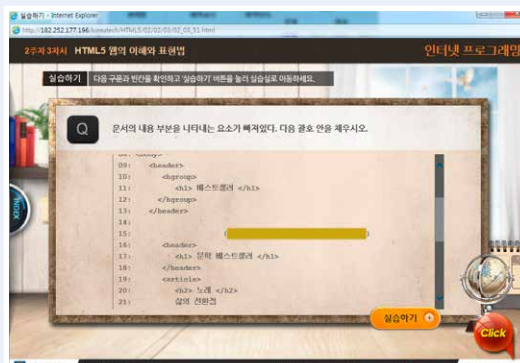
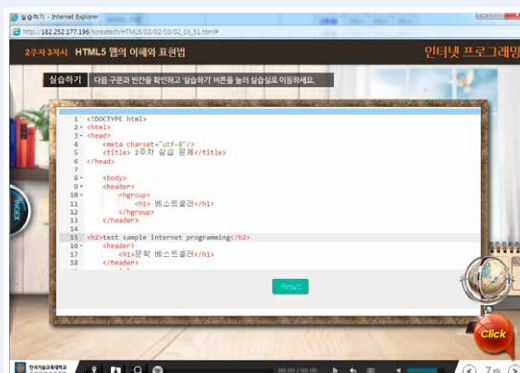
<p>1. Select a practice problem from the problem bank. Click on the 'practice' button.</p>	
<p>2. After writing programming codes to solve the problem, click on the 'compile' button.</p>	
<p>3. The correct answer is shown on the left; the learner's input is shown on the right.</p>	
<p>4. If you click on 'results view', you see the correct answer on the left, and the learner's coding results on the right.</p>	

Figure 8. A practice exercise for learning HTML5

1. Select a practice problem from the bank. Click on 'practice'.



2. Input HTML codes, and click on the 'result' button.



3. The correct answer is shown on the left; the learner's input is shown on the right.



4. If you click on 'results view', you can see both the instructor's and the student's codes.



Pedagogical approach

The design of e-koreatech courses using OPL was based on the constructivist approach to learning. OLEI believes that students have more meaningful learning when they actively participate in that learning. Accordingly, the instructor's role has been changed from delivering learning content to monitoring students' learning processes and giving them appropriate feedback.

Key points for effective practice

The key points for success in this form of e-learning are to provide students with sufficient and diverse relevant problems to solve and to motivate instructors to ensure they regularly check students' learning progress and give immediate feedback to individual student.

4.3.2. Virtual training: Online Lifelong Education Institute (Republic of Korea)

Challenges in teaching practice prior to the innovation

In the past, if a TVET institution wished to teach students how to handle industrial equipment, it either had to install the real equipment, which is expensive, or schedule a day trip to a site that allowed students to see the real equipment. In either case, learners were not able to do certain things, such as taking apart and reassembling the equipment. Furthermore, instructors could only teach using books, images and video clips, and they were not able to offer many interactive hands-on activities.

Project brief and intended outcomes

Recognizing the need for more hands-on learning about using industrial equipment, the OLEI developed virtual training content using simulators, emulators and virtual reality (and augmented reality) software. Using these ICT and the content, students can learn about various kinds of equipment, including macro-sized tools, ultra-mini tools and highly expensive equipment that institutions cannot afford to buy, and can also learn about how to stay safe in dangerous work situations. The first virtual training courses were designed to teach about a type of refrigerator and about the 'clean-room control system'.

The OLEI made the virtual training content available via the online platform (<http://vt.e-koreatech.ac.kr>). Therefore, trainees can log in and access the learning content at any time. This kind of learning environment enables students to access the learning material at a time most convenient for them, and they can practice as much as they want.

Since 2007, the OLEI has developed 31 virtual training courses, and offers them in 141 training centres; both public and private (See **Table 3** and **Table 4**). Using these courses, the centres have so far trained 24,418 students.

Table 3: Virtual training content

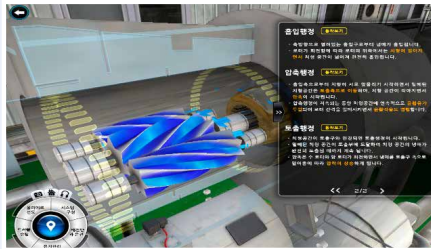


Year	Number of courses	Subject area					
		Mechanics	Electronics	Mechatronics	Architecture	Design	New Energy
Total	31	10	12	2	4	1	2
2007	3	1	2	-	-	-	-
2008	3	2	1	-	-	-	-
2009	4	1	1	1	1	-	-
2010	3	-	1	1	-	1	-
2011	3	-	2	-	-	-	1
2012	3	2	1	-	-	-	-
2013	3	1	-	-	1	-	1
2014	4	1	2	-	1	-	-
2015	5	2	2	-	1	-	-

Table 4: Number of training centres and virtual training courses taught (2008-2015)

	Total	2008	2009	2010	2011	2012	2013	2014	2015
Training Centres	141	1	2	2	2	8	33	43	50
Courses	354	1	2	2	2	8	86	101	152

The OLEI developed three distinct types of virtual training: component, scenario and equipment practice (see Figure 9). The component type helps learners understand the inner structure of equipment, by enabling them to disassemble and reassemble the equipment using 3D modelling. The scenario type helps learners understand how to operate equipment, through following a procedure. The equipment practice type generated a diversity of practice environments in which learners were free to control the equipment until they attain the right results.

Figure 9: The three types of virtual training content and examples of the equipment they provide training about

Type	Image	Examples
Component		<ul style="list-style-type: none"> • Turbo refrigerator • Hybrid automobile • Clean diesel automobile • Wind generator system
Scenario		<ul style="list-style-type: none"> • Absorptive hot and chilled water system • Concrete construction • SMT in-line system • Manufacturing process for solar batteries
Equipment practice		<ul style="list-style-type: none"> • EHC servo control • Siemens PLC • Proportional hydraulic control • Operation of Manufacturing • Equipment for semiconductors

Using the virtual training ICT, learners can gain a full understanding of how equipment works and under what conditions. They are able to master the work procedures for the equipment, and learn how to handle various emergencies at work.

Between 2013 and 2015, the OLEI conducted annual surveys of students to assess learner satisfaction with the virtual training courses. When asked to rate their satisfaction on a scale of 1 (low satisfaction) to 5 (high satisfaction), the average response over the three years of the survey was 4.45 (see Table 5). Satisfaction levels declined somewhat in 2015 following the introduction of an autonomous online system that was able to deliver a large amount of content to local training centres and which replaced the need for on-site support to set up equipment for training package delivery. The OLEI believes that the transition to the new content dissemination system, and the consequent disruption in services, was possibly the cause of the slight drop in satisfaction.

Table 5: User satisfaction survey results (score out of 5)

Questions	Average(points)	Year 2013	Year 2014	Year 2015
Total	4.45	4.42	4.64	4.31
Study prompts ⁸	4.69	4.82	4.77	4.48
Educational effects of contents	4.63	4.65	4.73	4.52
Adequacy of the content amount	4.19	4.05	4.38	4.14
Relevancy to real work	4.40	4.27	4.75	4.19
Differentiation from other media	4.58	4.52	4.84	4.38
User convenience	4.5	4.46	4.67	4.38
Replacement of real equipment	4.19	4.16	4.31	4.1

The OLEI's work on virtual training content was recognized with OLEI receiving first prize in 2015 for the best university e-learning practice, awarded by the Ministry of Education in Korea.

Pedagogical approach

The OLEI uses virtual training technology in the context of student-directed teaching, based on constructivism and the experiential learning approach, which emphasize active, hands-on learning and offers diverse learning experiences to ensure students have ownership of their learning. The OLEI believes that students learn better if they can control their learning and make their own choices with the learning content. Accordingly, students learn about basic concepts and practical skills using hands-on practice, work at their own pace and repeat activities as often as they want.

Key points for effective practice

For this practice to be effective, it is important to choose subject areas that have a good fit for the technology. Virtual training was appropriate for the courses offered by the OLEI and the technology met the need to train students in how to handle highly expensive (or macro-sized) industrial equipment and dangerous work situations.

It is also important that the technology that is chosen is cost effective. Despite the high cost of virtual training content development, and the rapidity with which such technologies become obsolete, the provision of virtual training contents freely to individual training centres reduced national vocational training costs.

⁸ Study prompts are visual indicators of student's learning rate vis-à-vis the average student learning rate.

4.3.3. Virtual and Augmented Reality: Institute of Technical Education (Singapore)

Institutional background

The Institute of Technical Education (ITE), established in 1992 under the Ministry of Education, is a post-secondary education institution. As a principal provider of career and technical education, and a key developer of national occupational skills certification and standards, the ITE's mission is to create opportunities for students and adult learners to acquire skills, knowledge and values for employability and lifelong learning.

Challenges in teaching practice prior to innovation

In the past, theory was largely taught using conventional methods, while practical lessons were given in authentic learning spaces such as in an operational hotel, restaurant, aeroplane hangar, etc. In such contexts, students learned how to deal with real customers, equipment and work situations. If authentic learning spaces were too costly or impractical, students learned in classroom environments through role-plays. While lecturers tried to incorporate situated learning into their lessons as much as possible, they faced challenges for the following reasons:

- Certain tasks were not replicable due to safety concerns (e.g. shipyard heavy equipment, running aircraft engines etc.).
- Certain tasks were difficult to replicate due to high costs and limited budget (e.g. use of flowers in largescale events).
- Authentic work environments were not replicable (e.g. adverse weather conditions in the sea).

Project brief and intended outcomes

In view of the need for more authentic learning experiences, the ITE decided to introduce two types of immersive technologies: 3D virtual reality and 3D augmented reality. The schools worked closely with technology solution providers to design relevant learning activities for students, based on the curriculum requirements.

The 3D virtual reality system

The ITE introduced a multi-wall 3D VR system (iCube). This is a revolutionary PC-based, multi-sided immersive environment in which participants are completely surrounded by virtual images and sound. iCube is a high-end visualization system that can be configured with four to six walls made of light-enhancing rigid material. Students interact with an authentic 3D environment using motion tracking devices, and use the system's built-in collaborative capabilities to discuss and explore solutions.

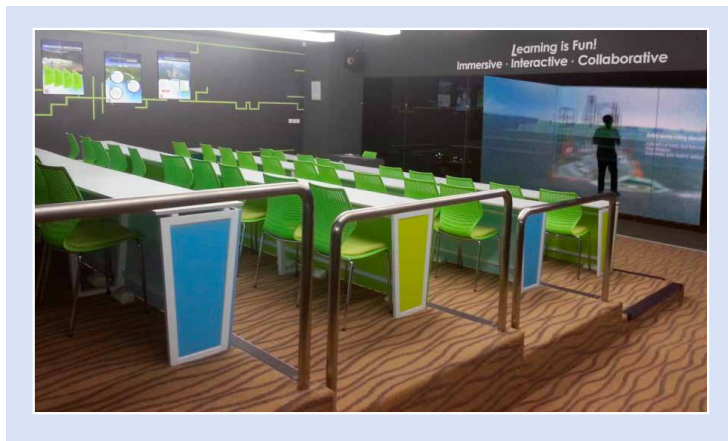
For example, students enrolled in the Marine and Offshore Technology course used the iCube technology to practice their skills on a simulated oil rig platform. Using this ICT, students were able to safely train for adverse weather conditions such as heavy rain and strong wind, and learned to adjust to a variety of environmental conditions and associated job hazards. This technology was also used for other courses, including the Floristry course and Aerospace Technology course.

The school and its technology partners designed and developed digital resources for use within the iCube (for various learning scenarios), based on selected units in the curriculum.

The 3D virtual reality system consists of two physical spaces (see Figure 10):

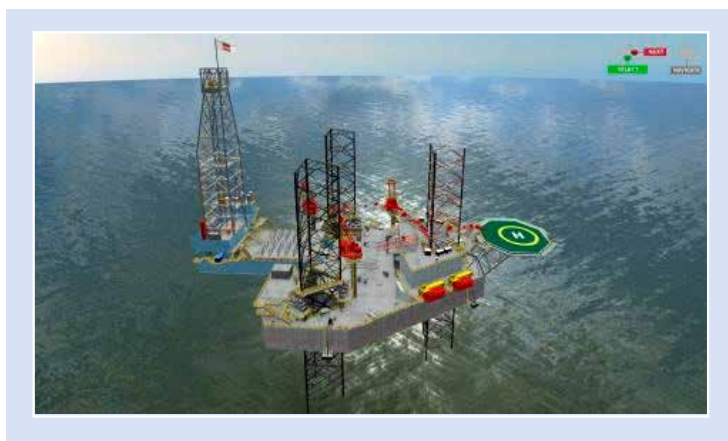
- A virtual reality learning environment (iCube): A four-wall system that allows between four and six students to interact in a virtual environment using motion tracking.
- A student learning space: An area in which the remaining students in the course can observe their peers and reflect on their learning progress in the iCube.

Figure 10: iCube learning environment



3D virtual reality technology is particularly useful when it is not possible for learners to access real-world work sites and when such sites pose dangers to learners. A good example is offshore oil rigs. Simulating bad weather conditions on the virtual oil rig platform is an authentic but safe experience (see Figure 11).

Figure 11: The virtual oil rig platform



In the Marine course, one of the tasks involves lifting a 0.9-ton pipe, a risky manoeuvre that can cause harm to workers if safety measures are not taken. Using virtual reality technology, students are able to undertake the task and experience the consequences of not following safety measures without being physically hurt. Having experienced this, the students can better understand that lives can be lost if workplace safety is not taken seriously. In the iCube, they can experiment with different scenarios, and have fun while learning (see Figure 12).

