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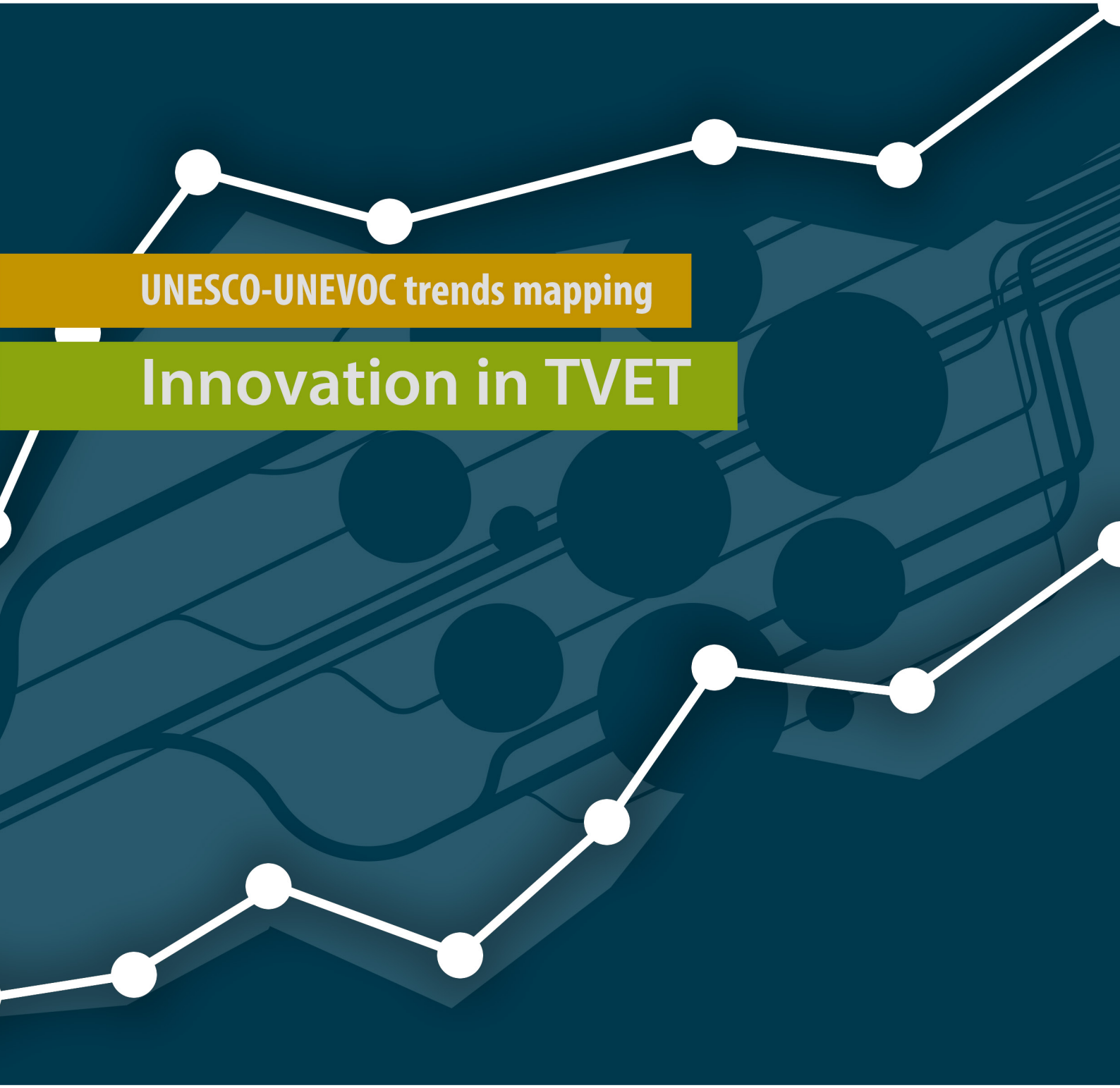

UNESCO-UNEVOC trends mapping

Innovation in TVET

Education 2030

United Nations Educational, Scientific and Cultural Organization

UNEVOC International Centre for Technical and Vocational Education and Training

UNESCO-UNEVOC International Centre

UNESCO-UNEVOC is a key component of UNESCO's international programme on technical and vocational education and training, and supports UNESCO Member States by strengthening partnership, capacity development, and knowledge sharing and development. This is done in collaboration with the UNEVOC Network, a global platform of TVET institutions.

Trends mapping studies

Coordinated by UNESCO-UNEVOC, trends mapping studies aim to further the international community's understandings on contemporary key issues concerning TVET. The studies review existing literature and policies, and engage TVET stakeholders from around the world through surveys and virtual conferences.

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User guide

The following report presents the results of the trends mapping study on innovation in technical and vocational education and training (TVET) conducted by UNESCO-UNEVOC. The study aimed to improve the understanding on innovation in TVET among the international community, as well as to map current trends and showcase different types and experiences of innovation in TVET around the world.

The document includes a series of important concepts and terms concerning innovation in TVET. The following presents a brief selection of some of the key terms used in this report:

- **Disruptions** can be defined as breaks or interruptions in the course or continuation of some activities or processes. In the study, the term disruption is used to describe the impacts of digitization, climate change, and displacement of people and demographic change. TVET systems around the world are facing significant challenges: technological developments, changes in climate, demography and mobility of people are affecting the way we work, live and learn. For example, the increasing automation of production processes in the next years is expected to impact the number and profile of new jobs. Furthermore, it is also expected to have a significant impact on the extinction of low-skilled jobs.

- **Innovation** is used as a broad concept. In general, the term is used to describe new or improved products, services, processes or practices that differ significantly from previous experiences. In the study, the term innovation is used in two different perspectives. Innovation can refer to new products, services, processes or practices developed by external actors such as private companies (e.g. the development of new technical software) that are made available for clients and markets. These types of innovations usually have important impacts on skills demands and labour markets that must be addressed by TVET systems. On the other hand, innovation in TVET can also refer to substantial changes in the way TVET is practiced, making it more relevant to the needs of the economy, society and the environment.

- This study presents four different dimensions of innovation in TVET, used to describe the different aspects of TVET systems, networks and schools that should be addressed when developing and implementing innovation in TVET. The dimension of **organizational practices** refers to planning, financing, human resource management, administrative structure, and internal monitoring and communication. The **ecosystem** dimension refers to how TVET institutions engage with partners through advocacy and external monitoring, networking, and external engagement and internationalization activities. The dimension of **teaching and learning processes** refers to the development and implementation of new and relevant teaching and learning approaches. Finally, the dimension of **products and services** refers to the development and provision of TVET products and services (e.g. skills development, applied research, and consultancy) to external actors such as students, companies and governments.

- **System of innovation** suggests that the base of the processes of generation, acquisition, and dissemination of innovation is the collective, interactive, and simultaneous learning between several actors and institutions. The concept rests on the premise that innovation and technical progress are the results of a complex set of relationships among actors (policy-makers and enactors, technology users, producers and lobbyists) producing, distributing and applying various kinds of knowledge.

- **Innovative practices**, as it is used in this study, refers to the wide range of initiatives and projects developed and implemented by TVET systems, networks and schools identified by the trends mapping study. In some cases, it is possible to perceive a focus on a specific dimension of innovation in TVET (e.g. the introduction of entrepreneurial education as a significant change in teaching and learning processes). However, innovative practices are usually shaped by the deployment of different types of internal activities in all four dimensions of innovation in TVET. For example, while introducing a new type of TVET service such as applied research, TVET systems, networks and schools also usually adopt changes in human resource management, external engagement, and teaching and learning processes.

Overview of the findings and recommendations

UNESCO-UNEVOC's 2018 Global Learning Forum on 'Managing skills in a time of disruption' noted that the transition to greener economies, the implementation of digital technologies in the world of work and the emergence of new forms of entrepreneurship, amongst other things, are changing the way we live and work. This scenario is driving technical and vocational education and training (TVET) systems to improve their capacity to identify the future demand of skills (e.g. soft and specific technical skills – including digital, greening and entrepreneurial skills) and to expand access to these skills.

In all, these changes represent a great challenge for the future of TVET, but at the same time also expresses a need to seize the prospects and enhance the social and economic benefits from TVET. As TVET adapts itself to the impacts of significant social, environmental and economic disruptions, innovative practices emerge with great potential to rejuvenate the future of skills development. Current developments in TVET suggest that many types of innovative practices are already being developed or deployed, significantly changing the way we define and practice TVET.

UNESCO-UNEVOC's trends mapping study on innovation in TVET aimed to improve the understanding and further clarify what innovation means for the TVET community, taking into account the different stages of development they find themselves at and different geographic, socio-economic and political contexts. With this in mind, the study presented a general framework that helps to analyse the development and implementation of innovative practices in TVET, including in organizational practices, ecosystem engagement, teaching and learning processes, and products and services offered by TVET institutions.

Main findings

The study identified several important issues from the literature review, as well as interesting insights from the data collected by means of the questionnaire and the virtual conference on innovation in TVET that was held in in February 2019:

- **Innovation comprises substantial change in the way TVET is practiced by an institution, making it progressively more relevant to its economic, social and environmental context.** TVET institutions innovate in different dimensions (organizational practices, ecosystem, teaching and learning processes, and products and services). However, they seem to focus on innovation in products/service, processes and external relations, with less attention being given to innovation in organizational practices (including TVET management related to the level of autonomy and human resource management).

- **The deployment of a broad set of organizational practices in TVET (including planning, financing, human resource management, administrative structure, and internal monitoring and communication) is crucial to support the development of innovation in TVET.** It may include the analysis of concrete motives, troubles or weaknesses, as well as the promotion of team-building processes. While ministries/national bodies have relevant experience in implementing actions plans for innovation, training centres are usually lagging behind when it comes to the development of such strategic documents.

- **It is crucial for TVET institutions to consider a comprehensive human resource management approach to build their capacity to develop and implement innovative practices.** All types of TVET institutions (ministries, national bodies, training centres and universities) reported a focus on training and skills development as their main human resource management practice. The study found that there was a lack of human resource management practices concerning recruitment, appraisals and incentives.

- **Innovations in the way TVET institutions reach out and foster relationships with external actors (ecosystem) are not only crucial to overcome barriers when it comes to collaboration between the TVET system and other sectors (including business), but can also be pursued with aims of creating a stronger and supportive sense of community between different stakeholders and enhancing the status of TVET.** Ministries/national bodies and universities/research centres reported a better distributed pattern of relationships with externals actors; training centres showed less capacity to get involved with external actors, such as applied research institutes, universities, business clusters, and large business enterprises.