Figure 12: 3D virtual reality: Safety during pipe-lifting operations



Another example is the Floristry course, in which students use virtual reality technology to learn the parts of different types of flowers. The tool enables students to fly like a bee around and into the flowers to examine them closely. Students can also virtually take flowers apart to learn about the parts without destroying (wasting) any flowers. In addition, students can use the tool to make virtual floral arrangements (e.g. for a wedding) and are able to collaborate in such tasks with other students (see Figure 13). Thus, 3D virtual reality technology supports students' acquisition of collaboration skills and prepares them for real workplace environments and operations.

Figure 13: 3D virtual reality: Floristry environment



Feedback from students indicates that almost all liked this mode of learning and most requested that more courses incorporate immersive technologies for learning, as they liked the combination of playing and learning in a realistic and safe environment.

3D augmented reality applications

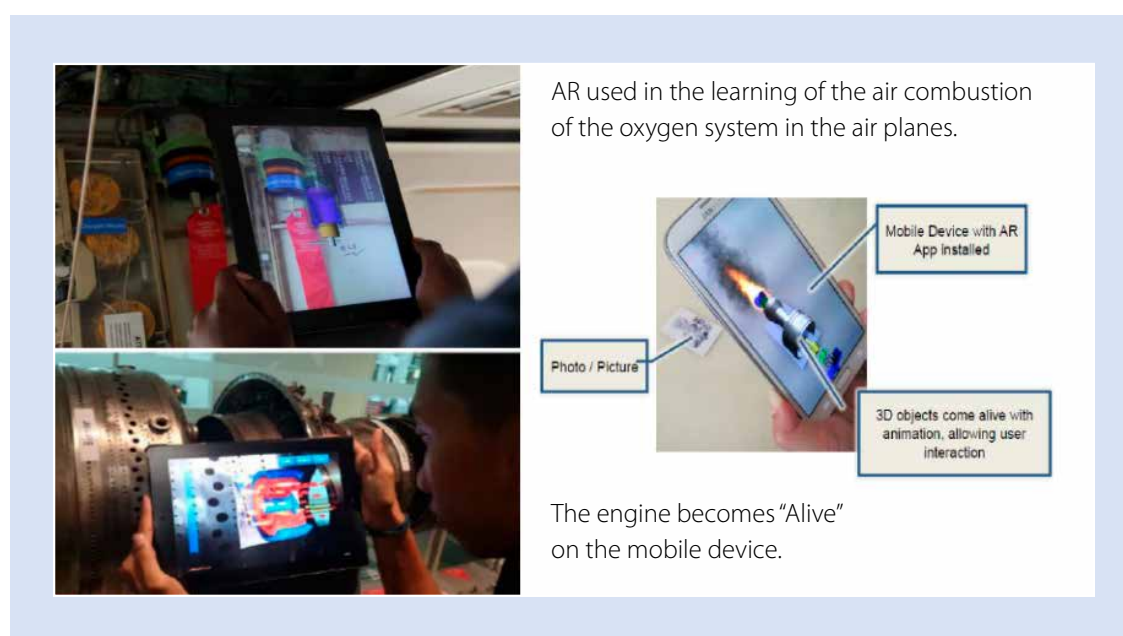
3D augmented reality applications enable students to interact with real world environment using real time data, thus contextualizing knowledge for just-in-time learning. These applications superimpose relevant data on top of the real world in the form of interactive 3D models or 2D information through graphical markers or QR codes. Augmented reality digital resources can be

accessed via viewers installed in students' mobile devices. When graphical markers are placed on related physical equipment and models in the workshop, e.g. aircraft engines and parts, learning can be contextualised and more meaningful.

For example, students in the Aerospace Technology course were able to load into their mobile devices 3D aircraft engine models and watch simulations of these engine parts in the AR viewer. These 3D simulations helped them to visualise details of complex systems and the operational flow inside the equipment.

3D augmented reality is suitable for students who are expected to understand the intricacies of sophisticated equipment. For example, using the augmented reality application, students who previously experienced difficulty in understanding how air combustion worked in the aircraft engine could now visualise the process and appreciate how complex components work together (see Figure 14).

Figure 14: Using 3D augmented reality technology to learn about air combustion



Pedagogical approach

The ITE has a 'Hands-on, Minds-on, Hearts-on' pedagogical approach. The ITE's curriculum comprises comparatively little theory, and rather has a focus on practical training sessions.

The 3D virtual reality and 3D augmented reality technologies make immersive hands-on practice possible, thus expanding the scope of authentic learning spaces for ITE students. Furthermore, through providing a multi-sensory experience in specific work settings, students can appreciate the scale/constraints of work environments and the complex interdependency of the component parts of a system/ workflow. These technologies also increase students' engagement in learning.

When using the ICT, students are required to use their judgment to make task-based decisions and must ‘face the consequences’ of their decisions, albeit virtually. Students can use the technology in both independent learning and in collaborative problem solving activities in the context of specific work situations, thus promoting authentic learning.

Key points for effective practice

As with any technology, the design and development of 3D virtual reality and augmented reality learning resources must be driven by curriculum requirements so that the benefits of such technologies are exploited and the high costs are justified.

For the technology to be appropriate to the curriculum, it is essential to have close partnerships between schools and the immersive technology solution providers when developing the content.

Another essential point is to train the teaching staff so that they are able to use the technologies effectively in the classroom and demonstrate to students how to use this type of ICT. Plans to increase usage would also have to be put in place.

Use of the 3D virtual reality system requires a dedicated space. The cost is significant, so a dedicated budget is also required, especially if immersive environments are installed on multiple campuses. For 3D augmented reality, the cost is lower as mobile devices can be used. Students can use their own mobile devices or school supplied devices.

4.4 Promoting reflective learning and knowledge creation

4.4.1. E-Portfolio: Box Hill Institute (Australia)

Institutional background

Box Hill Institute (BHI) is a leading vocational and higher education provider known in Australia and overseas for its collaborative and creative approach to education. Over its history, it has received many awards in recognition of its achievements, including the ‘Best eLearning Design: Video’ award from the LearnX Impact Awards in 2016 and the ‘Excellence in International Education – TAFE’ award from the Victorian International Education Awards in 2015.

BHI offers wide variety of courses to both local and international students, and various delivery modes, including full time, part time and off campus. As of 2016, BHI had about 40,000 students enrolled in its campuses in Australia and in licensed partners overseas.

BHI’s high quality strategic relationships, facilities and programmes make the organization a recognised leader in a number of vocational areas. Six key planks underpin its approach to education:

- A culture of community involvement
- A focus on relevance and currency in all courses
- Innovation in all aspects of its business
- Responsiveness to clients

- Equitable access for all
- A commitment to quality

BHI's teaching and service centres work in partnership with employers to ensure their graduates gain vocationally-relevant skills and knowledge, and experience a global dimension in their learning, so that they can achieve their career goals. With its international partners in the Global Education Network, BHI is expanding global learning opportunities for its students to enhance their employability in the global market.

BHI connects its people with best practices and new environments through industry partnerships and national and international activities. Students graduate ready for work. BHI's industry partnerships also give students access to internationally recognized training and practical experience with modern technology and processes.

Challenges in teaching practice prior to innovation

Box Hill Institute discovered, via student feedback surveys, that many students felt that the induction process at the institute could be improved in meeting their needs and in ensuring that they embarked on a successful learning pathway both during their studies at BHI and afterwards.

BHI also recognized that the institution did not have an organization-wide means of embedding e-learning as a means of encouraging lifelong learning among its students. This is a challenge because Moodle supports institution-based assessments while Mahara supports industry or portfolio-based assessments. If these two systems are not integrated, it can be difficult to have a holistic view of the students' achievements. In addition, the government-hosted e-portfolio tool did not managed to connect between classroom learning and workplace learning as well as between teachers, the institution and employers.

BHI decided that a methodological and organizational response was necessary to prepare the institution for the next steps in the evolution of personalized learning.

Project brief and intended outcomes

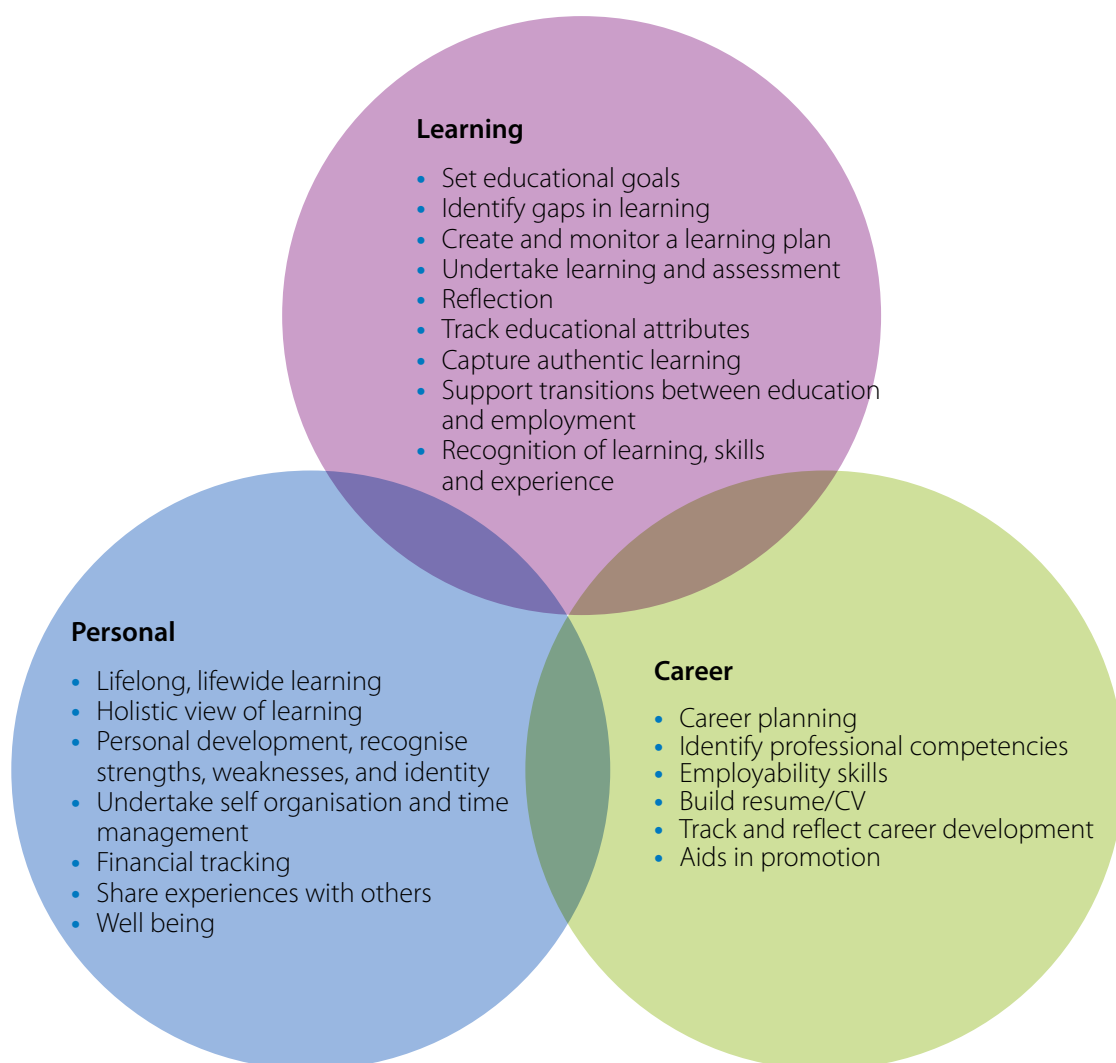
Recognizing the need to assist students to secure a pathway for lifelong learning and to embed e-learning, while also supporting connection and communication between classroom-learning and workplace-learning, the BHI introduced the Mahara e-Portfolio system.

An e-Portfolio can be described as 'a learner-driven collection of digital objects demonstrating experiences, achievements and evidence of learning'. Thus, e-Portfolios are an evidence-gathering tool that learners 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 Recognition of Prior Learning (RPL).

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-centred customized delivery and assessment strategies, and enables individualized and industry-contextualised assessment of learners (Figure 15).