- **Innovations in teaching and learning processes help to enhance the quality of TVET programmes, projects and initiatives.** These include the use of learner-centred pedagogies and innovations in the use of information and communications technology (ICT) in TVET.

- **Promoting technology diffusion and applied research in TVET can also act as an engine for innovation in local community and the society.** They help TVET institutions to access more resources and help increase the scope and scale of training. The study found that while training centres are still focusing more on providing solutions in terms of skills development, universities/research centres are more capable of providing a mix of skills development solutions and applied researches.
- **The great majority of the TVET institutions reported that the lack of time, resources or staff are significant barriers to develop innovative practices.** At the same time, the study shows a low level of using other types of funding structures, such as private equity or venture capital firms, or business angels, loans from governments and international organizations, as well as financing mechanisms from non-governmental organizations.

Recommendations

Based on the results of the literature review, the virtual conference and the results from questionnaire, the study came up with recommendations divided in three different levels: system, policy, and institutional levels.

System level

- Platforms should be developed to provide opportunities for TVET stakeholders to engage with other actors. For example, this can be in the form of local associations or councils.
- Support mechanisms should be developed to enable TVET actors, especially training centres, to map and assess the actors in their local skills ecosystem and their potential to act as partners in the development and implementation of innovative practices.

Policy level

- In addition to promoting the use of innovative practices in teaching and learning processes and the diversification of products and services, TVET policies, strategies and action plans – especially those of training centres – should also put a focus on internationalization strategies to ensure an efforts are made to engage with the local skills ecosystem.
- TVET policies should support the development of mechanisms which enable the identification of skills demands, the establishment of Labour Market Information Systems, and the development of up-to-date curricula.
- TVET policies and legislation should support the development of entrepreneurship in TVET by, for example, making it legally possible for institutions to establish incubators or income-generating activities with a focus on entrepreneurial learning.

Institutional level

- TVET institutions – especially training centres – should develop and implement specific action plans on innovation. The plan should include clear, practical and concrete priority actions to take the innovation process forward. It is also important for action plans to consider different aspects such as the institution's motives and objectives, the promotion of team-building processes, and the development of indicators to identify and measure innovation.
- TVET institutions need to consider different innovative activities for human resource management practices including the development and adoption of employee recruitment standards that focus on innovation skills, appraisals, and incentives for employee performance in suggesting ideas for innovation or in developing innovations, and promotion and career development opportunities. Furthermore, it is necessary to capacitate and motivate leadership teams to pursue innovative practices within their institutions.
- Staff should be given sufficient time and resources to develop innovative teaching and learning processes, including the development of products and services. Moreover, continuing training programmes should ensure that staff have the capacity to deal with such initiatives.
- Training centres should be supported in the identification and accessing of alternate sources of financing to support the development and implementation of innovative practices (where legally possible).
- Training centres are recommended to implement learner-centred pedagogies and methods such as project-based and problem-based learning with aims of enhancing student engagement and ensuring that programmes also help solve real problems in the local community.
- Training centres are recommended to enhance the use of ICT in courses in order to increase accessibility, effectiveness and quality of TVET. This includes the use of distance learning technologies as well as learning and teaching technologies.

Introduction

In 2018, UNESCO-UNEVOC's TVET Learning Forum on 'Managing skills in times of disruption' convened over 100 participants representing all sectors of the TVET community from all five regions of the world, including centres belonging to the UNEVOC Network. The Learning Forum discussed some of the main disruptions today that are shaping the future technical and vocational education and training (TVET) landscape. These include digital, climatic, and migration and demographic shift-related disruptions that are significantly changing the nature of the world of work and TVET.

Against this background, the Learning Forum identified an urgent need to further develop the capacity of TVET institutions to drive innovation and change. New and radical shifts are needed to ensure that TVET systems can respond to today's disruptions; TVET systems can no longer just operate according to a 'business-as-usual' model. Along this line, UNESCO-UNEVOC is currently implementing a series of initiatives to support the development of innovations in TVET institutions. In addition to conducting the trends mapping study on innovation in TVET, UNESCO-UNEVOC launched in 2019 the Skills for Innovation Hubs (i-hubs) initiative.

Traditionally, innovations have been used in the business context to refer to something new that generates business value. Recently, innovations have also been applied to different sectors (e.g. the public sector) to improve the quality of life, enhance public services and better respond to society's needs. As TVET adapts itself to the impacts of various disruptions, innovative practices emerge with the potential to ensure that the provision of quality TVET remains relevant and accessible to all. Importantly, current developments in TVET suggest that many types of innovative practices are already being developed or deployed.

In this context TVET systems are being reformed or reorganized in many places with the objective of creating more synergy between education and training on the one hand, and socio-economic and environmental demands on the other. Recent developments in TVET show different changes that are already being developed or deployed, meaningfully altering the objectives and purpose of skills development. These changes can be seen as innovations in TVET. Examples of innovations in TVET can include new ways of providing people with relevant skills, the development of applied research, entrepreneurship, the incubation of new technology firms, as well as the development of consultancy activities and technology diffusion for small- and medium-sized enterprises. The different types of strategies and solutions proposed by new TVET policies show the importance of investigating how diverse types of vocational education systems, networks and schools define the idea of innovation in TVET, as well as their roles within the processes of innovation development in their regional, national and local innovation ecosystems.

With the objectives of strengthening collaboration, knowledge exchange and peer learning on innovative practices in TVET,

Climatic disruption

The transition towards equitable and sustainable economies is placing pressure on TVET systems to prepare the labour force for green and sustainably orientated jobs.

Migration and demographic shift-related disruption

TVET systems need to be oriented not only to local skills supply, but also to the skills available for migrating populations.

Digital disruption

Developments in digital technology, including Industry 4.0, smart production and big data, not only affect the skills demands in labour market, but also change the profile of jobs.

UNESCO-UNEVOC's trends mapping study aimed to identify what innovation means for the TVET community and its implications, taking into account different geographic, socio-economic and political contexts.

The following sections will introduce the concept of innovation in TVET and briefly answer the following questions: what is innovation? Why is innovation important? How is innovation developed? And finally, what do we mean by innovation in TVET?

The 'Skills for Innovation Hubs' initiative aims to empower TVET institutions to act as drivers for innovation. The initiative adopts a systemic approach to innovation at the institutional level, combining innovation and skills for employability, growth and development within the institution's environmental outreach. The Skills for Innovation Hubs (i-hubs) project has the overall goal of ensuring that TVET institutions remain relevant in a fast evolving scenario, by consolidating their contribution to the innovation of skills and to skills and services for innovation.

In order to reach this objective, the initiative is co-developing and testing the i-hubs Innovation Framework (IIF) with ten TVET institutions from Africa, Asia and Europe. The IIF, which encompasses one process, the Guided Self-Assessment (GSA), and two tools, the Balanced Scorecard and the Skills and Innovation Ecosystem Map, allows TVET institutions to assess and document, through quantitative and qualitative data, their internal preparedness for innovating and how favourable to innovation the i-hub's ecosystem is.

UNESCO-UNEVOC's 'Skills for Innovation Hubs' project is part of the 'Developing TVET institutions for entrepreneurship, innovation and sustainability' initiative implemented by UNESCO since 2017 and is supported by the International Vocational Education City (IVEC) China, with contributions from the German Federal Ministry of Education and Research (BMBF) and the German Federal Ministry for Economic Cooperation and Development (BMZ). The project is due to last until March 2020 and a second phase of the initiative is currently under planning.

What is innovation?

'Innovation is a trending word. The concept is described by the OECD/Eurostat 2018 Oslo Manual as 'a new or improved product or process (or combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process)' (OECD/Eurostat, 2018). This broad definition reflects the multiple uses of the term – innovations can be found in nearly all dimensions of social life and workplaces, including in government, business and non-profit organizations. As a consequence, many new concepts of innovation have been developed in the last decades. The following provides a brief definition of three main concepts of innovation: business innovation, social innovation and innovation in public services.

a. Business innovation

Among the three concepts of innovation, business innovation reflects the most common representation of 'innovation' and are often used as synonyms. Business innovation can be seen as creatively changing one or more dimensions of the business system in order to generate substantial new value for customers and the company (Sawhney et al., 2007). In other words, business innovation is the creation and adoption of something new that generates business value. A simple example might be the development of a new software by a private company, or the application of new technologies in the industrial production processes.

b. Social innovation

Social innovation has come into the public discourses in recent years. In the *International Handbook on Social Innovation*, the concept refers 'to finding acceptable progressive solutions for a whole range of problems of exclusion, deprivation, alienation, lack of wellbeing, and also to those actions that contribute positively to significant human progress and development' (Moulaert, MacCallum and Hillier, 2013). Along this line, social innovation is often described as a distinctive type of innovation, especially when compared to business innovation. The aims of social innovations are mainly related to the improvement of the quality of life. An example of social innovation can be the development of practical tools that help communities to access clean water and renewable energy.

c. Innovation in public services

Innovation can also be found in the public sector, where the aim is to provide quality public services and to better respond to society's needs. According to the OECD's Observatory of Public Sector Innovation, innovation in the public sector includes solutions and changes in administration, ensuring public order and safety, education, health and social care, and

a variety of other functions for citizens and business (OPSI, n.d.). The main actor behind this type of innovations are national and local governments, public agencies and other public institutions, such as education and training systems and schools. An example might be the use of big data to inform the development and monitoring of social policies, or the development and use of ICT to enhance public debate on important social issues.

Why is innovation important?

Innovation is important for a number of reasons. For many institutions (mostly associated with policy-making), innovation is the main driver of future social and economic development (European Commission, 2011; OECD, 2015). Along this line, innovation is important because future economic growth is said to be highly dependent on innovation-led productivity in the post-financial crisis context (ibid.). Furthermore, social innovations and innovation in the public sector are understood as fundamental ways to meet social and environmental policy objectives, and in particular the targets set out in today's global agenda for sustainability, the Sustainable Development Goals[1].