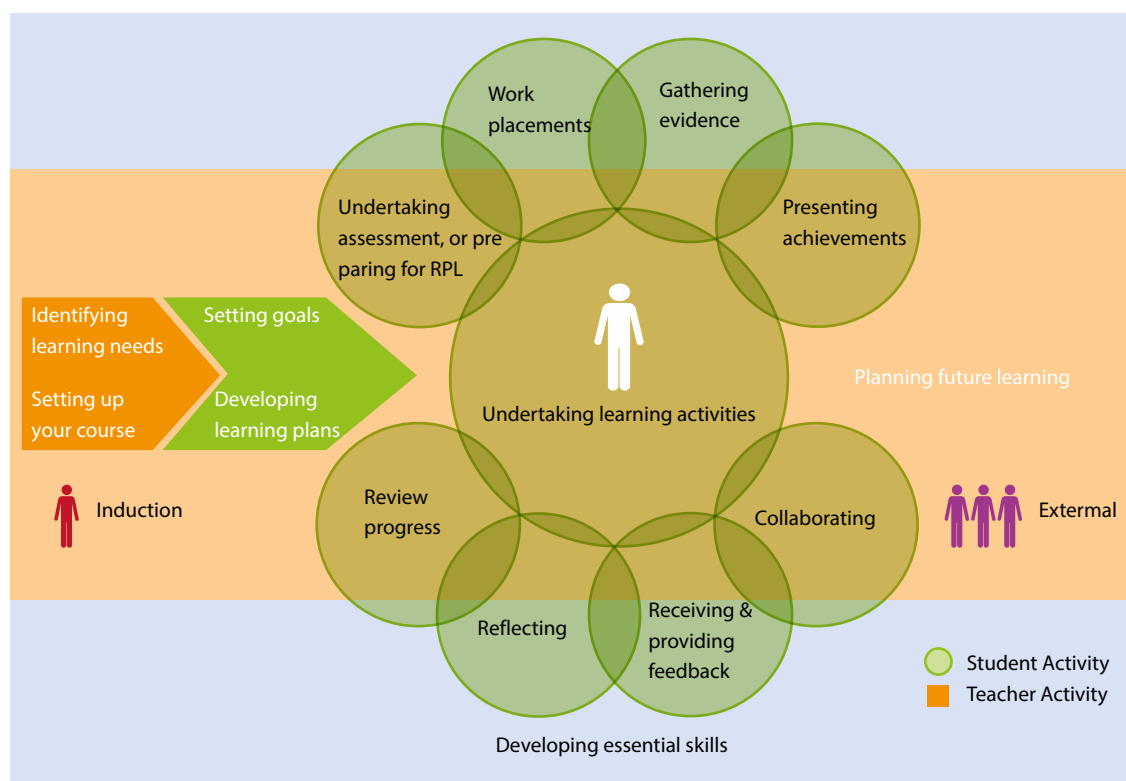
Figure 15: BHI e-Portfolio's student-centred model



E-portfolios can be a vehicle for (see Figure 15):

- Supporting transitions and student mobility.
- Planning and reflecting on learning and career development.
- Recognizing skills and learning styles.
- Verification of qualifications.
- Security and control of private information.
- Recording evidence of employability skills.

Figure 16: Benefits of e-Portfolios



Elements of personalized learning in practice that are relevant to the TVET sector are presented in Table 6.

Table 6: BHI's response to personalized learning

Elements	Response
<ul style="list-style-type: none"> Tailoring education to individual need 	Individual Learning Plan programme GPS Learning Pathways
<ul style="list-style-type: none"> ICT-rich learning environments 	iPad programme (mobility in education) and flipped classroom project which included the use of the 360 Collaborate programme.
<ul style="list-style-type: none"> Student voice 	Individual Learning Plan programme StudentWeb including Moodle and Mahara e-Portfolios

BHI introduced e-Portfolio in two phases. The first phase was designed to help new students to reflect on their personal, learning and career goals, while the second phase aimed to help all students to use the e-Portfolio system.

The first phase began with each student completing a SWOT analysis and a learning styles analysis, and preparing a list of SMART goals and a resume using Mahara e-Portfolios software. This process gave students the opportunity and time to reflect on why they had enrolled at BHI and in their chosen course, and to identify their career pathway. Students were able to identify their strengths and weaknesses and create a learning plan to optimize their future opportunities.

The information provided in this initial phase enabled BHI teachers to identify at risk students, including potential drop-outs, as well as students with learning challenges and those who could benefit from referral to student services. This had a significant impact on student retention.

The e-Portfolio advocates also designed assessment strategies that integrated e-Portfolios with summative assessment tasks ensuring the e-Portfolio became an integral component of the course structure.

Teachers can use the e-Portfolios as a tool for learning; for example by disseminating instructional videos for students to watch, then asking students to film visual diaries of their tasks and share those via their e-Portfolios. This promotes reflective learning and knowledge creation.

While students tend to use e-Portfolios collaboratively, teachers tend to use e-Portfolios for assessment purposes or as a means of communication. E-portfolios have lifelong learning applications, such as on-the-job applications and building a resume, and are used by BHI students in many fields and contexts (see **Table 7**).

Table 7: BHI e-Portfolio learning contexts

Teaching Centre	Context
• Biotechnology	• Work placements
• Creative Industries	• Industry portfolios for fashion and music
• Business Programmes	• Work placements
• Hospitality	• Work placements and industry based RPL
• Health and Community Services	• Work placements and industry based RPL

Pedagogical approach

The e-Portfolios system is based on a student-centric and process-oriented pedagogical approach that encourages students to develop their ability to plan, synthesise, share, discuss, reflect and create knowledge. The system supports BHI's efforts to equip students with the skills, knowledge and attitudes to apply their learning to new situations, solve problems, work creatively and cooperatively and engage in lifelong learning. BHI believes that e-Portfolio-based learning encourages rich and complex processes of planning, synthesising, sharing, discussing, reflecting, giving, receiving and responding to feedback, and that this process is as important as the end product. Use of e-Portfolios goes beyond course delivery, supporting student-led, lifelong and life-wide learning objectives through informal, non-linear and chaotic learning processes.

Key points for effective practice

For the e-Portfolio system to succeed, it is essential that an institute-wide strategy is adopted, with support for the system at every level of the organization. Furthermore, the institute's assessment strategies should be adapted to include the e-Portfolio as an integral tool for summative assessment.

Buy-in from the teachers and their commitment to the e-Portfolio system is critical for its success. Teachers provide context and support. Given the importance of the teachers, it is of course essential that the teachers receive training in how to use the e-Portfolio system. Furthermore, this training must be provided not only when the system is introduced, but also at frequent intervals every year,

in order to address concerns, meet emerging needs and maintain the momentum of the system. Students also require both initial training and ongoing training. The necessity of ongoing training was demonstrated at BHI when the Professional Development team became overloaded and stopped providing training. This led to a distinct decrease in the use of the e-Portfolios by the students and teachers already using the system, and a direct impact on the uptake rates for the teachers and students who had not yet adopted the technology.

The training should go beyond explaining how to use the technology to cover concepts of lifelong and life-wide learning, and to explain how e-Portfolios can improve classroom and workplace-based assessment and expand collaboration. In the training, teachers should be encouraged to collaborate with each other and to use e-Portfolios at the course level, not just at the unit level. Aside from group training, it is also necessary to provide teachers with one-on-one support and mentoring so that they can overcome obstacles quickly and therefore integrate e-Portfolios smoothly into their assessment and delivery strategies.

If the system is to be successful, the TVET organization must have the necessary information technology (IT) infrastructure and have trained IT staff who are capable of maintaining the system. It is also necessary to ensure that information entered into the e-Portfolios is secure and that the privacy of students is protected.

It is also necessary to design and develop templates suitable for the local context and courses. This design process should be undertaken in consultation with students, the key users of the system, to ensure the look and feel of the e-Portfolios matches their needs and tastes. In this way, the system will be student-centred and students will have 'ownership' of the e-Portfolios; the students will therefore be more likely to use the e-Portfolios and benefit from them.

The organization should also solicit teachers' opinions and inputs, as the teachers will be both users and managers of the system. The use of e-Portfolios should be integrated into workplace-learning contexts. This requires explaining the benefits of e-Portfolios to workplace managers. Overall, it is vital to have clear communication with all of the stakeholders.

For the e-Portfolio system to have benefits for students and teachers, it is necessary to ensure that the system meets the changing needs of teachers and students. Mahara is an open-source software so can potentially be adapted, with the support of the open-source community, to suit the needs of each TVET organization. However, given that it is open source, it is possible that the software could one day cease to be usable. Therefore, it is essential to consider whether alternative systems could achieve the desired outcomes. For example, it may be possible to create Facebook groups for collaborative information sharing.

Organization-wide policies are needed, along with a phased approach. First expand the programme from Year 1 students (orientation objectives) to senior students (collection of learning evidences); then transit from teacher-led e-portfolios to student-driven e-portfolios; then move on from standalone e-Portfolios to those that are integrated with all learning and assessment activities embedded in students' learning workflows; and adopt a customized approach for each industry/profession.

4.4.2. Project-based collaborative learning: Informatics Holdings (Philippines)

Institutional background

Informatics Philippines provides training and tertiary education in the subject of Information Technology (IT) and through IT-empowered courses, to full time and part time students. Informatics has its roots in Singapore, where it was established in 1983. Each year, Informatics trains around 10,000 students.

The training courses provided at Informatics Philippines range in length from one day to six months. Some courses cater to working adults seeking to upgrade or acquire ICT skills, while Higher Education (HE) courses enable students to gain academic credit that leads to certificates, diplomas, advanced diplomas and bachelor's degrees.

Informatics Philippines seeks to produce globally competitive individuals who are innovators. Therefore, it seeks to ensure that its graduates possess technical skills, expertise, good communication skills, skills in analysis and critical thinking, and the ability to work in teams.

Challenges in teaching practice prior to innovation

Informatics faced two challenges. First, many students wanted to enrol to study at the organization but they did not have the luxury of time for a regular training schedule and, second, the Informatics graduates needed not only technical skills, but also soft skills (transversal competencies) in order to be employable.

Project brief and intended outcomes

In view of the challenges it faced, Informatics adopted two important learning innovations: blended learning and the 'Inculab'.

With the blended learning approach, students are able to access online learning materials developed by partner content developers (such as Mind Leaders) at their own pace and time, and learning is supported by a face-to-face facilitation, through which learners are encouraged to reflect on what they have learned online. This teaching arrangement ensures that learners are able to meet course goals while also developing the ability to inquire, reflect on and consolidate what they have learned. The blended learning approach allows learners to acquire the skills they are interested in. Students can review the online materials as much as they want and reflect on them until they understand the concepts. This learning is reinforced in the classrooms.

The Inculab programme aims to encourage and stimulate students' creative skills, leading to knowledge creation and product innovation and seeks to foster an entrepreneurial spirit. Inculab promotes collaborative learning in which students work in teams and are mentored by industry experts with expertise relevant to the subject.

Pedagogical approach

The Inculab programme promotes experiential and reflective learning through the blended learning and project-based learning pedagogies. For Inculab, collaborative learning is the key lever to socially constructed knowledge and solutions.

Because ICT is integral to the courses at Informatics and students require hands-on practice to fully grasp the technology, teachers use ICT-supported project-based learning approaches. With a 1:1 student-computer ratio in teaching technology to students, project-based pedagogy guided students to evolve their projects progressively from beginning to end of class. For assessment, rubrics are used, provided by its Singapore head-office. For blended learning, professional content-developers designed and developed digital materials for e-learning. Students are supported with digital learning resources and face-to-face coaching by trainers and industry experts. Students engage in collaborative problem solving and value creation using real-world projects, thereby mimicking the expectations of the ICT industry.

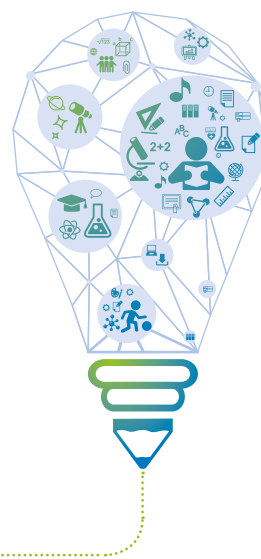
Key points for effective practice

For graduates of ICT-based courses to succeed in gaining employment, it is necessary for them to engage with the latest and most reliable technology tools during their studies. Therefore, any TVET institution that wants to deliver ICT-based courses must ensure that it has equipped with the required ICT infrastructure and software, along with adequate bandwidth to support online learning, and skilled information technology (IT) personnel.

When introducing new forms of ICT and associated pedagogy, it is essential that teachers become familiar with them before they are integrated into teaching and learning.

Learner maturity is a significant factor for online learning to be effective because the premise of this approach is independent learning.

Inculab is only effective if all team members have the same enthusiasm and share what they learn. Team members are expected to do their own share of the work because slacking members affect the entire flow and quality of work.



5. Cross case analysis: Conceptual framework

This section introduces a conceptual framework for analysing the extent to which technology has been integrated into the participating TVET organizations. Conceptual frameworks guide sampling decisions and procedures for data collection and analysis (Miles and Huberman, 1994) and this approach provides flexibility and room for in-depth inquiry. The researchers established the conceptual framework for this study based on the literature regarding factors influencing the effective integration of ICT into TVET and the various levels of integration.

5.1 Factors influencing the effective integration of ICT in TVET

Use of ICT for teaching and learning is often ad hoc and experimental, and is fraught with challenges. For sustainable and pervasive integration of ICT into curriculum delivery, TVET providers and other stakeholders must consider certain factors (BECTA, 2004). An article by Kotsik et al. (2009) suggests four key factors to consider when integrating ICT into curriculum delivery: strategic readiness; organizational readiness; pedagogical readiness and technical readiness. Other key factors are operational readiness (Victoria State Government, 2015) and learner readiness. Although learner readiness is seldom an issue, especially for younger trainees who have grown up using ICT in their daily lives, learner engagement is influenced by the other five factors.

Strategic readiness: Any organization serious about successful ICT implementation must ensure strategic readiness. This requires formulating an e-education vision, as well as a mission, values, goals, strategies and programmes. When these are in place, relevant cross-functional stakeholders can then translate them into a specific implementation timeline and deliverables, and calculate the budget required to install, scale up and sustain the infrastructure, system hardware and software, as well as provide professional development for staff.

Having a strategic view, with a pedagogic vision of what the organization hopes to achieve, will prevent veering into a mechanical mode in which technologies are used without due consideration of the impact on teachers, students and learning outcomes, and without measures to evaluate their efficacy. The strategic plan should be developed with the inputs of all stakeholders, especially from teachers, as they are instrumental in delivering effective ICT-enabled TVET to students. Furthermore, teachers' input into the process will ensure buy-in.

Organizational readiness: This can be achieved when the majority of the key stakeholders, including teachers, are ready to embrace the changes brought about by the infusion of technologies into delivery. For this to happen, academic leaders must provide guidance and resources to support teaching staff. It is necessary to identify any gaps in teachers' skills, then give teachers the time required to attend training. Leaders should appoint teachers who are passionate about using ICT in their instructions as 'e-education champions' and recognize and reward their work. Furthermore, to achieve the e-education vision, academic leaders must themselves model innovative use of ICT and proactive collaboration with leaders from cross-functional establishments.