While innovation is largely seen as positive, the negative impacts of innovation are still controversial. The optimistic view of innovation as a solution for many socio-economic and environmental problems sometimes contrasts with a more realistic perspective that questions the negative impacts of innovation. For instance, the OECD's Oslo Manual – Guidelines for Collecting, Reporting and Using Data on Innovation recognizes that the benefits of business innovation do not necessarily mean positive outcomes for all stakeholders:

> The definition of an innovation does not require it to have a positive value for society, or a positive benefit for the firm. In the former case, an innovation can lead to a significant boost in the financial performance of the firm while providing fewer benefits to consumers than other offerings from the same firm or its competitors. An innovation can also result in safety, health or environmental problems. Conversely, an innovation does not necessarily improve the market position or financial performance of the firm when their users benefit from it. For example, an innovation can improve the utility for users without increasing a firm's sales, market share or net earnings. (OECD Oslo Manual, 2018, p. 69)

The debate between the positive and negative impacts of innovation can also be seen when addressing the impacts of business innovations in labour markets. A frequent issue discussed nowadays refers to the balance between jobs created and lost as a result of automation in production processes in the next years. According to a report on the future of work produced by the McKinsey Global Institute, 'while about half of all work activities globally have the technical potential to be automated by adapting currently demonstrated technologies, the proportion of work actually displaced by 2030 will likely be lower, because of technical, economic, and social factors that affect adoption' (Manyika et al. 2017, p.8). In their study, the institute investigated different scenarios across forty-six countries suggesting that around fifteen per cent of work activities will probably be displaced by 2030. On the other hand, the study also identified that the capacity to create new jobs could increase as economies grow, partly fuelled by productivity growth enabled by the development of advanced technologies and technological progresses.

In all, innovation is an important subject for discussion given its capacity to significantly impact (positively and negatively) many spheres of social and economic life. Therefore, it is important to consider questions on the governance of innovation when applied to the field of TVET: Why and in which direction should TVET innovate? Are innovations in TVET strengthening skills ecosystems? How are the TVET learners benefiting from innovations in TVET?

1 Source: https://www.un.org/sustainabledevelopment/

The Sustainable Development Goals are the blueprint to achieve a better and more sustainable future for all. They address the global challenges faced today, including those related to poverty, inequality, climate, environmental degradation, prosperity, and peace and justice. The Goals interconnect and in order to leave no one behind, it is important that each Goal and target is achieved by 2030.

How is innovation developed?

Questions about how different types of innovations are developed require a brief insight into the development of the concept of innovation. In its early stages, literature on the field of 'Innovation Studies' suggested that innovation were developed through a 'linear model' that encompasses the progressively implementation of five main steps: pure science, invention, innovation, finance, and acceptance (or diffusion). The linear model suggested that innovations were the result of transferring 'fundamental research' to 'applied research' (Godin, 2006, 2008). After the early 1970`s, this idea was refuted by different researchers who were interested in providing a different perspective on how innovations are developed. These authors were interested in studying the complex relationships between knowledge and skills behind innovations. Their work created the base for the development of a new paradigm in innovation studies: the National Innovation System (Freeman, 1988; Lundvall, 1992; Nelson, 1993). This approach on innovation suggests that the base of the processes of generation, acquisition, and dissemination of innovation is the collective, interactive, and simultaneous learning between several actors and institutions. By the end of the 20th century, the approach on national systems of innovation became hegemonic in innovation research and policies, being addressed for the first by OECD in 1997:

> The concept of national innovation systems rests on the premise that understanding the linkages among the actors involved in innovation is key to improving technology performance. Innovation and technical progress are the results of a complex set of relationships among actors producing, distributing and applying various kinds of knowledge. The innovative performance of a country depends to a large extent on how these actors relate to each other as elements of a collective system of knowledge creation and use as well as the technologies they use. These actors are primarily private enterprises, universities and public research institutes and the people within them. (OECD, 1997, p. 9)

In general, systems of innovation include different types of stakeholders and sets of established practices, rules and laws that regulate how these actors interact with one another (Edquist, 2005; Edquist and Johnson, 1997). The practices, rules and laws are important components of the system, and they tend to differ considerably among different contexts. An example is the rules and norms that influence the relations between universities (or other education institutions) and industries. In the last decades, many countries have changed the rules of ownership of knowledge created in universities with hopes that this will increase the number of patents, and that it will accelerate the commercialization of useful knowledge. Another important example refers to the laws and regulations governing companies' involvement in the financing and provision of TVET also vary in different countries.

A system of innovation is usually composed of different actors, divided according to the capacity in which they act (Pontikakis et al., 2005):

- Policy-makers play an instrumental role by providing overall direction and devising measures to advance innovation at the national level. Examples of relevant policy-makers in the field of TVET include individuals who develop TVET policies in ministries, national and local bodies.
- Policy enactors are charged with ensuring the efficiency of public sector bodies carrying out policy. Examples of relevant policy enactors in the field of TVET include individuals who implement activities suggested by TVET policies in institutions such as universities/research institutions and training centres.
- Technology users and producers are the most important actors in the system. These actors are traditionally understood as private companies and their clients. However, individuals who develop innovation and technology in universities/research institutions and training centres are also emerging as relevant technology producers.
- Technology lobbyists are responsible for information flows about the direction of inventive activity (including specialist advice, calls for funding and market signals). Examples of relevant technology lobbyists in the field of TVET include independent specialists, academic researchers, and different social and political leaders.

Finally, it is important to understand the different types of activities that can or should be performed within a system of innovation. Edquist (2005) identifies five main groups of key activities (Table 1).

Table 1 – Five main groups of activities (Edquist, 2005)

Groups of activities	Activities
Providing knowledge inputs to the innovation process	• Conducting Research and Development and thus creating new knowledge, primarily in engineering, medicine and the natural sciences • Educating and training the labour force in order to implement innovation and Research and Development activities
Demand-side activities	• Formation of new markets in which final goods and services are offered • Articulation of quality requirements emerging from the demand-side with regard to new products
Provision of constituents for systems of innovation	• Creating and changing organizations needed for developing new fields of innovation. Examples include enhancing entrepreneurship to create new firms and intrapreneurship to diversify existing firms, and creating new research organizations and policy agencies • Networking through markets and other mechanisms, including interactive learning among different organizations (potentially) involved in innovation processes • Creating and changing policy and regulations – for example, patent laws, tax laws, environment and safety regulations, Research and Development investment routines – that influence innovating organizations and innovation processes by providing incentives for, and removing obstacles to, innovation already available in innovating firms
Support services for innovating firms	• Incubating activities such as providing access to facilities and administrative support for innovating efforts • Financing of innovation processes and other activities that can facilitate commercialization of knowledge and its adoption • Provision of consultancy services for innovation processes, for example technology transfer, commercial information and legal advice

Despite the extensive list of activities within a system of innovation, it is important to recognize that most systems present different configurations in terms of which actors perform one or several of the key activities. Because of this, a system of innovation can present a more complex configuration with many specialized actors or a more centralized structure, depending on whether it is a company-based system or an innovation hub, where a single actor concentrates several activities.

Traditionally, systems of innovation have mainly been organized around specific actors, such as universities, companies and the government, with little space and relevance given to TVET institutions. Having said this, this trends mapping study shows a different scenario with TVET institutions adding new types of services and activities to their scope and achieving new roles in the development of innovation within local and national systems of innovation. This raises the possibility that TVET institutions are able and well placed to take part in all activities and thus become nodal points in national and local systems of innovation.

What is innovation in TVET?

As mentioned previously, the transition to green economies, the implementation of digital technologies in the world of work and the emergence of new forms of entrepreneurship, among others, are not only changing the profile of jobs but are also creating new possibilities for generating solutions for social and economic problems. The speed and scale of change calls for a broad process of transformation, with TVET institutions increasingly acting as drivers of innovation in their local ecosystem, and in parallel innovating the learning processes and products offered to youth and adults and increasing citizens' potential to innovate. As TVET adapts itself to the impacts of significant social, environmental and economic disruptions, innovative practices emerge with great potential to rejuvenate the future of TVET.

Systems of innovation can incorporate many different types of actors and can be organized around different activities, depending on the context. Similarly, the financing and delivery of TVET also involves different types of public and private stakeholders. It can be taken in different forms and be found in formal, non-formal and informal settings. With this in mind, a general definition of innovation in TVET needs to be broad enough to be applicable in these different contexts. After reviewing different definitions of innovation from previous literature and engaging the international TVET community in an extensive virtual debate, this study proposes the following broad definition of innovation in TVET:

> Innovation comprises substantial change in the way TVET is practiced by an institution, making it progressively more relevant to its economic, social and environmental context.

This definition has two parts. First, innovations in TVET refer to 'substantial changes', that is to say, systematic transformation of TVET towards new practices, not only from a theoretical point of view, but also from a performative perspective. Second, innovations in TVET must be of relevance to external actors (e.g. developing solutions to local social and economic problems) or to TVET systems, networks and schools (e.g. deploying new teaching and learning methods).

Moreover, interactions with the global TVET community also showed that the definition could be understood from two different perspectives. First, TVET institutions can enhance regional and national capacities to generate and implement innovation. From this perspective, TVET institutions act as producers of innovation with aims to create value and benefits for external actors (e.g. development of applied research or consultancy services). Second, TVET institutions are also capable of producing and implementing different types of innovations to improve the quality of TVET and to generate benefits for internal actors, such as students and TVET staff (e.g. new teaching and learning processes and entrepreneurship).

It is also important to note that, while the definition is broad enough to be relevant to different contexts, some participants of the virtual conference organized on innovation in TVET referred to the technological gap between developed and developing countries and its impact on the way TVET systems, networks and schools in developing countries understand what innovation in TVET is:

> "In the developing world, innovation often implies trying to catch-up with other developed states. Whereas in developed nations, innovation most likely means forging ahead into uncharted waters "
>
> (A participant from Jamaica)

While focusing exclusively on the definitions of innovation in TVET provided by TVET institutions from developing countries, it is possible to perceive a great focus on the idea of innovation as a 'solution' to different types of social, economic and environmental problems, with a specific focus on labour market issues. In general, innovation in TVET in developing countries refers to providing quality education with social inclusion, social engagement, and solving community problems.

Exploring the link between skills development and innovation

The link between innovation and TVET can be explored from multiple dimensions. On one hand, the development of innovation and technologies shapes skill demands and therefore the types of skills TVET needs to cater to. On the other hand, skills development also contributes to the development of systems of innovation by providing skilled labour that are able to help shape and develop the system.

Traditionally, literature on the role of TVET in the processes of innovation development commonly identify skills development as one of the mechanisms of skills formation and diffusion, oriented to equip different types of workers not only with general and specific skills, but also with innovation-related skills such as creativity, analytical thinking, problem-solving and leadership. From this perspective, TVET is considered as a key instrument for equipping the workforce with the skills required for the 'jobs of tomorrow' (Tether et al., 2005).

It is generally recognized in innovation studies that skilled labour are a basic requirement for innovation development, production capacity and economic competitiveness.