Pedagogical readiness: TVET organizations should have the pedagogical capacity to use appropriate technologies that can increase learning gains for their trainees. This may require appraising teaching practices and teachers' knowledge of progressive learning theories. Apart from training teachers in the areas in which competency gaps exist, it is necessary to provide a means by which to evaluate training outcomes and applications.

Technical readiness: This should begin with an assessment of the current technologies being used by employers, as well as an assessment of the upcoming technologies, to ensure that the organization obtains ICT that is appropriate for both current and future needs. ICT infrastructure planning must make provisions for sufficient network bandwidth and speed, enterprise-wide learning systems that are mobile and internet enabled, software and licences to support learning, and user privacy and security. Estate infrastructure planning should include the provisions of adequate access points, charging points, computers and mobile devices, wireless projectors, and equipment and furniture that support collaboration and the new ways of learning.

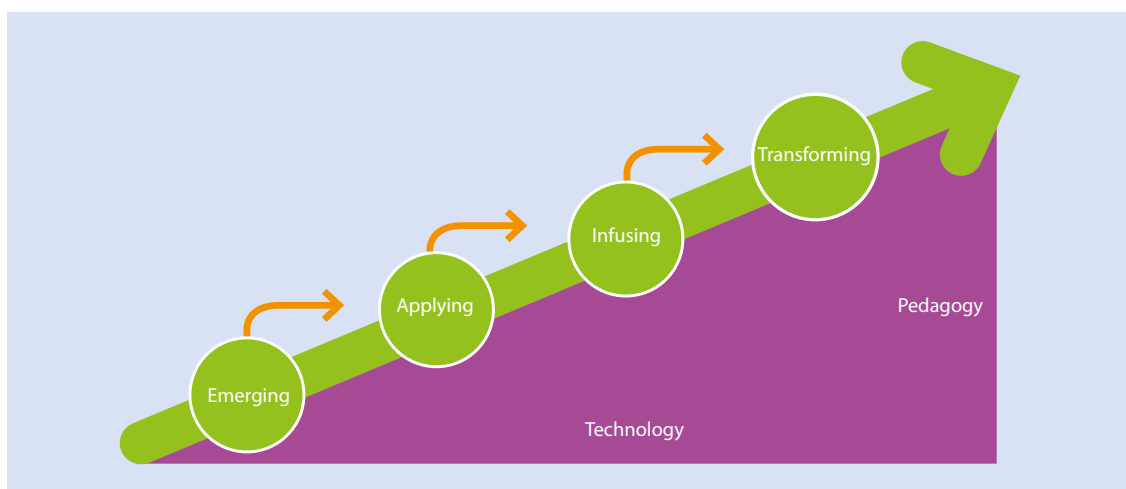
Operational readiness: To support the ICT-based learning systems that have been launched, it is necessary to provide the users of the system: teachers and students, with day-to-day support, which could be in the form of an information technology (IT) helpdesk for technical issues and an application support helpdesk. Organizations should also provide users with a self-help knowledge base and a platform to build communities of practice to support one another. Organizations should also actively communicate new policies and encourage sharing of innovative practices among the teachers.

Learner readiness: While younger students are often familiar with ICT, students who have experienced a rigid education system that emphasizes testing over learning and memorization over performance, are often overwhelmed when being asked to conduct their own research and find their own answers. It is therefore important for teachers to acquaint their trainees with the methods trainees will use for ICT-enabled learning. Once students are familiar with their teachers' expectations and the ICT tools they will use, they will be able to take on complex and challenging tasks and apply higher order thinking skills. The use of ICT can then move from supporting learning to trainees selecting their own ICT tools to enhance their learning.

5.2 Level of integration of ICT into TVET

TVET organizations differ in terms of their ICT infrastructure and the extent to which they have integrated ICT into teaching and learning. UNESCO (2005) suggests a model to measure the extent of ICT development in an organization, with four stages: emerging, applying, infusing and transforming. This model can also serve as a guide for systematic teacher development in the area of ICT-enabled teaching (see Figure 17).

Figure 17: Stages of ICT development



Source: UNESCO, 2005

In this model, the 'emerging' stage is considerably driven by management and is focused on building up the ICT and physical infrastructure, including the acquisition of equipment and software. At this stage, teachers use mostly productivity-enhancing ICT tools such as word processors, presentation software, spreadsheets, emails, etc. At the 'applying' stage, teachers use specific software and ICT tools to supplement traditional classroom teaching, for example, drawing, designing and modelling tools. At the 'infusing' stage, various ICT tools are integrated across the curriculum, such that it is possible to have inter-disciplinary curriculum delivered to emulate real-world applications. The ICT tools used at this stage include multimedia, simulation and modelling software. At the 'transforming' stage, there is ubiquitous use of ICT not only for management and productivity, but also within the curriculum. Teachers are confident users of ICT and are capable of designing learner-centred lessons that creatively exploit ICT to engage students in solving real-world problems.

The Victoria State Government (2015) also has a four-stage model. This was developed to provide schools with a structure for ICT planning. The four stages are: foundation, emergent, innovation and transformation. Organizations at the 'foundation' stage use ICT and ICT-based practices in an ad hoc manner. Organizations at the 'emergent' stage use ICT and ICT-based practices consistently on a school-wide basis and are supported by resources. At the innovative stage, organizations have integrated ICT and ICT-based practices into teaching and learning, and processes ensure scalability beyond the schools. At this stage, e-learning is part of the school culture. Organizations at the transformative stage are integrating ICT and ICT-based practices systematically, in line with policies and processes that are evidence-based, thus ensuring scalability and sustainability beyond the schools.

Five elements support the integration of ICT into education:

- e-Learning leadership – This is demonstrated when an organization has an e-learning vision that drives its e-learning plan, and the organization therefore sets aside resources to support the use of ICT and engages stakeholders to ensure buy-in.
- Learning, teaching, assessment and reporting: Curriculum leadership is demonstrated when teachers are encouraged to infuse a variety of appropriate technologies to extend learning opportunities and differentiate learning. Teachers can also use ICT to deliver assessment for learning through more timely feedback, thus improving learning outcomes.
- ICT professional learning: Structures and programmes to improve teachers' ICT capabilities may include collaborative professional learning models, which are reflective and based on inquiries. Effective teacher development can be achieved when teachers are given resources and adequate support and when outcomes are measurable.
- Learning places and spaces: Learning spaces need to be learner-centred and flexible, so that they can support a diverse range of learning styles and facilitate group learning and both teacher-directed and self-directed learning. Learning environments should be digitally connected to facilitate seamless access to e-resources and virtual communities.
- Learning communities: Digital environments can connect learners, teachers, families and experts from local and global knowledge networks, thereby extend learning beyond the TVET organization. Through participation and collaboration, members can engage in authentic communities of practice.

The Ministry of Education of Singapore uses a similar model called 'Benchmarking Your ICT Practices for Excellence in Schools' (BY(i)TES) (MOE Singapore, 2011). Like the UNESCO and Victoria government models, the BY(i)TES model also has four stages: beginning, intermediate, progressive and advanced. At the 'beginning' stage, organizations use ICT and ICT-based practices inconsistently, while at the 'intermediate' stage, implementation and integration are school-wide and consistent. At the 'progressive' stage, integration is supported by processes that facilitate scaling up to a higher level. At the 'advanced' stage, implementation is sound, systemic and research-based, thereby sustaining the school-wide integration of ICT and ICT-based practices.

5.3 ICT integration matrix

Based on the three frameworks (UNESCO, the Government of Victoria and the Ministry of Education of Singapore) as well as on findings of the review regarding the issues and challenges facing TVET, the researchers developed an ICT integration matrix to measure the degree of ICT integration in each TVET organization. The matrix consists of four domains and four stages of development as shown in Table 8.

Table 8: ICT Integration matrix

Levels of ICT integration		Foundation	Emergent	Innovative	Transformative
1.	SCHOOL ICT LEADERSHIP (Strategic-organizational readiness)				
1.1	Level of ownership and influence of school leaders				
1.2	Focus of ICT implementation				
1.3	Level of engagement of students, staff and partners				
1.4	Processes for ICT implementation to support learning				
2.	DESIGN AND DEVELOPMENT OF ICT-ENABLED LEARNING EXPERIENCES (Pedagogical readiness)				
2.1	Design of ICT-enabled learning experiences				
2.2	Focus of schools' professional learning strategy				
2.3	Learning communities				
3.	DEPLOYMENT OF ICT FOR LEARNING (Learner readiness)				
3.1	Level of higher order thinking facilitated by ICT				
3.2	Level of ICT-enabled Learning				
3.3	Use of ICT tools to support learning				
3.4	Extent of student involvement in curriculum, and learning activities facilitated by ICT				
4.	IT AND ESTATE INFRASTRUCTURE AND SUPPORT (Technical readiness)				
4.1	Access to ICT resources in digital spaces				
4.2	Physical setup of learning spaces				
4.3	Availability of ICT systems and tools to support learning				
4.4	IT Helpdesk				

The ICT-integration matrix can be used by any institution, including TVET providers, to devise, track and drive ICT implementation strategies, particularly in domains that are relatively weak. It can also be used to start conversations with teachers on the kinds of professional learning needed to equip them with required pedagogical knowledge and ICT skills. Apart from strategic and technical readiness, the success of ICT-enabled programmes hinges on teachers' competency to redesign lessons for more innovative and engaging delivery. Transformation happens only when school leaders work hand in hand with their teachers.

For this particular study, the matrix was used as a means by which the respondents of the case study could self-rate the degree of transformation of their institutions.

The four levels of progress are described in Table 9.

Table 9: The four levels of progress

Levels of progress	Descriptions
Foundation	E-learning is based on ad hoc ICT-based practices and technologies.
Emergent	Consistent ICT-based practices and technologies on a school-wide basis.
Innovation	Sound integration of ICT-based practices and technologies with processes that ensure scalability beyond the schools.
Transformation	Sound and systematic integration of ICT-based practices and technologies with policies and processes that are evidence-based, thus ensuring scalability and sustainability beyond the schools.

When measuring the level of integration, it is necessary to consider the context of each domain and each indicator. The level of integration describes the organization's *current* ICT practices that are prevalent, i.e. representative of at least half of the student and teacher populations. Where the requirements of a level are only partially met, the preceding level should be assigned. The four levels indicate a progressively deeper level of ICT integration. Hence, the requirements of the lower levels must be satisfied before higher levels can be assigned.

For the study, the researchers computed the average score in each organization of all indicators for each domain. This score was used to determine if readiness for that domain was closest to foundation, emergent, innovative or transformative. For example, if the average score for a domain was 3.6, then it was deemed to be 'close to transformative'; but if the average score was 3.2, then it was deemed to be 'close to innovative'. Similarly, the average scores over all domains were computed for each organization, and banded accordingly.

5.4 Results

This section shares the results of the analysis of participants' inputs in the ICT integration matrix, the barriers to ICT integration, commonly used digital content, commonly adopted pedagogies and promising e-learning practices.

Extent of ICT integration

Table 10 summarizes the self-ratings of each organization for their levels of ICT integration in all four domains (Leadership, Teacher, Student and Infrastructure).

Table 10: ICT-integration levels, by domain, for each organization

	Foundation	Emergent	Innovative	Transformative
Leadership (Strategic-Organizational Readiness)		BHI, CIT, UCOL, TWC, SP	VTC, WIT, IHP, OLEI, ITE	
Teacher (Pedagogical Readiness)	TWC, OLEI	CIT, UCOL, SP	BHI, VTC, WIT, IHP, ITE	
Student (Learner Readiness)	TWC	BHI, CIT, ITE	VTC, UCOL, IHP, OLEI, SP	
Infrastructure (Technical Readiness)	TWC	CIT	UCOL, IHP, ITE, SP	BHI, VTC, WIT, OLEI

Analysis across the four domains revealed the following:

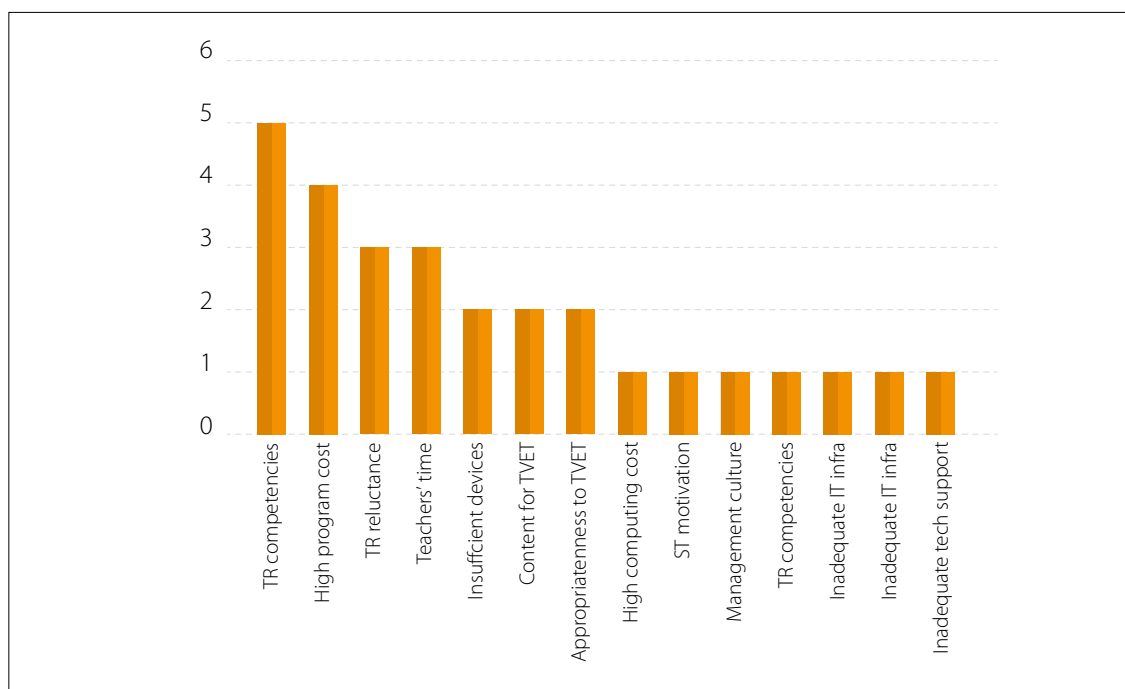
- As all of the organizations that participated in the study are from sophisticated education systems, the level of technical and infrastructural readiness is high.
- There was a relatively high level of ICT integration in the student and leadership domains: The current generation of learners is technology savvy and, when given the opportunity, will make the most of ICT to support their own learning. Furthermore, leaders of these organizations recognize the value of ICT for learning outcomes, and leadership has been recognized by most organizations as being critical to the success of e-learning.
- Half of the organizations were at either the foundation level or the emergent level for teacher readiness. In these organizations, there is an ongoing need to develop teachers' competency in the design and delivery of e-learning, and to support a coherent strategy for teacher training and professional communities.