> Human capital is the essence of innovation. People generate the ideas and knowledge that power innovation and they apply this knowledge and the resulting technologies, products and services in the workplace and as consumers. Innovation requires a wide variety of skills, as well as the capacity to learn, adapt or retrain, particularly following the introduction of radically new products and processes. Empowering people to innovate relies not only on broad and relevant education but also on the development of wide-ranging skills that complement formal education. Opportunities to use and leverage these skills throughout the economy and society are vital. (OECD, 2010, p. 9)

Innovation and technical changes are said to be associated with an increasing demand for high-skilled workers, and a declining demand for low-skilled workers in modern economies (Arundel et al., 2006; Edquist, 2005). The large-scale implementation of automation on low-skilled labour tasks can help explain the declining demand for low-skilled workers, while the increasing demand for high-skilled workers can be described as a consequence of the proliferation and acceleration of new information technologies and new organizational structures. According to the OECD 2015 Innovation Strategy, skills shape innovation in a number of ways:

- Skilled people generate knowledge that can be used to create and implement innovative practices
- Having more skills raises the capacity to absorb innovations. Educated workers also have a better foundation for further skills acquisition
- Skills interact synergistically with other inputs to the innovation processes, including capital investment. For instance, studies show that human capital complements investment in and the use of ICTs
- Skills enable entrepreneurship, which is often a carrier of innovation and structural change
- Skilled users and consumers of products and services often provide suppliers with valuable ideas for improvement

With this in mind, there are three ways in which a vocationally skilled labour force can contribute to the development of innovation (Toner, 2010):

1. Technicians and tradespeople (considered the main types of TVET occupations) play a fundamental role in the development of innovation through learning by doing. Technicians and tradespeople are equipped with the skills to design, install, adapt, operate and maintain equipment, software and other technologies and can therefore perform a variety of skilled tasks, applying broad or in-depth technical, and trade or industry specific knowledge, often in support of scientific, engineering, building and manufacturing activities;
2. A vocationally skilled labour force can also contribute to public and private Research and Development activities, as they possess practical and problem-solving oriented skills. Across the European Union and Australia, around 45 per cent of the business Research and Development workforce is comprised of TVET qualified workers, mostly technicians and tradespersons (Toner, 2011);
3. A skilled workforce will also act as competent users and clients of innovations, being key actors in processes of learning by using that help companies and public sector to listen to users' needs and suggestions for changes and adaptations.

Innovations are also capable of introducing new skills demands that impact employment, education and training systems. On the one hand, innovation and technological changes have negative impacts on employment because innovations allow firms to produce the same amount of goods with a lower amount of production factors such as labour. However, different economic theories describe that market mechanisms can potentially balance the initial labour-saving impact of innovation. For example, product innovation can also lead to job-creating effects (Vivarelli and Pianta, 2000; Edquist, et al, 2001) and the quantitative effect of innovation in skills and employment is balanced by the positive qualitative effects (number of hours, working conditions, etc.) of technological changes on the different categories of workers (Milgrom and Roberts, 1990; 1995). Therefore, it is difficult to measure the impacts of innovation on skills and employment since these 'compensation mechanisms' are influenced by a broad set of conditions and can be hindered by the existence of important drawbacks, namely, the macroeconomic and cyclical conditions, and the labour market dynamics (Vivarelli, 2014).

Against this background, there seems to be a general conclusion in the literature on innovation and skills: innovations are usually a source of imbalance between the supply and demand for skills. For this reason, policy-makers should consider the development of policies and institutional conditions, and achieve a reasonable minimization of skills mismatches, given that in any dynamic economy such mismatches will not be eliminated entirely. In Europe, the recently launched Cedefop database 'Matching skills: Inspiring policies for anticipating and matching skill needs' presents education and training and labour market policy instruments in European Union Member States that aim to match the individuals'[2] skills (jobseekers and students) to current and anticipated labour market needs. This tool helps policy-makers to understand and compare the approaches used and the rationale behind them. It provides information on practical organization, funding and stakeholder involvement, as well as insights into how an innovative and successful policy instrument should be, and whether it could be successfully applied elsewhere.

Another interesting example of matching skills policy can be found in the work of the Federal Institute for Vocational Education and Training (BIBB) Establishment-Panel on Qualification and Competence Development (BIBB Training Panel) in Germany. The training panel defines the training and competence requirements for TVET occupations by looking at the profiles of tasks exercised and the use of digital technologies at the surveyed companies. The BIBB's analyses are introducing the expression of 'VET 4.0' to describe modern TVET programmes' capabilities to address important issues on the future of work and skilled workers:

> (…) the analysis described enables us to confirm that, from the companies' perspective requirements for employees will increase as a result of digitalisation. If computer-assisted tools and technologies for networking with customers, for human resources and work organisation and for the processing of large amounts of data are deployed in the company, employees on average carry out more demanding tasks. In individual terms, this means that employees at such companies perform fewer repetitive routine tasks and more manual, knowledge-intensive and subject-related tasks. Because the use of digital technology already correlates with higher requirements, the expectation is that dealing with complexity will become increasingly important for employees in the wake of digitalisation (BIBB, n.d).

In summary, the complex relationship between skills and innovation reinforces the need to better identify and minimize skills mismatches. Along this line, the main role of TVET systems is to identify the skills demands and to provide these skills to a vast range of TVET learners. TVET institutions have a very important role in processes of innovation development and implementation by acting as mechanisms of skills formation and diffusion. The development and implementation of vocational curricula are some of the most fundamental activities in TVET systems, especially considering the recent impacts of new technologies related to industrial automation or the changes in working environments and practices.

Framework and methodology

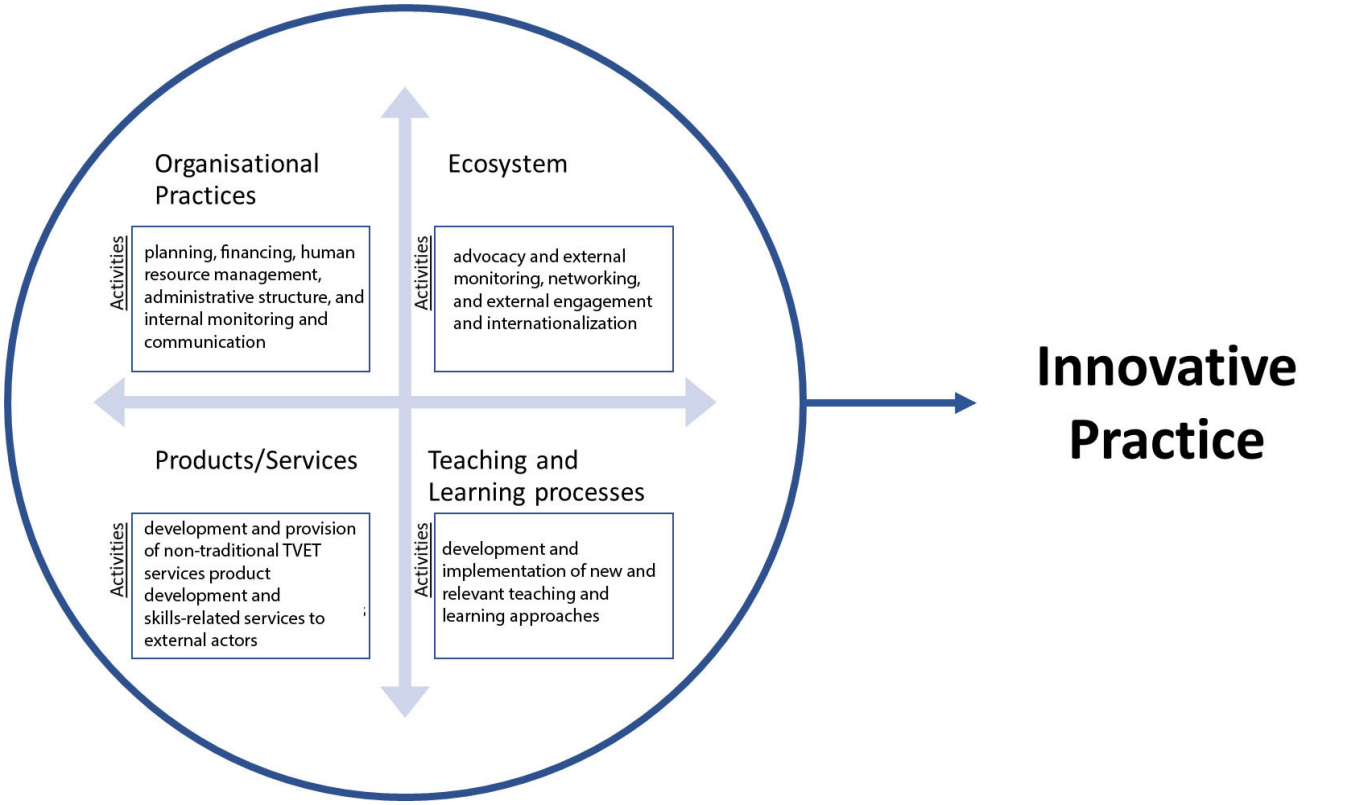
The definition of innovation in TVET can also be further elaborated when looking at the vast group of innovative practices identified by the trends mapping study. Based on the inputs from the international TVET community, including discussions that are taking place as part of UNESCO-UNEVOC's Skills for Innovation Hubs (i-hubs) initiative, the study produced a general framework to map innovative practices in TVET. This framework helped understand the different processes taking place.

The framework is composed of four dimensions of innovation in TVET, and each describes different activities deployed by TVET systems, networks and schools when developing and implementing innovative practices in TVET.

- Organizational practices refer to planning, financing, human resource management, administrative structure, and internal monitoring and communication
- Ecosystem refers to how TVET institutions reach out, engage and foster their interactions with external actors through advocacy and external monitoring, networking, and external engagement and internationalization activities.
- Teaching and learning processes refer to the development and implementation of new and relevant teaching and learning approaches.
- Products and services refer to the development and provision of non-traditional TVET services (applied research, consultancy, etc.), product development and skills-related services to external actors such as students, companies and governments.

2 http://www.cedefop.europa.eu/en/news-and-press/news/cedefop-launches-matching-skills-online-information-tool

Figure 1 –Innovative practice framework



The framework highlights the importance of considering all the different dimensions of innovation when developing and implementing an innovative practice in TVET. For example, it is impossible to succeed in the implementation of new TVET courses and curricula without considering the needs and impacts concerning TVET planning, human resource management and external engagement.

Based on this general framework, the trends mapping study developed a questionnaire with quantitative and qualitative questions (see Annex) to capture the current trends of innovation in TVET. The questionnaire covered different subjects related to innovation in TVET, namely: planning innovation in TVET, the definition of innovation in TVET, the types of services and/or products provided by TVET institutions, the types of activities deployed by TVET institutions to implement innovative practices, the relationships between TVET and external actors, and finally, the main barriers to the development and implementation of innovative practices in TVET. In total, sixty-two TVET institutions from thirty-six countries answered the questionnaire. The group of respondents is composed of different types of TVET institutions:

- Twenty-three ministries/TVET national bodies
- Eighteen universities/research centres
- Twenty-one training providers

A one-week virtual conference on UNESCO-UNEVOC's TV*e*T Forum[3] debated the initial findings of the study. The virtual conference helped to reinforce the TVET community's understanding on what innovation in TVET means, and shared innovative practices from the field. In total, two hundred and five participants from seventy-five countries attended the virtual conference organized from 25 February to 01 March 2019. The discussions were informed by earlier publications related to the fields of economy, innovation and TVET, as well as presentations provided by external contributors on applied research in TVET, ICTs in TVET, and strategies and planning for innovation in TVET. Additionally, other resources and links were shared, including short thematic videos, relevant YouTube videos, and different publications. The outcomes of the virtual conference, which were captured in a summary report[4], helped strengthen the results of the trends mapping study.

In order to capture as many perspectives and practices as possible, the trends mapping study covered all five regions of the world and involved members of UNESCO-UNEVOC's global platform, the UNEVOC Network, and the wider TVET community.

3 Virtual conference on Innovation in TVET: https://unevoc.unesco.org/go.php?q=Virtual%20conference%20on%20innovation%20in%20TVET

4 Virtual conference summary report innovation in TVET: https://unevoc.unesco.org/up/vc_synthesis_23.pdf

The current state of innovation in TVET: results from the trends mapping study

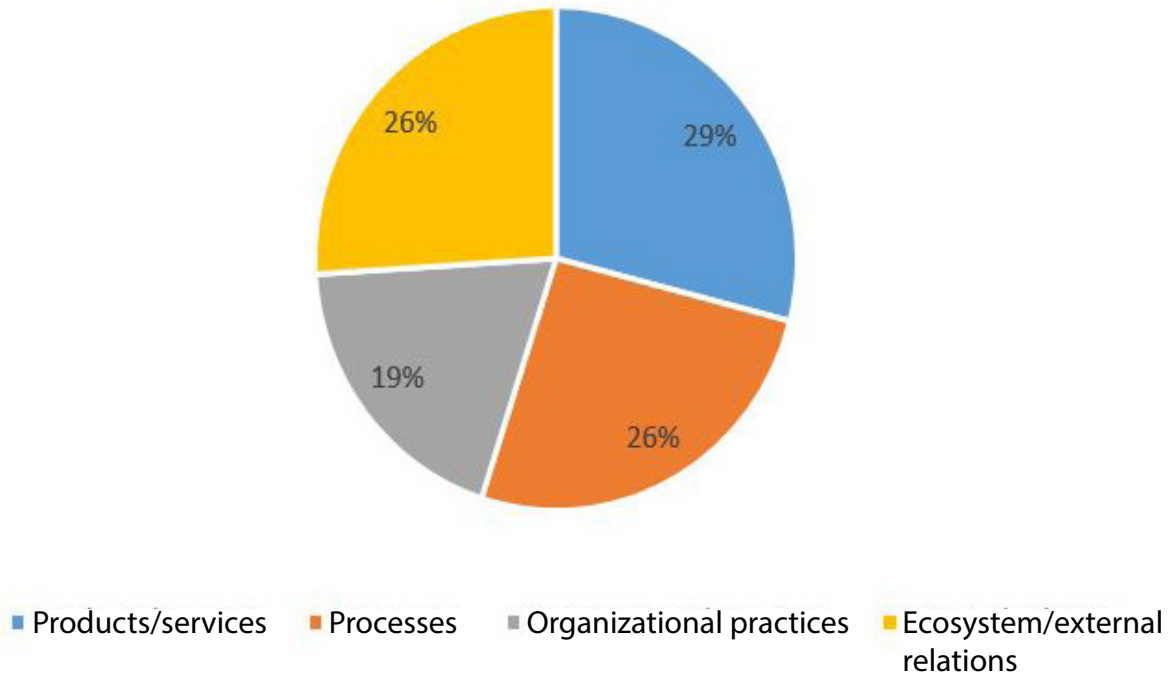
This section presents the results of the trends mapping based on the review of relevant literature (e.g. journal articles, position and working papers and reports), the questionnaire on innovation in TVET, as well as some of the insights and ideas discussed in a one-week virtual conference at the UNESCO-UNEVOC TV*e*T Forum.

In general, it is possible to conclude that despite the growing interest from international organizations and research communities, the subject of innovation in TVET still has not been addressed thoroughly in the field of TVET research. This section is divided in three main parts: the first part includes a summary of the discussions on the importance of skills development for innovation. The second part presents the results of the study divided by different dimensions of innovation in TVET (organizational practices, ecosystem, teaching and learning processes, and products/services), including the most relevant cases of innovative practices identified by the study. Finally, the last part discusses some of the main barriers to the development and implementation of innovative practices in TVET.

Different dimensions of innovation in TVET

In general, the study shows that TVET institutions innovate in all four dimensions of the innovative practice framework (Figure 2). Having said this, TVET institutions seem to focus on innovation in products/service, processes and external relations, with less attention being given to innovation in organizational practices.

Figure 2 – Types of innovative practices undertaken, by all stakeholder types



Organizational practices

To recap, innovation in organizational practices refers to how TVET institutions integrate innovation through leadership, strategy, culture and structure. Activities related to this dimension focus on internal administration and management such as planning, financing, human resource management, administrative structure, and internal monitoring and communication. In order for TVET systems, networks, and schools to have a stronger focus on innovation and technology, it is necessary to establish a proper culture for innovation in TVET. Literature on innovation in education shows that creating a culture for innovation depends on a solid TVET management and human resource management approach.

TVET management is at the core of organizational practices. It considers especially the analysis, evaluation, and adaptation of structures, processes, and projects with regards to school management and school organization. Innovations in TVET management are directly related to the level of autonomy provided to TVET centres and schools (Preddey, 2009).

According to literature, devolution is defined as giving local actors more autonomy to govern and manage their activities. It suggests that higher levels of autonomy in TVET systems can provide incentives for institutional managers and teaching staff to decide upon their strategic planning, institutional objectives and strategies to achieve them, including financial and asset management.

The *Handbook Management for TVET Institutions* published by the BIBB provides an insight into the field of management for TVET institutions, based on the applied training materials and the experiences of the German experts and based on experiences of implementing training in different countries. The handbook highlights that TVET management faces the same challenges and implications as any other management task. The handbook describes TVET management as 'a communication that is open-minded, respectful, marked with esteem, willingness to help and support each other, the will to understanding, fair negotiations and the will to discourse' (Richter, 2014, p. 5).

Table 2 – TVET management in the future

In the future there will be more	In the future there will be less
• Recognition and emphasis on informal learning • Collaboration within and between educational institutions and the world of work • Networking activities among institutions • Focus on international perspectives on training, the use of ICT (Information and communication technology) and digital networks • Need for a holistic perception • Need for learner autonomy and self-directed learning • Competence requirements for pedagogies • Networking among teachers and trainers, and requirements placed on them regarding communication skills, and using new media in education and training • Interaction between education and society • Organizational competence development	• Formal training • Fixed and inflexible systems • Hierarchy • Classroom teaching • Differences and barriers among general, vocational, and higher education and training

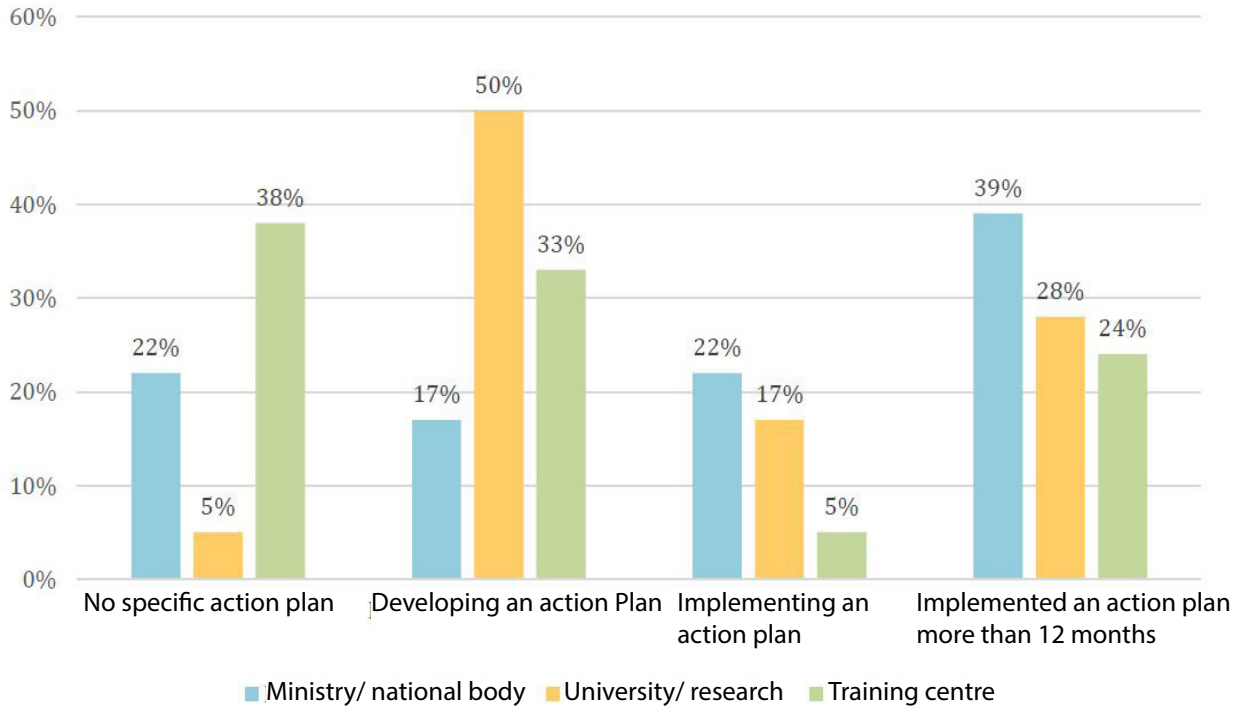
The handbook also suggests that structural innovation comes from internal changes in the TVET institutions (Heusner, 2014). It describes some requirements to start structural innovation and overcome fears and prejudices against changes in TVET:

- **Starting with the analysis of concrete motives, troubles or weaknesses**, TVET institutions can use specific methods such as the SOFT-analysis (Strengths, Opportunities, Faults, and Threats). This type of analysis should include a broad circle of interested colleagues with aims to identify internal difficulties in dealing with change in TVET;
- It is important to **involve all participants** at the beginning of the process, which can minimize internal resistance while implementing a plan for structural innovation;
- **Adapting structures to colleagues, people and institutions** refers to finding suitable solutions in the internal organization to adapt to local circumstances;
- **Promotion of team building and teamwork support** is important during the complete innovation process;
- **A process-oriented perspective** that recognizes mistakes and resistances as part of the whole process is needed to adapt to new circumstances caused by structural innovation;
- **TVET leadership** is based on values like respect for your personal and trust in their performances.