Barriers to ICT integration

The barriers to ICT integration most commonly cited by the participating organizations (see Appendix 1: Survey Section C; Questions 1 and 2), were (see **Figure 18**):

- Teachers' lack of ICT competencies
- High cost of programme development
- Teachers' reluctance to change their roles and instruction styles
- Teachers' time constraints for ICT-enabled development and delivery

Figure 18: Barriers to ICT integration cited by participants



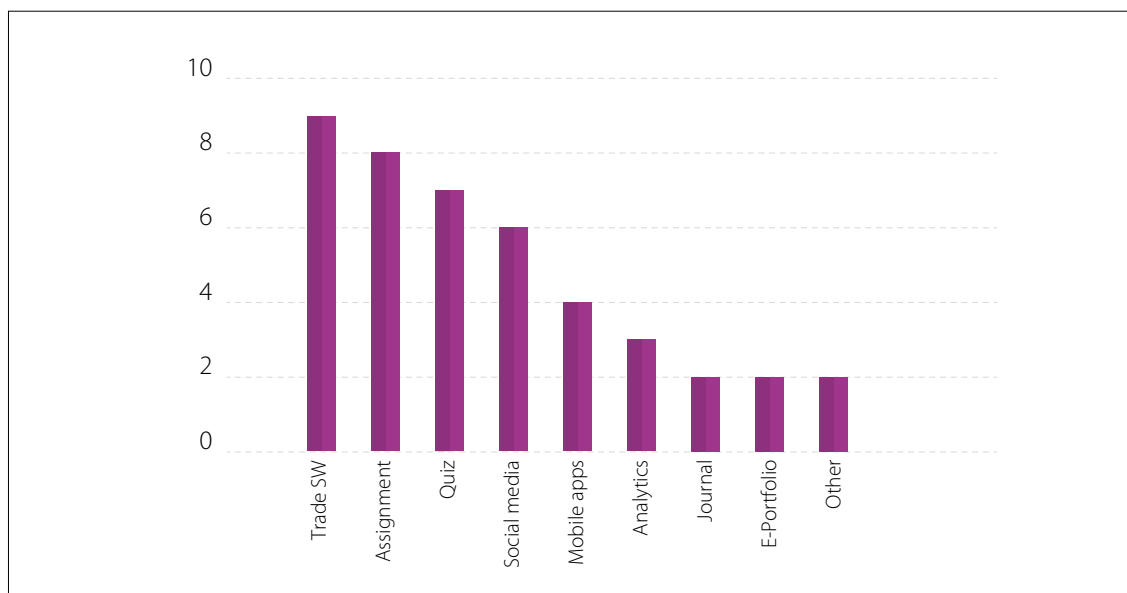
Among the top barriers cited in the study, three barriers were related to teachers: teachers' lack of ICT competencies, teachers' reluctance to change their roles and instruction styles, and teachers' time constraints for ICT-enabled development and delivery. It is evident that teachers are the key to change, yet they are not sufficiently supported in that process.

Commonly used ICT, content and pedagogies

According to the participating organisations (see Appendix 1: Survey Section D; Question 1), the four most commonly used forms of ICT are (see **Figure 19**):

- Trade software i.e. software used by professions (e.g. Autodesk for engineering drawings; Photoshop for graphic design)
- Assignment tools (i.e. online assignment submissions)
- Quiz tools (i.e. online quizzes)
- Social media (e.g. blogs, wikis, discussion forums)

Figure 19: Commonly used forms of ICT



These forms of ICT are the most commonly used for the following reasons:

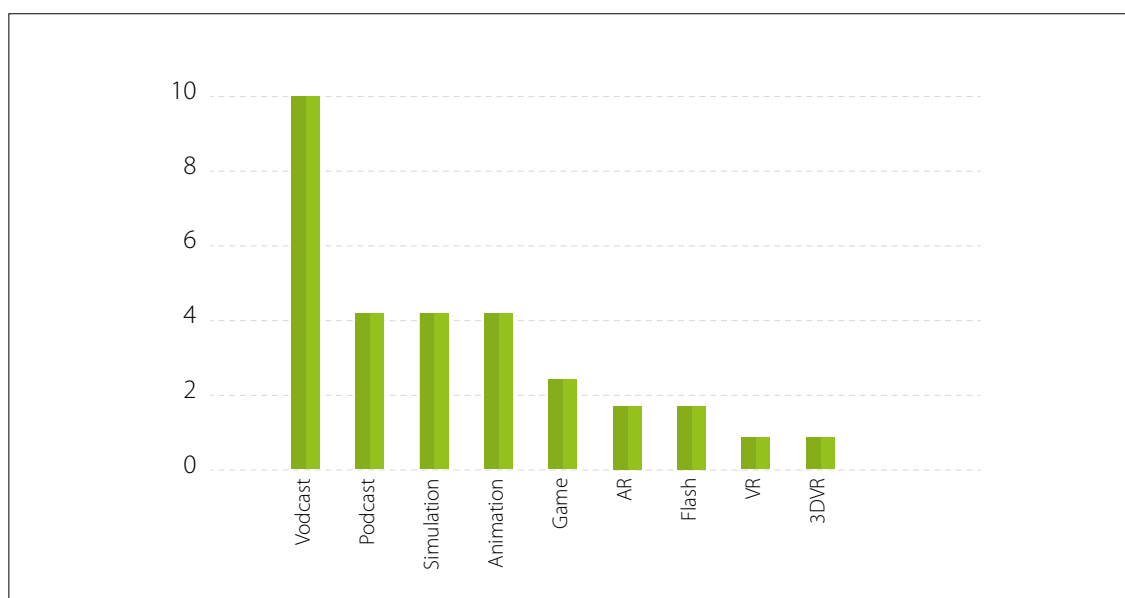
- In industries where specialized software are required to support business and operational processes, training in the use of these trade software is a necessity.
- ICT tools for online assignment submissions and quizzes have become standard in most organizations that have installed learning management systems (LMS). These tools have made training delivery more efficient as they have eliminated the need for paper copies, manual marking and manual data entry of marks and grades.
- Social media tools such as blogs, wikis and discussion forums allow learners to connect with their teachers and peers for learning and the exchange of information. It should be noted, however, that although social media tools are widely used for social purposes, their pervasive usage for teaching and learning requires a change in mind-set among teachers and students.

Other ICT tools, such as mobile apps, analytics, reflection journals and e-portfolios, are less commonly used as these require more time and resources to adapt for learning purposes. The use of these technologies also requires thoughtful policy design to couple them with assessment specifications and curriculum outcomes. Furthermore, the use of these technologies in education is not ubiquitous as usage depends on the requirements of particular subjects.

The four types of digital content most commonly used by the participating organizations (See Appendix 1: Survey Section D; Question 2) are (see **Figure 20**):

- Vodcasts (instructional videos)
- Podcasts (instructional audio clips)
- Simulations (a medium that allows learners to experience various scenarios in the workplace or to acquire skills to control parameters in the tasks or environment, in order to achieve desired outputs.)
- Animation (a medium that depicts the complex dynamics of internal processes within machines or environments, and interactions among the component parts.)

Figure 20: Commonly used digital content

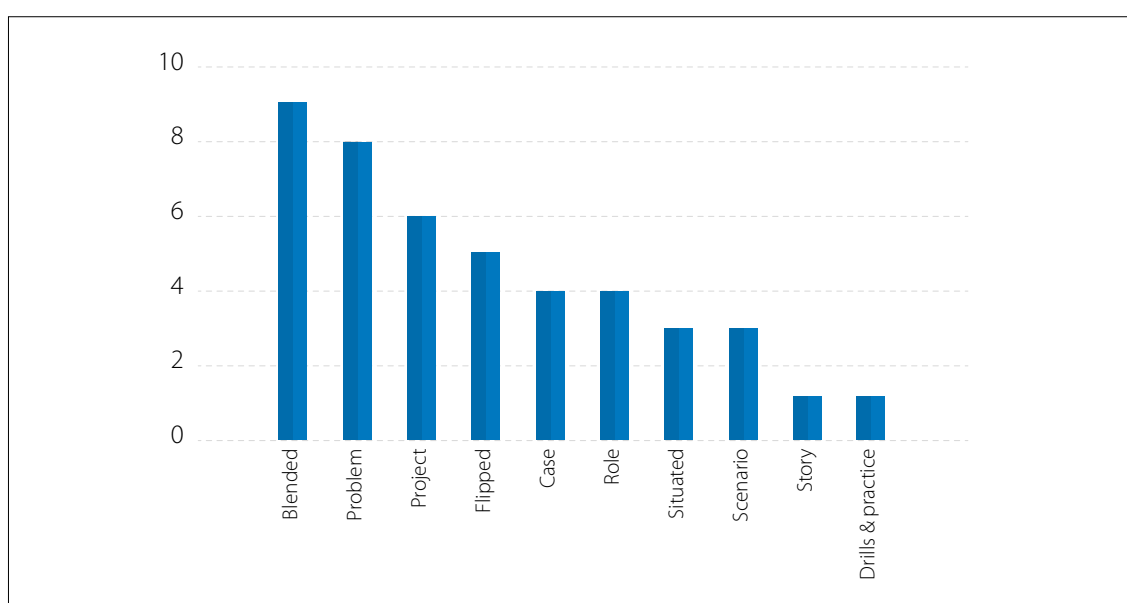


These forms of digital content are commonly used because they are easy to use and cost-effective. With the advent of mobile devices equipped with cameras, and audio and video editing software, it has become easy and cheap to produce videos and audio clips. Videos enable learners to visualize processes, and both video clips and audio clips enable students to learn anywhere and at any time. Simulations and animations are also effective forms of ICT for enabling learners to visualize and comprehend complex processes in work tasks. The costs and technical skills to produce such content can be deterrents, however. Other types of ICT (e.g. games, augmented reality, flash objects, virtual reality and 3D virtual reality) are used less often because of even greater complexities and higher costs of production.

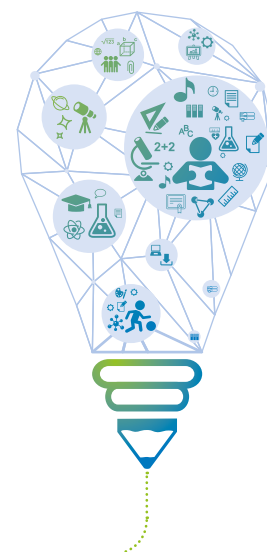
The four most common pedagogies adopted by teachers (see Appendix 1: Survey Section D; Question 3) are (see **Figure 21**):

- Blended learning
- Problem-based learning
- Project-based learning
- Flipped classroom

Figure 21: Commonly adopted pedagogies



These types of pedagogies are commonly adopted because they can be used in any type of subject and because they generally supplement, rather than replace, face-to-face teaching. Pedagogical approaches that are used less frequently tend to be those that are designed for particular trades or disciplines. The drills-and-practice approach, once the core method in computer-assisted learning in the early days of e-learning, is now seldom used.



6. Conclusions

This study identified diverse approaches to using ICT to enhance teaching and learning in TVET and skills development, including those driven by innovations in platforms, ways of delivery, new content and applications, and those driven by emerging technologies for outcomes management and learner profiling.

The case studies submitted by the participating TVET organizations reflect four themes, and show how ICT can contribute towards: ubiquitous lifelong learning, enhancing learning engagement and social learning, authentic and simulated learning, and reflective learning and knowledge creation.

The case studies illustrate the nature of ICT tools as enablers rather than as substitutes for hands-on training, and also demonstrate how modern technologies with social networking functionalities have expanded opportunities for learners to receive peer and expert feedback to improve their performance. Other new technologies, such as virtual/augmented reality and virtual training packages, have provided authentic learning situations that allow learners to make mistakes in safe environments, practice more frequently and apply what they have learned. For teachers, technologies have made it easier for them to facilitate their students' learning and have helped them to communicate with their students. Using ICT, teachers can arrange for students to learn independently, using the flipped classroom approach, and ICT can serve as a tool to facilitate project learning by students in small groups.

Cross-case analysis identified commonly used pedagogies, commonly encountered challenges, and implementation approaches.