Results from the questionnaire showed that TVET stakeholders had various experiences regarding innovation in organizational practices. For example, when asked about the development and implementation of action plans for innovation in TVET, fourteen TVET institutions reported not having a specific action plan for innovation, while twenty-one institutions said that they are currently developing an action plan. Moreover, nine institutions said that they had implemented an action plan for innovation in the last twelve months, and nineteen institutions had implemented an action plan for innovation more than twelve months ago.

The results are significant when they are assessed with the type of TVET stakeholder in mind (Figure 3). So while nearly half of the respondents said that they had no specific action plan for innovation, only five per cent were from universities and research centres. In contrast, thirty-eight per cent of training centres reported having no action plan. Among those who reported having an action plan, thirty-nine per cent of ministries/national bodies had developed a plan for more than twelve months.

Figure 3 – Stages of implementing action plans for innovative practices, by stakeholder type



Innovative practice

Innovative practice: Programme for the Development of Renewable Energies and Energy Efficiency in the Federal Network of Vocational, Scientific and Technological Education - EnergIF
Institution: Ministry of Education
Country: Brazil

In Brazil, the public sector accounts for approximately eight per cent of the total electricity consumption. With this in mind, the Ministry of Education is implementing the 'Programme for the development of renewable energies and energy efficiency in the Federal Network of Vocational, Scientific and Technological Education – EnergIF', supported by the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The project aims to induce a culture that promotes the development of renewable energies and energy efficiency in the Federal Network of Vocational, Scientific and Technological Education.

The project applies a number of measures to improve the energy performance of the Federal Network in order to: reduce energy costs; boost the acquisition of power generation equipment and training centres in the areas of wind, solar, biogas and energy efficiency; increase vocational and technological training in renewable energies and energy efficiency with new courses; and foster research, development, innovation and entrepreneurship in renewable energies and energy efficiency. Other actions implemented by the EnergIF project include the training of teachers and managers to act as multipliers in renewable energies and energy efficiency, promoting partnership between companies and the Federal Network for the realization of courses, as well as creating a Thematic Committee on Renewable Energies and Energy Efficiency and instituting a Consultative Committee on Renewable Energy and Energy Efficiency with representatives from different stakeholders.

It is hoped that the programme will contribute, amongst others, to increase the capacity of the country in renewable energy, mainly photovoltaic, which currently accounts for only 0.01% of the Brazilian electricity production. The main results achieved by the project so far include the implementation of four projects by the Federal Network of Vocational, Scientific and Technological Education, supported and approved by the Energy Efficiency Programme of the National Electric Energy Agency (ANEEL), which is a programme with almost five million dollars investment.. Other results include the training of hundred and thirty-nine teachers from the Federal Network to act as multipliers of renewable energies and energy efficiency and the development of ten new courses on photovoltaic energy, biogas, wind energy and energy efficiency elaborated by the Federal Network's teachers.

Additional information can be found at http://www.energif.org/ (only in Portuguese)

Based on this, three aspects that can be highlighted:

1. Ministries and national bodies tend to have more experience in implementing actions plans for innovation compared to universities/research institutions and training centres and schools
2. Universities/research institutions are currently paying more attention than training centres and schools to the development of action plans for innovation
3. Training providers are lagging behind in terms of action plans for innovation compared to other types of TVET institutions

As previously mentioned, in addition to TVET management, human resources management approaches are also important to promote innovation in institutions. The 'human resources' of an institution can be seen as all the efforts, skills and capabilities of all the people who work for that organization. In a broad sense, the capacity of institutions to innovate depends directly on how its human resources are managed. In other words, people, their efforts, knowledge and skills form the basis for the development of innovation. Human resource management should therefore be designed to maximize employees' performance through a series of activities and programmes.

Literature presents a complex view of human resource management that goes beyond the traditional focus on teacher-training requirements and programmes, describing an extensive list of human resource management practices in TVET schools (Howe, 2014):

- **The personnel requirement determination** provides the number and the qualifications of teachers needed at school or needed to achieve the desired quality of teaching. For this, it is necessary to have a clear picture of the school's quality concept. In addition, the activity of personnel requirement determination is concerned with forecasting and estimating the future demand for teaching at a certain college.
- **The personnel status analysis** aims to understand the present qualifications, skills and capabilities of the school's employees. The personnel status analysis is crucial to further organize the recruitment of new employees.
- **Recruitment** requires profiling and what the role and tasks the person will do. The recruitment process can be internal (e.g. particularly suitable for promotion) or external when a vacancy is filled by someone outside of the TVET institution. It is important that the details of vacancies are circulated to all and that selection is to be made in a fair and impartial way, based on merit and performance. The methods used to select the candidates should also assess the applicant's knowledge, behaviour, mind-set and attitude.
- **Personnel use planning** ensures that each employee can reach their best performance in certain circumstances of the college. In addition, the personnel use planning has to project further training of employees.
- **Personnel management** refers to a more personal type of management, which is particularly important when solving conflict situations. It aims to reach a compromise between conflicting viewpoints of, for example, the school management team and teachers.
- **Personnel cost management** refers to planning and assessing the efficiency of TVET personnel costs. This type of activity is proved to be relevant not only in private TVET institutions, but especially in state-funded TVET institutions where access to financial resources is highly limited.

Learn more

INVEST Africa - Innovation in Vocational Education and Skills Training, run by the Commonwealth of Learning, has been supporting the development of innovation in TVET institutions by assessing institutional readiness, developing projects and monitoring and evaluation (based on the LOTS approach). During the virtual conference, Terry Neal (Commonwealth of Learning) presented on the and also presented the case of the Koforidua Technical University. The presentation is available here: https://www.youtube.com/watch?v=vxhnA2EkL70

There is also literature on the different instruments of human resource development, such as appraisal interviews, target agreements and the (individual) feedback. An appraisal interview or performance appraisal[5] refers to a systematic evaluation of the performance of an employee. According to the Howe (2014), the appraisal is 'a tool for discovering and analysing qualifications, skills, opinions, vision, and mind-set, and it is for using of potentials'. Based on the vision statement and the school programme, the appraisal should generate individual target agreements. The targets of target agreements must make sense for the employees so that they can be motivated to achieve them. Moreover, every target is an individual target. After a certain period of time, a further short appraisal interview can be conducted in order to control the achievement of the target. Finally, feedback is one of the most important instruments of personal development. Some of the forms of feedback include individual feedback, peer review as cooperative and collegial feedback and 360-degree feedback, a process whereby feedback is gathered from an employee's subordinates, colleagues, and supervisor(s), as well as a self-evaluation by the employee themselves.

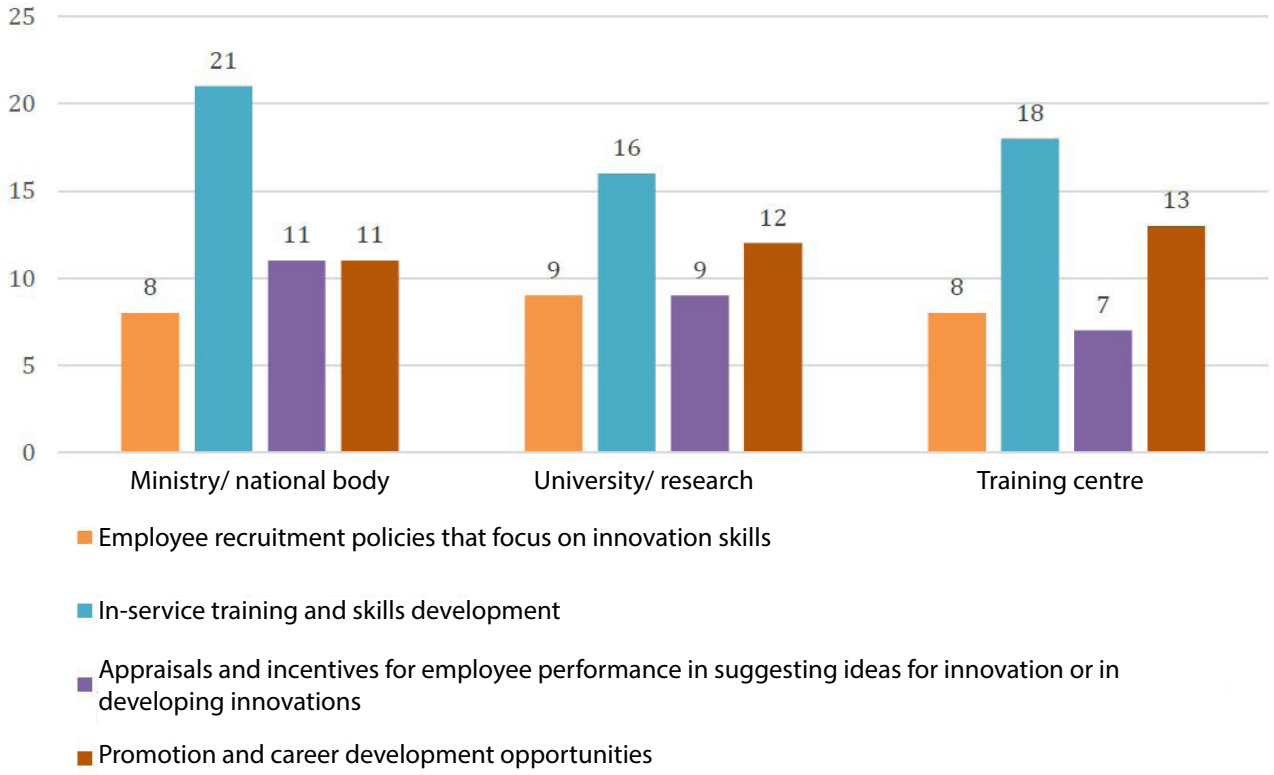
The questionnaire asked respondents which types of human resource management practices are usually deployed by TVET institutions. The question provided four different types of practices: (a) employee recruitment policies that focus on innovation skills; (b) in-service training and skills development; (c) appraisals and incentives for employee performance in suggesting ideas for innovation or in developing innovations; and (d) promotion and career development opportunities.

5 There are various methods of appraisal you can use exclusively or in combination. Find more at http://www.humanresources.hrvinet.com/performance-appraisal-methods/.

The survey results show that in-service training and skills development are the most common types of practices developed by almost ninety per cent of TVET institutions. Thirty-six institutions (fifty per cent) reported the implementation of promotion and career development opportunities. Less than fifty per cent of the TVET institutions reported implementing appraisals and incentives for employee innovative performance and employee recruitment policies that focus on innovation skills (Figure 4).

The results show that there are not many differences among ministries/national bodies, universities/research centres and training centres. In general, all types of TVET institutions reported a focus on training and skills development as their main human resource management practice. On the other hand, all the types of TVET institutions presented a great lack of human resource management practices concerning recruitment, appraisals and incentives. This scenario suggests a greater need to diversify human resource management practices in order to support the development of innovation in TVET. For example, focusing on innovation skills during recruitment activities can help TVET institutions to find professionals that show greater aptitude with new technologies and problem-solving. Also, the creation of mechanisms of appraisal and incentives can help to create a more innovation-oriented TVET culture, providing the opportunities for TVET professionals to develop new projects and finding innovative solutions. Finally, promotion and career development opportunities are crucial not only as ways to motivate TVET professionals to innovate, but also to assure that TVET leaders are able to deal with the scenario of different types of disruptions and rapid technological development.

Figure 4 – Human resource management practices for supporting innovative practices



Innovative practice

Innovative practice: INVEST – Innovation in Vocational Education and Skills Training
Institutions: Commonwealth of Learning and Commonwealth Association of Polytechnics in Africa

The INVEST initiative was created by the Commonwealth of Learning in partnership with the Commonwealth Association of Polytechnics in Africa - CAPA - to support their member institutions to integrate ICT into TVET teaching and learning. INVEST challenges TVET teachers, managers and policy-makers to change the way they think about how to provide TVET. INVEST involves educational media and technology in flexible approaches to teaching and learning. By investing in staff capacity-building and ICT infrastructure, creating new organizational structures and designing new strategic objectives, TVET institutions can increase the quality of their courses, becoming more efficient and opening up provision for learners who have historically been locked out of the TVET system. Innovative flexible and blended TVET programmes which benefit from the application of ICT offer the potential to increase access with quality and efficiency.

In the INVEST initiative, each partner was invited to apply a strategic plan that includes institutional readiness assessment and the development of activities focused on enhancing ICT infrastructure and capacity-building. Capacity for innovation in vocational education and skills training was built through workshops, institutional visits and online training. Teachers, policy-makers, managers and other TVET stakeholders were engaged in learning through specially designed online courses on the COL Moodle Learning Management System (LMS). The INVEST Community Learning Network is an online informal learning and social networking platform offering a community of practice for managers, administrators, teachers and national policy-makers.

Each INVEST partner has an institutional champion for flexible skills development, that is to say, specialist units who are responsible for promoting training and integrating technology in teaching and learning. At the Koforidua Technical University, an Institute for Open and Distance Learning was established with ten professionals to support flexible skills development in campus-based programmes. The IODL leads to the development and implementation of programmes and infrastructure required to implement the flexible skills development model throughout the university. Through monthly seminars, the champions train their colleagues on using the MOODLE Learning Management System. For existing users, the monthly training sessions serve as refresher courses and provide an opportunity for them to share with prospective users on the advantages and challenges of using these systems. The strategy allowed Koforidua Technical University to show results in in teachers' and students' use of ICT: in five years, the number of teachers using ICT in TVET courses jumped from three to hundred and fifty-six, benefiting more 12,000 learners in one hundred and eighty-four online courses.

Ecosystem (External relations)

As previously discussed, the ecosystem dimension refers to the innovative ways TVET institutions engage with external partners through advocacy and external monitoring, networking, and external engagement and internationalization activities. These activities can help an institution leverage the local, national and international TVET communities' capacities to innovate. The activities implemented by TVET institutions related to this dimension play an important role in identifying the demands, issues and opportunities for innovation in their environment, helping to create bridges and partnerships among several types of stakeholders.

In the context of significant changes in the world of work, TVET institutions are expected to deploy new sets of managing practices with the objective to enhance external relationships with companies, students, government and suppliers. Activities which aim to develop and foster relationships with external actors are not only crucial to overcome obstacles to collaboration between the TVET and other sectors (including businesses), but can also be pursued with the aim of creating a stronger and supportive sense of community between different stakeholders. This can also help promote and enhance the status of TVET in that local context.

There are different types of partnerships between TVET institutions and external actors with different aims, including:

- **Partnerships in public policy** aim to shape public and political debates and bring about substantial changes in TVET legislation and governance
- **Partnerships in systemic educational improvement** aim to combine and channel resources in different ways and implement specific TVET policies
- **Partnerships in TVET management** aim to provide TVET managers with support running an organization and business expertise in a broad range of areas
- **Partnerships in teacher training and development** aim to provide opportunities to TVET personnel to maintain or upgrade their skills
- **Partnerships in classrooms** aim to bring business and occupational expertise directly into classrooms
- **Partnerships in special services** aim to provide short-term, project-based or student-specific activities or resources to help with a specific problem or need identified by external actors (Hiniker and Putnam, 2009)

Public-private partnerships are prevalent forms of collaboration. These strategies address the challenges of modern TVET systems defined by the provision of real-work learning. According to Okoye and Okwelle (2013), these types of partnerships are viewed as a generic term for relationships formed between private and public sector bodies, often with the aim of introducing private sector resources and/or expertise in order to provide and deliver public sector assets and services. A great part of the literature on public-private partnerships in TVET describe the challenges and possibilities related to partnering with the business sectors in order to implement national qualifications frameworks. The Global inventory of regional and national qualifications frameworks (Cedefop, 2017) suggests a four-stage process to engage external actors and stakeholders:

1. **Identifying:** listing and mapping relevant groups, organizations and people
2. **Analysing**: understanding stakeholders' perspectives and interests
3. **Mapping**: visualising relationships, mapped to objectives and to other stakeholders
4. **Prioritising**: identifying issues and ranking stakeholders' relevance by likely impact

TVET institutions must develop innovative partnerships in order to create a better work-based learning system, based on:

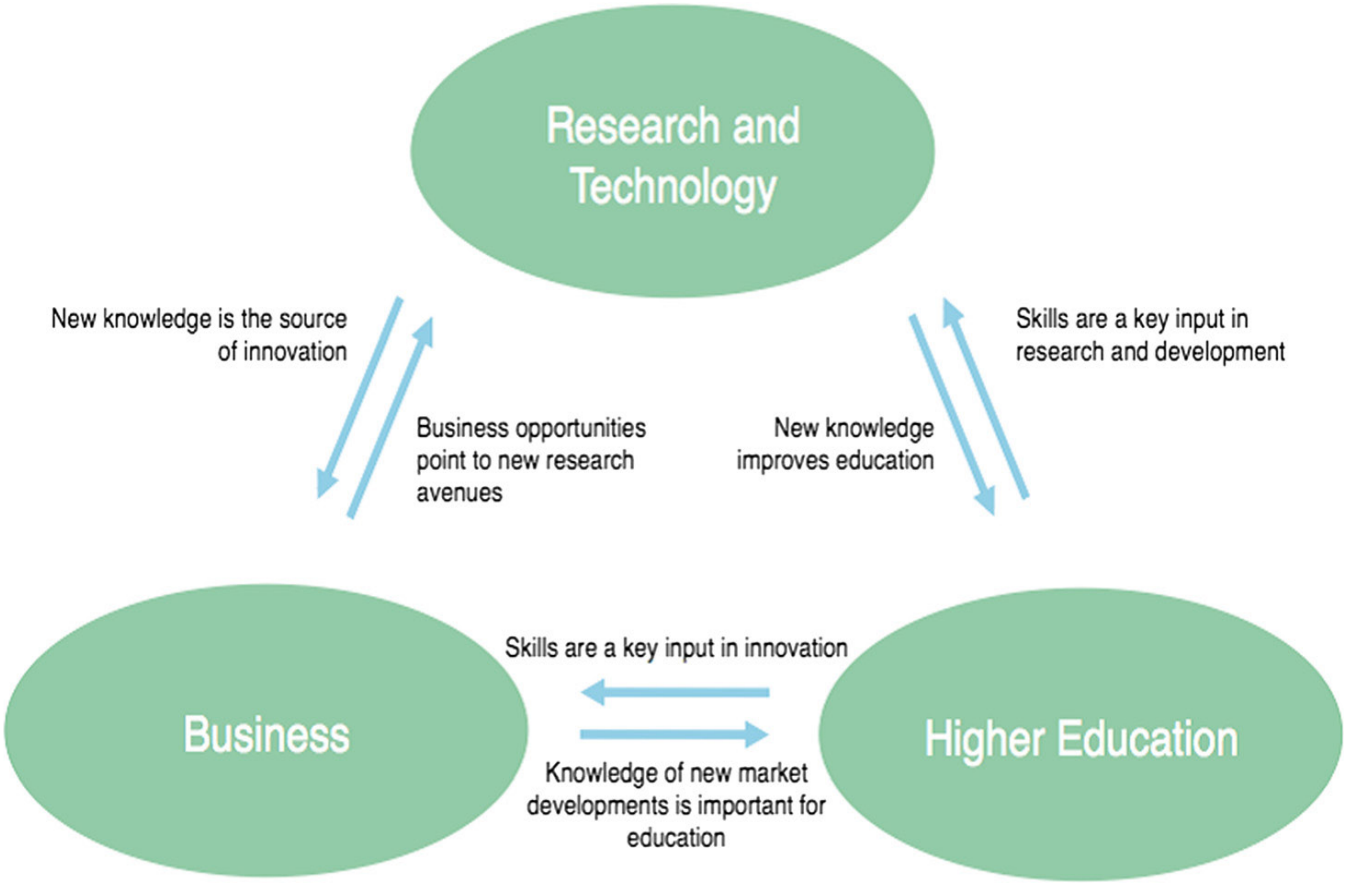
- Clear understanding and agreement upon goals
- A focus on customers, both internal and external
- Commitment to excellence in which all functions focus on continuous improvement
- Commitment to teamwork
- Decision-making based on measurement and data
- Commitment to lifelong learning (Hiniker and Putnam, 2009)

It is also important to recognize the role of the informal sector in TVET programmes. The informal sector encompasses production units without an administrative registration number and/or which do not keep formal written sets of accounts (Walther, 2011). The informal sector is mainly made up of micro- and small enterprises that are often the first training ground for young people in many countries (Langer, 2013). Therefore, it is crucial to consider the informal sector in training programmes. Innovative partnerships with the informal sector benefit TVET as it gives access to localized knowledge flows, helping to generate innovative ideas and solutions (Sedon et al., 2009). Furthermore, some important recommendations on how to engage with the informal sector can be draw:

- TVET institutions should help stakeholders in the informal sector to identify their skills demands and also consider strategies to address these demands (e.g. developing TVET programmes and curricula);
- Partnerships with the informal sector can help generate new ideas and products not only by providing skills formation services but also by dealing with other factors such as credit, material, equipment and market analysis;
- TVET can provide short-term courses with high quality standards and effective learning environments that aim to provide skills for self-employment;
- TVET and informal sector stakeholders can develop innovative partnerships with the objective to create new learning spaces, including in workplaces, small businesses, community settings and informal learning networks (Sedon et al., 2009).