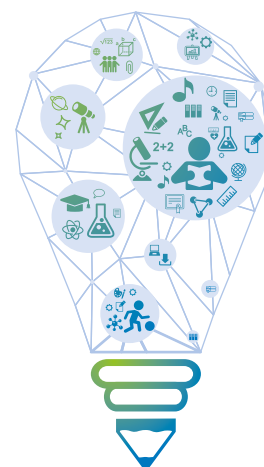
The philosophies underlying the pedagogical approaches used in the case studies were constructivism and social constructivism. The learning technologies were carefully selected to support the learning theories and the impacts of those technologies were closely monitored. For example, the philosophy of social constructivism was supported through the use of platforms to promote collaboration and group reflections, and tools such as social media, blogs, wikis, instant messaging and discussion forums, which encourage students to socially construct their knowledge and skills. The case studies also showed that adequate media-rich resources and a teacher online presence are necessary for self-directed learning.

The study examined the participating organizations' leadership readiness, teacher readiness, student readiness and infrastructure readiness. The ICT integration matrix (Table 8) can be a guide to monitor the achievement milestones in each domain. The matrix calibrates progress from one level to the next, namely: foundation, emergent, innovation and transformation. The rubrics in this matrix clearly describe what an organization must do to move from one stage to another in the four key domains, as elaborated below.

- (1) Leadership: Strategic and organizational readiness depend on the school leaders' level of ownership and influence, the focus of ICT implementation, the level of engagement of students, staff and partners, and the processes for ICT implementation to support learning. For example, the focus of ICT implementation is at the 'foundation' level if it is driven mainly by technological considerations; 'emergent' if driven mainly by curriculum and pedagogical considerations; 'innovative' if it is also informed by learning theories and research findings; and 'transformative' if it is improved by reflective practices within the organization.
- (2) Teacher: Pedagogical readiness relates to the teachers' ability to design ICT-enabled learning experiences, the focus of schools' professional learning strategy and the breadth of learning communities the teachers are involved in. For example, teachers' ability to design ICT-enabled learning experiences is seen as at the foundation level, if teachers are only able to use tools and learning resources to support flexible, self-directed learning; emergent, if they are also able to adapt technologies to support active, participatory learning; innovative, if they are able to also adapt technologies to support and monitor collaborative learning; and transformative, if they can also transform learning experiences through lifelong and reflective learning in a real world work context.
- (3) Student: Learner readiness can be demonstrated by the level of higher order thinking that is facilitated by ICT, the level of ICT-enabled learning, the type of learning that is supported by the use of technologies and the extent of student involvement in curriculum and learning activities facilitated by ICT. For example, students' ability to use ICT tools is considered at the 'foundation' level if they have basic ICT skills such as use of office applications to support their learning; 'emergent' if, under their teachers' guidance, they are also able to select and use appropriate ICT tools for learning; 'innovative' if they are able to exploit the features of ICT tools to enhance their learning; and 'transformative' if they can transfer current knowledge of the use of ICT tools to the learning of new technologies to enhance their learning.
- (4) Infrastructure: Technical and operational readiness can be measured in terms of students' access to ICT resources in digital spaces, the physical setup of learning spaces, the availability of ICT systems and tools to support learning, and the availability of an IT Helpdesk. For example, students' access to ICT resources is considered at the 'foundation' level if their access is limited to the use of schools' network and computing devices in fixed venues; 'emergent' if their access is supported by ready availability of computing devices and wireless connections across the campus; 'innovative' if ICT resources are also available outside the campus using students' own computing devices; and 'transformative' if students' access to a variety of ICT resources is seamless, anywhere and anytime within and outside the campus, because various technologies have been integrated to support teachers and students in using their own computing devices (including mobile devices).

Each TVET organization conducted its own efficacy evaluation, but this study did not examine the effectiveness of these evaluations or the effectiveness of the ICT-enhanced programmes they offer. Readers seeking further information are advised to access the organizations' websites.

Further studies are required to identify what types of ICT work best for developing particular skills and for particular TVET learners in a given TVET context. Future studies can leverage this research to assess the degree of ICT integration in other TVET systems at both the practice and policy level, thus providing a more complete picture of the state of ICT-enabled teaching practices across different countries.



7. Policy recommendations

The policy recommendations listed below can help to guide TVET organizations that are just embarking on ICT-supported practices to avoid known pitfalls and to step up their integration of ICT with greater chance of success. Policy-makers must note, however, that the achievements of the TVET organizations described in the case studies are replicable only in institutions with a similar level of readiness.

- **Conduct an honest assessment of current readiness**

Before embarking on any long-term ICT plan, it is strongly recommended that the organization begins by conducting an honest assessment of its current level of ICT integration in the four key domains: leadership, teachers, learners and infrastructure.

- **Explore and employ various pedagogical approaches to improve outcomes**

Problem-based learning and project-based learning are commonly used pedagogies that can support practical skills development. ICT can, in turn, support and enhance these pedagogical approaches to ensure effective delivery and student engagement. While technologies cannot replace the need for hands-on, psychomotor practices in TVET, ICT tools can be employed to enhance pedagogies such as project-based and problem-based learning, either situated in real work conditions or simulated through virtual learning packages and interactive content. Coupled with independent learning, group learning and reflective learning, ICT-enhanced pedagogical approaches can give students opportunities to apply their technical, cognitive, entrepreneurial and professional competences.

It is recommended that organizations explore means of meeting diverse needs of students in curriculum delivery, for example, to meet the needs of learners who are working. The case studies show that ICT-enabled delivery has the potential to expand TVET capacity so that programmes are accessible beyond geographical boundaries and available to learners with full-time work. Blended learning and flipped classroom are pedagogies commonly used to provide flexibility for students. Independent learning must be supported with interactive content and easy-to-use tools like online quizzes and assignment submissions. Conducting online learning activities using tools like blogs and discussion forums can enrich teacher-student and student-student interaction.

- **Seek partnership with industry and employers**

To meet industry needs and ensure graduates are employable, TVET institutions must have a coherent policy on institution-industry partnership – seeking input and participation from employers in aspects such as curriculum development, digital content development and programme delivery.

- **Review and redesign holistic curricula and assessment**

Organizations should review and redesign the curricula towards more holistic assessment of students performance using e-Portfolio and learning analytics in order to support their career development. Such curricula and assessment integrate students' workflows and individual learning pathways with career development plan through the collection of various artefacts in e-portfolios and data from learning analytics.

The level of e-Portfolio usage can be as simple as collection of student's academic records, but can also be greatly complex if it were to expand the scope of assessment. For example, it may need the quality assurance for workplace-based learning outputs, tracking on-going attainment of student's competences and collection of credible evidences of learning. The e-Portfolio initiative must be taken throughout student training period from beginning to the end and embedded in students' learning cycle.

Data from the learning analytics system can configure customized dashboards for different users, namely e-learning managers, teachers and learners. The data produces insights into students' learning behaviour and needs. At the institutional level, the data can be used to improve the quality of course development and delivery; and at the individual level, they can be used to personalise e-learning services, or reduce course attritions. To ensure ethical use of data and safeguard individuals' privacy, governments and institutions must develop policies and systems that define the purpose for the different access rights for different target users.

- **Support teachers**

For teachers to have the capacity to design and deliver ICT-supported courses using appropriate pedagogical approaches, they should be given time and support to attend related training workshops, and conferences, and to participate in online training. Training topics could include the re-design of courses for different modes of delivery, motivation strategies for online learners and, pedagogical techniques such as flipped learning, blended learning, work-based learning. It is also important to keep teachers abreast of innovative pedagogies with new technologies as well as the learning theories behind self-directed learning, reflective learning and collaborative learning.

Furthermore, TVET organizations should consider teachers' time spent on training, course re-design, facilitating learning and responding to students' learning needs (online and face-to-face) as part of the teachers' overall workloads. TVET organizations should also recognize and reward teachers' efforts to develop and curate content and learning applications.

For teacher training to be effective, institutions should ensure teachers are empowered to select and use discipline-appropriate pedagogies (such as the integration of workplace learning into course delivery). Training should also be differentiated according to teachers' competency levels.

For greater mutual reliance, set up learning communities among teachers (including an online platform to support organization-wide sharing) to enable them to share experiences, tools and templates and learn from each other.

Make helpdesk support available and responsive, in order to provide technical support when teachers encounter technical glitches and need application support. This will go a long way towards building confidence among teachers and towards overcoming fear of using new technologies in their teaching delivery.

- **Select appropriate technology and pedagogy to ensure that graduates' skills are relevant**

One of the major criticisms that TVET institutions face is that graduates' skills are not relevant to the needs of the rapidly changing workplace. It is therefore important to choose technologies that match the expectations of industries. Furthermore, it is important to use pedagogy that enables students to explore real-world projects and engage in collaborative problem solving, thereby mimicking the industry contexts.

Specialized technology centres, like the OLEI, could be set up in collaboration with industry and external funding agencies. Projects that support technologies for online learning could be co-managed by TVET organizations and industries.

- **Identify the issues before deciding which ICT to use**

As seen with the case studies, it is necessary to choose technologies that are appropriate for the issues faced in the TVET institution, rather than choosing the technology before identifying what the issues are or how the technology will improve the situation. For ICT that require significant investment, it is particularly important to examine the costs and benefits of the ICT and to decide whether and to what extent the benefits outweigh the costs (including the costs of the learning environments, maintenance, upgrades and replacements). It may be possible to pool the resources of several TVET organizations to gain economies of scale in development and delivery of training packages.

- **Employ phased approaches**

It is critical that TVET organizations build up their readiness phase by phase. To ensure readiness is developed effectively and there is smooth roll-out of enterprise-wide initiatives, organizations must prepare policies to clarify the objectives and they must get buy-in from stakeholders, particularly teachers. This is particularly necessary when reforming pedagogical practices. Furthermore, management must have long-term commitment.

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Appendix 1: Questionnaire

A. Information on the TVET organization

1. My organization's full-time student enrolment number is (Choose one)
 - a. Less than 1,000
 - b. Between 1,001 and 5,000
 - c. Between 5,001 and 10,000
 - d. Above 10,000
2. The TVET provided by my organization consists of: (Choose one)
 - a. Comprehensive range of courses to meet human resource needs in the economy
 - b. Specific range of niche courses to meet human resource needs in certain industry sectors
 - c. General vocational training leading to higher level of technical certifications
 - d. Others (Please specify)
3. The range of TVET programmes offered by my organization consists of: (Check any that apply)
 - a. Full-time programmes
 - b. Continuing Education and Training
 - c. Apprenticeship and/or Traineeship
 - d. Others (Please specify)
4. My organization's management structure can be described as follow: (Choose one)
 - a. Single campus with one organizational level governance
 - b. Multiple campuses with one organizational level governance
 - c. Multiple campuses with campus level governance and autonomy
 - d. Others (Please specify)

B. Level of ICT integration into TVET

Please use the *ICT Integration Matrix* (Appendix 3) to indicate the level of ICT integration into your organization's TVET.

The *ICT Integration Matrix* consists of four domains:

1. School ICT Leadership
2. Design and Development of ICT-enabled Learning Experiences
3. Deployment of ICT for Learning
4. IT and Estate Infrastructure and Support

These domains also correspond with different areas of readiness:

1. Strategic and organizational readiness
2. Pedagogical (Teacher) readiness
3. Learner readiness
4. Technical and operational readiness

Each domain has several indicators. For example, School ICT Leadership has the following indicators:

- 1.1 Level of ownership and influence of school leaders
- 1.2 Level of engagement of students, staff and partners
- 1.3 Processes for ICT implementation to support learning

1.4 Focus of ICT implementation Each indicator has four levels of ICT integration into the curriculum for delivery:

1. Foundation	Beginning the e-learning journey with ad hoc ICT-based practices and technologies
2. Emergent	Consistent ICT-based practices and technologies on a school-wide basis
3. Innovative	Sound integration of ICT-based practices and technologies with processes that ensure scalability beyond the schools
4. Transformative	Sound and systematic integration of ICT-based practices and technologies with policies and processes that are evidence-based, thus ensuring scalability and sustainability beyond the schools

The above four levels of integration must be interpreted within the context of each domain and each indicator. The level of integration describes the organization's current ICT practices that are prevalent i.e. representative of at least 50 per cent of the student and teacher populations.

Where the requirements of a level are only partially met, the lower preceding level shall be assigned. As defined above, these four levels indicate a progressively deeper level of ICT integration. Hence, the attainment of all the lower levels must be satisfied before the next higher level can be assigned.

C. Barriers to ICT Integration into TVET

1. The **most critical** barriers to ICT integration into TVET for our organization are (Check any that apply):
 - a. Lack of relevant and well-designed digital content suitable for TVET
 - b. Perception that ICTs are not appropriate for delivering TVET
 - c. Teachers' reluctance to change their roles and instruction styles
 - d. Teachers' lack of ICT competencies
 - e. Students' lack of motivation
 - f. Insufficient computing devices
 - g. Inadequate IT infrastructure
 - h. Inadequate technical support and services
 - i. High cost of programme development
 - j. High cost of system hardware and software
 - k. Others (Please specify)
2. Please elaborate the top three barriers that have prevented deeper ICT integration into the curriculum for delivery and propose possible policies to rectify/overcome these barriers.

D. Promising and Innovative Examples

1. The following technologies have been used **pervasively** for course delivery in our organization: (Check any that apply)
 - a. Technologies required of the professions in the industries (e.g. Autodesk for engineering drawings; Photoshop for graphics design, etc.)
 - b. Online quizzes
 - c. Online assignment submissions
 - d. Reflection journals
 - e. Social media tools e.g. blogs, wikis, discussion forums, etc.
 - f. E-Portfolios
 - g. Mobile applications
 - h. Learning analytics
 - i. Others (Please specify)

2. The following types of digital content have been used pervasively for course delivery in my organization: (Check any that apply)
 - a. Audio clips (podcasts)
 - b. Videos (vodcasts)
 - c. Animations
 - d. Games
 - e. Augmented reality
 - f. Lab simulations
 - g. 3D Immersive virtual reality
 - h. Others (Please specify)
3. The following pedagogical approaches have been infused with ICTs and used pervasively for course delivery in my organization: (Check any that apply)
 - a. Problem-based learning
 - b. Project-based learning
 - c. Case-based learning
 - d. Story-based learning
 - e. Role-based learning
 - f. Scenario-based learning
 - g. Situated learning
 - h. Blended learning
 - i. Flipped classroom
 - j. Others (Please specify)

Appendix 2: Computation of scores in the ICT integration matrix

Levels of ICT Integration		Foundation (Value=1)	Emergent (Value=2)	Innovative (Value=3)	Transform -ative (Value=4)	Av. Score
1.	SCHOOL ICT LEADERSHIP					
1.1	Level of ownership and influence of school leaders					
1.2	Focus of ICT implementation					
1.3	Level of engagement of students, staff and partners					
1.4	Processes for ICT implementation to support learning					
	Average Score for 1 st Domain					A1
2.	DESIGN AND DEVELOPMENT OF ICT-ENABLED LEARNING EXPERIENCES					
2.1	Design of ICT-enabled learning experiences					
2.2	Focus of schools' professional learning strategy					
2.3	Learning Communities					
	Average Score for 2nd Domain					A2
3.	DEPLOYMENT OF ICT FOR LEARNING					
3.1	Level of higher order thinking facilitated by ICT					
3.2	Level of ICT-enabled learning					
3.3	Use of ICT tools to support learning					
3.4	Extent of student involvement in curriculum, and learning activities facilitated by ICT					
	Average Score for 3rd Domain					A3

Levels of ICT Integration		Foundation (Value=1)	Emergent (Value=2)	Innovative (Value=3)	Transform -ative (Value=4)	Av. Score
4.	IT AND ESTATE INFRASTRUCTURE AND SUPPORT					
4.1	Access to ICT resources in digital spaces					
4.2	Physical setup of learning spaces					
4.3	Availability of ICT systems and tools to support learning					
4.4	IT Helpdesk					
Average Score for 4th Domain						A4
Average Score across 4 Domains (Average of A1, A2, A3 and A4)						A

Appendix 3: ICT Integration Matrix

Levels of ICT Integration		Foundation	Emergent	Innovative	Transformative
1.	SCHOOL ICT LEADERSHIP (STRATEGIC AND ORGANIZATIONAL READINESS) Scope, ownership and engagement				
Indicator		Band 1	Band 2	Band 3	Band 4
1.1	Level of ownership and influence of school leaders	School leaders <u>articulate</u> the ICT vision and goals which are aligned with the organization's Strategic Plan.	School leaders take the <u>lead in developing and communicating</u> the shared ICT vision and goals to <u>gain buy-in</u> from staff.	School leaders lead in <u>harnessing</u> ICT to support <u>student-centred and innovative</u> classroom practices.	School leaders lead in <u>developing an ICT culture and model</u> the effective use of ICT.
1.2	Focus of ICT implementation	ICT implementation is driven mainly by <u>technological</u> considerations.	ICT implementation is driven mainly by <u>curriculum and pedagogical</u> considerations.	ICT implementation is driven mainly by curriculum and pedagogical considerations as well as informed by <u>theories and research findings</u> .	ICT implementation is driven mainly by curriculum and pedagogical considerations and improved through <u>reflective practices</u> .
1.3	Level of engagement of students, staff and partners	School leaders engage <u>middle managers</u> in developing, communicating, implementing and <u>monitoring</u> school initiatives to intensify ICT-enabled learning.	School leaders engage middle managers and other <u>academic staff</u> in developing, communicating, implementing and <u>reviewing</u> the school initiatives to intensify ICT-enabled learning.	School leaders engage middle managers, other academic staff and <u>partners</u> in <u>collective decision-making</u> , and in the <u>assessment</u> and review of school initiatives to intensify ICT-enabled learning.	School leaders engage middle managers and other academic staff, <u>students</u> and partners to bring about <u>shared responsibilities</u> to support the school initiatives to intensify ICT-enabled learning.

Levels of ICT Integration		Foundation	Emergent	Innovative	Transformative
1.4	Processes for ICT implementation to support learning	There are <u>loosely defined and limited</u> processes that enable ICT implementation in the school.	There are <u>clearly defined</u> processes that enable ICT implementation. <u>Monitoring and review</u> processes are in place.	There are clearly defined processes for school-wide ICT implementation. Monitoring and review processes are in place for <u>continuous improvement</u> as well as to inform <u>future</u> ICT planning.	There are detailed and clearly defined processes that enable ICT implementation in the school. These include using <u>research</u> and review findings to <u>account</u> for the impact on student learning and improvement of ICT implementation.
2.	DESIGN AND DEVELOPMENT OF ICT-ENABLED LEARNING EXPERIENCES (PEDAGOGICAL (TEACHER) READINESS)				
Indicator		Band 1	Band 2	Band 3	Band 4
2.1	Design of ICT-enabled learning experiences	Teachers design ICT-enabled <u>learning activities by adopting ICT tools and learning resources</u> to support students' flexible and self-directed learning <i>E.g. Students view digital course notes, learning videos, do self-check quizzes, etc.</i>	Teachers design ICT-enabled <u>learning activities by adapting ICT tools and learning resources</u> to support students' <u>learning and progress in participatory learning</u> . <i>E.g. Students do individual assignments, search and consolidate learning information, etc.</i>	Teachers design ICT-enabled <u>learning activities by adapting ICT tools and learning resources as well as monitoring of students' progress in collaborative learning</u> . <i>E.g. Students work together on group assignments, use group/class tools (Discussion Forums, Blogs, Wikis), etc.</i>	Teachers design ICT-enabled <u>learning activities by using technology to transform learning experiences that support students' progress in lifelong/reflective learning</u> for the <u>real world/work context</u> . <i>E.g. Students work in groups and set group goals. Work on real world problems and solutions. Reflection during Internship, Project Work, etc.</i>

Levels of ICT Integration		Foundation	Emergent	Innovative	Transformative
2.2	Focus of schools' professional learning strategy	The schools' professional learning strategy focuses on <u>equipping teachers with ICT skills</u> to deliver ICT-based lessons.	The schools' professional learning strategy focuses on <u>building the capacity of teachers on the pedagogical use of ICT</u> to deliver ICT-based lessons.	The schools' professional learning strategy adopts a <u>customized and differentiated</u> approach to build teachers' capacity to <u>deliver</u> ICT-enriched learning experiences that are learner-centric. <u>Monitoring and evaluation</u> processes are in place to ensure that training programmes achieve desired outcomes.	The schools' professional learning strategy adopts a <u>customized and differentiated</u> approach, and fosters a <u>collaborative culture</u> . This enables teachers to engage in collective inquiry and reflection in the <u>design</u> of ICT-enriched learning experiences. <u>Monitoring and evaluation</u> processes are frequently applied to measure efficacy of training programmes.
2.3	Learning Communities	Teachers <u>share and exchange</u> ICT-supported learning and teaching resources, usually face to face and on <u>ad hoc</u> basis.	Teachers <u>leverage</u> ICT platforms to enlarge the communication and sharing <u>within the school community</u> . They <u>collaboratively design</u> ICT-enabled learning experiences for students.	Teachers <u>routinely showcase</u> and share exemplars with peers in the organization's ICT professional networks, including <u>online communities across schools</u> . They <u>experiment and reflect in teams</u> on their teaching practices.	Teachers <u>proactively collaborate and co-create</u> with <u>experts</u> and with one another in the ICT professional networks, including virtual learning communities within the and <u>beyond the organization</u> . Teachers lead in <u>mentoring</u> their peers and providing just-in-time <u>coaching</u> .

Levels of ICT Integration		Foundation	Emergent	Innovative	Transformative
3.	DEPLOYMENT OF ICT FOR LEARNING (LEARNER READINESS)				
Indicator		Band 1	Band 2	Band 3	Band 4
3.1	Level of higher order thinking facilitated by ICT	Students are involved in ICT-enabled learning activities that facilitate the <u>recall</u> of information.	Students are involved in ICT-enabled learning activities that facilitate <u>understanding and application</u> of information to arrive at a conclusion.	Students are involved in ICT-enabled learning activities that facilitate <u>analysis and evaluation</u> of information resulting in the deepening of understanding and knowledge.	Students are involved in ICT-enabled learning activities that facilitate <u>creation</u> of new ideas, products or ways of viewing things.
3.2	Level of ICT-enabled learning	Students meet learning goals with ICT-enabled learning tasks according to instructions given by the teacher. They work on <u>teacher-facilitated</u> ICT-enabled learning activities for self-directed learning .	Students meet learning goals within ICT-enabled learning tasks, with guidance from the teacher. They work on <u>teacher-scaffolded</u> ICT-enabled learning activities for participatory learning .	Students set <u>group goals</u> and ICT-enabled learning tasks according to instructions given by teachers. Students' ICT-enabled learning activities are closely <u>guided and monitored</u> by Teachers for collaborative learning	Students within groups with the support of ICT <u>contribute ideas</u> and consider the <u>viewpoints of others</u> to <u>construct knowledge</u> , create new ideas, products or ways of viewing things that is crucial to their learning. They reflect on their own learning and evaluate their <u>own progress</u> towards lifelong learning
3.3	Use of ICT tools to support learning	Students use ICT tools that require them to apply <u>basic ICT skills</u> to support their learning.	Students <u>select and use appropriate ICT</u> tools to support their learning as guided by Teachers.	Students <u>maximise</u> the use of ICT tools to enhance their learning as guided by Teachers.	Students <u>transfer</u> current knowledge of the use of ICT tools to the learning of <u>new technologies</u> to enhance their learning.

Levels of ICT Integration		Foundation	Emergent	Innovative	Transformative
3.4	Extent of student involvement in curriculum , and learning activities facilitated by ICT	Students are involved in ICT-enabled learning activities for 5% or less of the curriculum.	Students are involved in ICT-enabled learning activities for 5% to 10% of the curriculum.	Students are involved in ICT-enabled learning activities for 10% to 30% of the curriculum	Students are involved in ICT-enabled learning activities for more than 30% of the curriculum
4.	IT AND ESTATE INFRASTRUCTURE AND SUPPORT (TECHNICAL AND OPERATIONAL READINESS)				
Indicator		Band 1	Band 2	Band 3	Band 4
4.1	Access to ICT resources in digital spaces	Students' access to ICT resources is limited to the <u>school's network</u> and computing devices in <u>specified locations</u> .	Students' access to a range of ICT resources is <u>flexible and across</u> the campus, since computing devices and wireless connections are readily available <u>on campus</u> .	Students' access to a variety of ICT resources is <u>flexible anywhere anytime</u> within and <u>outside the campus</u> since <u>wireless and mobile</u> technologies support teachers and students using their <u>own computing devices</u> (including mobile devices).	Students' access to a variety of ICT resources is <u>seamless, anywhere</u> anytime within and outside the campus since different technologies have been <u>integrated</u> to support teachers and students using their own computing devices (including mobile devices).
4.2	Physical setup of learning spaces	Learning spaces are not designed or adapted to support the use of ICT for instruction. <u>Teacher-directed</u> ICT-enabled learning activities occur mostly in <u>computer laboratories</u> with <u>desktops</u> .	Learning spaces have flexible physical layouts that can be configured to support teacher- <u>scaffolded</u> ICT-enabled learning activities that encourage student <u>participation</u> .	Learning spaces have flexible physical layouts that can be configured to support <u>teacher coaching for</u> students to <u>collaborate</u> in small group ICT-enabled learning activities.	Learning environment is <u>not bounded by</u> physical time and space as lessons have been redesigned to support ICT-enabled <u>personalized</u> learning that requires students to <u>reflect, evaluate</u> progress and regulate their own learning.

Levels of ICT Integration		Foundation	Emergent	Innovative	Transformative
4.3	Availability of ICT systems and tools to support learning	Individual teachers establish their <u>own</u> <u>systems</u> to store and record student works for assessment.	Organization-wide systems are in place to support the setting up of an electronic work space to disseminate <u>learning resources</u> including media-rich resources like videos.	Organization-wide systems are <u>integrated</u> to support seamless dissemination of learning resources and provide <u>learning and assessment tools</u> e.g. blogs, wikis, quizzes, assignment submissions, e-portfolio, etc.	Organization-wide systems are <u>integrated</u> to support seamless dissemination of learning resources, provide learning and assessment tools, as well as <u>learning analytics</u> for teachers to assess if students are reaching their learning goals or falling behind.
4.4	IT Helpdesk	Helpdesk support is <u>ad hoc</u> , available only to staff and limited to <u>technical</u> problems.	Helpdesk support is <u>accessible</u> , available to staff and includes both technical and <u>application</u> problems.	Helpdesk support is accessible, available to both staff and <u>students</u> and includes technical, application and <u>estate</u> problems.	Helpdesk support is accessible and <u>responsive</u> , available to both staff and students and includes <u>analysis</u> of the type of problems reported for more proactive interventions.

Appendix 4: Case Study Template

Case study

Please share example(s) of successful and innovative ICT integration into the curriculum for TVET course delivery. (Please use the structure provided in this *Case Study Template*.)

Case Study Title	
Name and Designation of Participant	
Name of Organization/Institution	

Background information

Please provide the following background information. (Additional articles or documents that provide more details can be sent separately.)

- 1. Background:** A brief description of your country and its culture and people; socio-economic development, status and needs.
- 2. Education:** Government policies governing the management and provision of the country's education system
- 3. TVET education:** Education priorities for TVET and how they might address human resource needs, and access and equity in training opportunities.
- 4. National ICT Master Plan:** Government plans to drive the use of ICT nationally and in education, including policies and resources to overcome barriers such as funding, infrastructure, training and quality assurance.
- 5. ICT in TVET education:** Government policies governing the management and provision of e-learning in TVET organizations / institutions (Single and dual-mode colleges / polytechnics / universities); workplace training; continuing education and training.

CASE STUDY DETAILS: Please provide information on at least one innovative practice of harnessing the potential of ICT in TVET. This may include practices that are being employed within or outside classrooms/laboratories/workshops/lecture theatres, distance education, non-formal adult as well as community education and development.

1. Organization/Institution background [Give brief details of organization/institution and course(s), characteristics of learners and desired graduate outcomes]	
2. Previous teaching practice [Identify features of the teaching practice previously in use - this may include the learning environment and any aspects that were subsequently amended e.g. frontal teaching, classroom-based, paper tests etc.]	
3. The challenge(s) [Identify the issues that required attention or which prompted you and/or your colleagues to re-assess your previous practice]	
4. Intended outcome(s) [Provide an overview of the innovative teaching practice e.g. when, where and how long, etc. Describe the objective(s) behind this practice and how they align with course objectives]	
5. Pedagogical approach [Describe the teaching philosophy, e.g. constructivist, social constructivist, experiential learning etc., and the pedagogical approach adopted in the current innovation e.g. project-based learning, problem-based learning etc.]	
6. The learning environment [Describe the learning environment in which the innovative activity/ies took place e.g. online, blended, flipped, field etc., and the technology tools and/or digital resources being used]	
7. The digital advantage [Describe the benefits of the addition or amendment of an element of ICT-enhanced learning, as experienced by learners, practitioners and/or the institution as a whole]	
8. Key points for effective practice [Briefly identify the most important points in the case study for other practitioners – these may include benefits and risks, as well as resources needed to support the implementation]	
9. Conclusions and recommendations [A summary of how and why the practice outlined here has been innovative and effective, including policy recommendations for future and/or large scale implementation]	

Appendix 5: Glossary

Term	Description	Where used
ICT-enabled learning	<p>Learning that is supported by the use of technology tools and/or resources. <i>For example:</i></p> <ul style="list-style-type: none"> • <i>self-directed learning through using interactive learning resources</i> • <i>self-check understanding through completing online quizzes</i> • <i>research and consolidate learning information based on topic assigned by lecturer</i> • <i>work collaboratively using online discussion forums, and/or wikis</i> • <i>review, complete and submit their assignments online</i> • <i>reflect on own learning by posting in journals and/or blogs</i> • <i>consolidate learning artefacts using digital portfolios</i> • <i>simulation based learning through use of virtual reality</i> 	ICT IM: 1.2, 2.1, 2.3, 3.1, 3.2, 3.4. 4.2
Terms related to the organizational and human resource structure		
Organization	A TVET institution or training provider that may consists of several colleges, campuses, schools and departments.	ICT IM: 1.1, 2.3, 4.3 Survey Section A Q1-4
Apprenticeship / Traineeship	Systematic training, with alternating periods in a training organization and in the workplace. The apprentice has an employment contract and receives remuneration. The employer is obligated to provide training opportunities that impart skills a specific occupation.	Survey Section A Q3
Partners	<p>Internal partners can be other organizations or departments in the organization that support the implementation of ICT-enabled learning initiatives.</p> <p>External partners can be companies (vendors), statutory bodies and organizations that support the implementation of ICT-enabled learning initiatives.</p>	ICT IM: 1.2
Teachers	Instructors, trainers, training instructors, lecturers, educators, etc.	ICT IM: 2.1, 2.2, 2.3, 3.2, 3.3, 4.1, 4.3

Term	Description	Where used
School leaders	Principals, directors, heads of schools, course managers and/or heads of department responsible for the academic success of their students.	ICT IM: 1.1, 1.2
Staff	School leaders, teachers and administrative staff.	ICT IM: 1.1, 1.2, 4.4
Terms related to learning pedagogies		
Flexible/Self-directed learning	Where learning happens anytime, anywhere because of ready access to digital resources and expert guidance. <i>E.g. Students view digital course notes, learning videos, do self-check quizzes etc.</i>	ICT IM: 2.1, 3.2
Participatory learning	Where learners are empowered and view themselves as active participants in learning instead of passive recipients of knowledge. <i>E.g. Students do individual assignments, search and consolidate learning information etc.</i>	ICT IM: 2.1, 3.2
Collaborative learning	Where learners know how to work with others to find solutions. <i>E.g. Students work together on group assignments, use group/class tools such as discussion forums, blogs etc.</i>	ICT IM: 2.1, 3.2
Reflective Learning	Where learners know how to apply learning strategies to acquire new knowledge and how to pick out salient learning points from past learning experiences. <i>E.g. Students work in groups and set group goals. Find solutions to real world problems and produce artefacts as evidence of learning. Reflection during enhanced internships, project work, etc.</i>	ICT IM: 2.1, 3.2
Problem-based learning	Problem-based learning is a teaching method that requires students to solve an open-ended problem through thinking strategies, problem solving techniques and application of domain knowledge.	Survey Section D Q3
Project-based learning	Project-based learning is a teaching method that requires students to respond to a complex problem or challenge through planning, scheduling, resourcing, prototyping and developing viable solutions.	Survey Section D Q3
Case-based learning	Case-based learning is a teaching method that requires students to collaboratively analyse and discuss cases that are derived from past real-world problems or scenarios.	Survey Section D Q3
Story-based learning	Story-based learning is a teaching method that uses a fictional narrative with interesting characters and an engaging plotline to present thought-provoking issues and challenges.	Survey Section D Q3

Term	Description	Where used
Role-based learning	Role-based learning is a teaching method that focuses on specific roles and the tasks to be performed.	Survey Section D Q3
Scenario-based learning	Scenario-based learning is a teaching method that requires students to work their way through a scenario, which usually involves a complex problem requiring critical thinking and decision-making.	Survey Section D Q3
Situated learning	Situated learning is a teaching method that requires students to create meaning from real-world interactions with people and tasks, connecting prior knowledge with authentic, informal and often unintended contextual learning.	Survey Section D Q3
Blended learning	Blended learning is a teaching method in which students learn via a combination of e-learning (e.g. with digital and online media) and face-to-face instruction in the classrooms.	Survey Section D Q3
Flipped classroom	Flipped classroom is a teaching method that reverses the traditional learning arrangement by delivering content online and outside of the classroom so that assignments and learning activities can be conducted in the classrooms.	Survey Section D Q3
Terms related to processes in ICT practice		
Processes	Refers to series of actions or steps taken by an organization in order to achieve ICT-enabled teaching and learning.	ICT IM: 1.3
Innovative	Refers to creating new possibilities using ICT for learning and teaching through adaptation, improvisation or invention, for the purpose of improvement.	ICT IM: 1.1
Model effective use of ICT	<p>School Principal or Head of School invest time, effort and resources to encourage the use of ICT in learning and teaching through:</p> <ul style="list-style-type: none"> • Constantly looking for ways to use ICT to support learning. • Sharing new ideas with staff. • Motivating staff to try new ideas for learning and teaching. • Harnessing ICT for their own professional duties and development. 	ICT IM: 1.1
Shared responsibility	All stakeholders have a sense of ownership, accompanied by commitment to and support for a common goal.	ICT IM: 1.2
Reflective practices	Guided by research and learning theories to enhance lecturers' understanding in lesson design and delivery in an iterative process for improvement.	ICT IM: 1.4

Term	Description	Where used
Terms related to technology tools		
Wiki	<p>An online collaborative space where all students can view, contribute and edit content. Wikis can also be used as a resource for students to view information and content relevant to their modules.</p> <p><i>E.g. Use of Wikis as a means by which students can work together to conduct group research.</i></p>	<p>ICT IM: 2.1, 4.3</p> <p>Survey Section D Q1</p>
Blog	<p>An online tool that students can use to post their thoughts, reflections and document their learning progress (through blog entries). Blog entries are dated and arranged in reverse chronological order so that the most recent entries are posted at the top.</p> <p><i>E.g. Blogs can be used by students to reflect on their personal learning.</i></p>	<p>ICT IM: 2.1, 4.3</p> <p>Survey Section D Q1</p>
Online assignment submission	<p>A feature in a learning system that allows students to submit assignment files (text and/or digital media) to their teacher online, for feedback and/or grading.</p> <p><i>E.g. Online assignments may be PowerPoint slides, PDF, Word or Excel spreadsheet, videos, audio clips, animation clips.</i></p>	<p>Survey Section D Q1</p>
Reflection journal	<p>An online tool that students can use to capture their thoughts and lessons learned as a result of participating in learning activities (whether online, blended or face-to-face interactions).</p>	<p>Survey Section D Q1</p>
Social media tools	<p>Social media tools support online social interactions between members of a community.</p> <p><i>E.g. blog, wikis, discussion forums</i></p>	<p>Survey Section D Q1</p>
E-Portfolio	<p>An online tool that students can use to compile, organize and present evidence of their learning.</p> <p><i>E.g. Students can document significant achievements, mastery of knowledge and skills, innovative projects, etc.</i></p>	<p>Survey Section D Q1</p>
Mobile application	<p>A function-specific software that users can install in their mobile devices (e.g. smartphones and tablets).</p>	<p>Survey Section D Q1</p>
Learning analytics	<p>Analysis of data gathered about students' learning from IT systems to enable teachers and other stakeholders to gain insight into students' learning behaviour.</p> <p><i>E.g. Quiz results and other assessment marks/grades are monitored regularly using a ICT tool, and compared with the class or cohort average.</i></p>	<p>Survey Section D Q1</p>

Term	Description	Where used
Augmented reality	<p>An ICT tool that uses computer-generated sensory inputs such as sound, video, graphics or geo-positioning data to view lifelike situations.</p> <p><i>E.g. Rendering an image into 3D object; Overlaying a physical location with related information.</i></p>	Survey Section D Q2
Laboratory simulations	<p>Imitation of the operation of a real-world process or system. Parameters can be manipulated by students to appreciate the effects of these parameters.</p> <p><i>E.g. Simulations of chemistry and physics experiments, simulations of business or logistics operations</i></p>	Survey Section D Q2
3D immersive virtual reality	<p>3D immersive virtual reality is a computer technology that places the users inside a simulated environment where they can interact with the objects and avatars in the artificial worlds.</p> <p><i>E.g. Flight or driving simulations, 3D virtual worlds</i></p>	Survey Section D Q2

Appendix 6: Mapping research questions to data collection instruments

Research areas	Data collection instruments	Data analysis methods	Level of analysis
1) Current practices of infusing ICT in curriculum delivery that are innovative and pedagogically relevant to TVET	<ul style="list-style-type: none"> ICT Integration Matrix (B) – Level of infusion in each of the 4 domains: <ol style="list-style-type: none"> School ICT leadership Design and development of ICT-Enabled Learning Experiences Deployment of ICT for Learning IT and estate infrastructure and support 	<ol style="list-style-type: none"> For each organization, comparative analysis of scores across domains with overall score in (B). Across organizations within the same country, comparative analysis of scores across each domain and overall score in (B). Across countries, comparative analysis of scores across each domain and overall score in (B). 	<ol style="list-style-type: none"> Intra-organizational Inter-organizational (same country) Inter-organizational (different countries)
2) Pedagogical approaches to integrating ICT in TVET delivery that meet the changing skill needs of a digital society.	<ul style="list-style-type: none"> ICT Integration Matrix (B) – Focus on Domains on Pedagogical (Teacher) Readiness and Learner Readiness Promising and innovative examples (D) 	<ol style="list-style-type: none"> For each organization, comparative analysis of scores in these two domains in (B). Across organizations within the same country, derive emergent theme. Across countries, comparative analysis of scores in these two domains for common themes. Descriptive statistics and comparative analysis for (D) 	<ol style="list-style-type: none"> Intra-organizational Inter-organizational (same country) Across country cases Inter-organizational (different countries)

Research areas	Data collection instruments	Data analysis methods	Level of analysis
3) Policy recommendations to encourage innovative and pervasive use of ICT in TVET.	<ul style="list-style-type: none"> Barriers to ICT integration into TVET and Recommendations (C) Case study (E) 	<ol style="list-style-type: none"> Descriptive statistics and comparative analysis for (C) Descriptive and comparative analysis for (E) 	<ol style="list-style-type: none"> Inter-organizational (same country) Inter-organizational (same country and different countries)
4) Promising practices in TVET teacher training that can equip teachers with ICT competencies required to deliver ICT-enhanced teaching.	<ul style="list-style-type: none"> ICT Integration Matrix (B) – Domain on Pedagogical (Teacher) Readiness Case study (E) 	<ol style="list-style-type: none"> Descriptive analysis for (B) Descriptive and comparative analysis for (E) 	<ol style="list-style-type: none"> Intra-organizational Inter-organizational (same country and (different countries))

Legend:

There are FIVE sections to this study:

- Section A: Information on TVET organization (Four questions)
- Section B: Level of ICT Integration into TVET (matrix for rating in four domains)
- Section C: Barriers to ICT Integration into TVET (Two questions)
- Section D: Promising and Innovative Examples (Three questions)
- Section E: Case Study (Text entries using template)



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**Sustainable
Development
Goals**