During the virtual conference, participants stated that TVET usually plays a marginal role in the 'knowledge triangle' – the link between businesses, education and research (Figure 5). This may be explained by the great impact of the Triple Helix Model (Etzkowitz & Leydesdorff, 1995) in shaping innovation policies since the end of the 1990's. The model provided a solid framework for exploring the phenomenon of university-industry-government relations as a vital condition for successful knowledge and technology transfer which becomes a source for innovation, regional, national and global economic growth as well as social development (Miller, McAdam, & McAdam, 2016; Perkmann & Walsh, 2007; Urbano & Guerrero, 2013). However, this framework has historically neglected TVET institutions as relevant actors in the development of innovations, being understood rather as in-companies training centres or a part of the general education system. As a consequence, TVET institutions have been less likely to be considered as crucial actors in processes of innovation development.

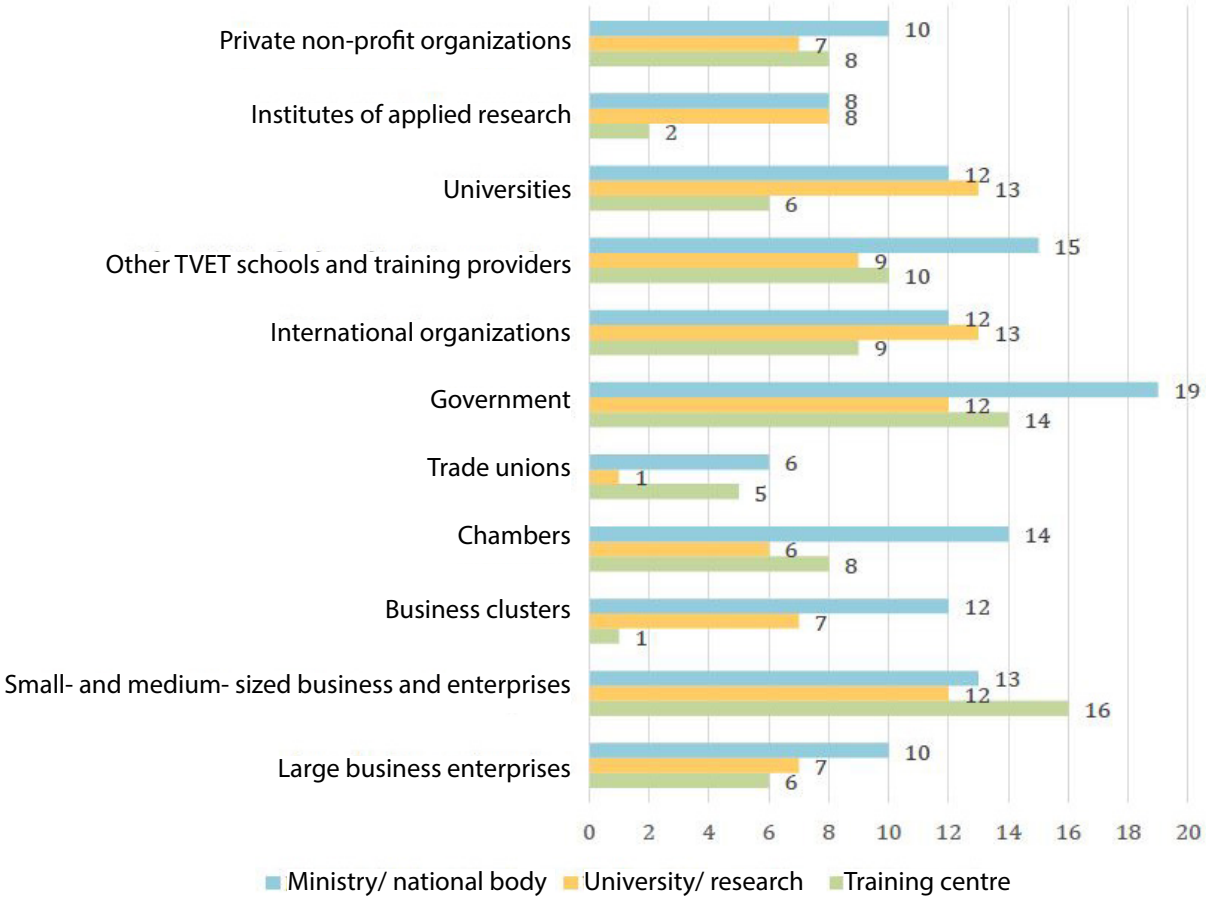
Figure 5 – Model of the knowledge triangle (EIT, 2012)



The results from the questionnaire show that, concerning the relationships between TVET institution with external actors, there is a clear difference depending on the type of institution: while ministries/national bodies and universities/research centres reported a better-distributed pattern of relationships with external actors, training centres showed less capacity to get involved with external actors such as applied research institutes, universities, business clusters, and large business enterprises (Figure 6). For example, only two training centres reported having institutes of applied research as their main partners in the development of innovative practices in TVET.

In general, different types of TVET institutions perceived government, small- and medium enterprises and other TVET schools and training providers as their main partners in the development and implementation of innovative practices. This result contradicts the Triple Helix Model: while the theoretical discussions neglect the role of TVET institutions (especially training centres) in macro-level processes of innovation development, TVET institutions show willingness and capacity to engage in different types of partnerships with public and private actors. This scenario suggests a need to better include TVET institutions in theories and models of innovation development.

Figure 6 – Main partners in the development and implementation of innovative practices, by stakeholder types



Innovative practice

Innovative practice: Pivot-Ed and Pivot-Works
Institution: Bow Valley College
Country: Canada

Bow Valley College aims to facilitate and develop a technology ecosystem from which an education innovation cluster can emerge. The ecosystem is structured as a Calgary-based, innovative, collaborative and catalytic partnership between Bow Valley College and well-established industries in the Calgary region. Against this background, the Pivot-Ed and Pivot-Works initiative focuses on creating a new technological platform that will contribute to talent acceleration in the Alberta province and function as an innovation intermediary that draws new technology and entrepreneurship to Calgary from around the world. Furthermore, the project aims to contribute to job creation and economic growth by providing Calgary-based companies, and beyond, with opportunities to develop and market technology solutions for the education sector.

The Pivot-Ed project aims to access the available data provided by the Calgary Economic Development initiative and others to focus on the most pressing skill and talent gaps in Calgary, and to work with companies to identify in-demand skills and required competencies of Calgary's labour force. Furthermore, the project develops scalable solutions to assess and recognize skills, knowledge, and competencies, as well as innovative, competency-based training programmes or modules that are short, focused, validated and directly aligned with what industry partners need. The platform will integrate scalable and automated assessments tools that rely upon artificial intelligence, with bespoke learning solutions that employ virtual and augmented reality, and a blockchain system for managing academic and non-academic credentials.

The Pivot-Works component involves Bow Valley College helping entrepreneurs to innovate and grow by supporting them to develop and deploy technology solutions. Through the Pivot-Works initiative, the college identifies problems to be solved that have lucrative commercial potential, identifies suitable companies, and trains the required talent.

The Pivot-Ed and Pivot-Works initiatives represent a disruption in the continuing education sector and aims to reinvent how continuing education is developed, delivered and credentialed, not only at Bow Valley College, but also at other post-secondary institutions across Canada. The enabling technology developed can be broadly applied across the adult education market and other economic sectors.

Additonal information can be found at https://bowvalleycollege.ca/teaching-and-research/pivot-ed

Innovative practice

Innovative practice: FADIO
Institution: Cegep de la Gaspésie et des Iles
Country: Canada

Eastern Quebec is characterized by its large size and low population density and these factors increase the challenges to ensuring that training is accessible throughout the territory. As a consequence, distance training is expected to flourish. FADIO (Formation à distance interordres) is an innovative and inter-regional project in distance education initiated to respond to the challenge of accessibility to training in Canada.

FADIO is based on a major supra-regional partnership. It brings together fifteen institutions that have decided to join forces and agree to share their expertise and costs to make their platforms compatible to provide quality distance education. The project also aims to raise awareness among their staff to the benefits of providing distance education and train their staff in a community of practice. While the competition between educational institutions is no longer limited to one region, the FADIO project also aims to enable the institutions to be recognized as innovative and successful, and to position themselves as leaders in distance learning.

In FADIO, each TVET institution has an action plan and a committee. Their composition varies according to the resources available. Having said this, each committee consists of at least one manager, one teaching resource, one technical resource and one liaison officer who monitors projects with other institutions. Every two years, each institution presents their development during the FADIO Partners Meeting, where about forty workshops are presented with more than 200 participants including TVET managers, teachers, educational consultants and computer resource experts.

Additional information can be found at the FADIO YouTube channel: https://www.youtube.com/channel/UCKYehqjEHfPPO8hmzSyhJGA/videos

Teaching and learning processes

The range of activities deployed by TVET institutions as part of innovations in teaching and learning process includes mainly pedagogical activities with the objective to enhance the quality of TVET. New pedagogical practices are the core element of innovations in teaching and learning processes, understood as combinations of specific approaches and techniques that aim to improve effectiveness, equity and delivery.

In this section, the focus mainly lies on practices at the classroom level that can improve the development of skills and effectiveness of learning outcomes. Recent TVET policies have focused their efforts on the development of new TVET curricula, occupational standards and stakeholder consultations, with little attention given to how teachers will deliver TVET curricula (Pavlova and Chen, 2019). This section presents new types of pedagogical approaches and discusses the use of information and communications technologies (ICTs) and the implementation of entrepreneurial education in TVET.

Innovative teaching pedagogies and instructional practices

A number of examples of innovation in teaching pedagogies and instructional practices can be found in TVET literature. For instance, pedagogy for education for sustainable development (ESD) aims to enable all human beings to acquire the knowledge, skills, attitudes and values necessary to shape a sustainable future (Leicht et al., 2018). This includes introducing key sustainable development issues into teaching and learning, for example, climate change, disaster risk reduction, biodiversity, poverty reduction and sustainable consumption. The introduction of these topics should aim to capacitate and motivate learners to consider sustainability issues and search for solutions and innovations. ESD also

requires participatory teaching and learning methods that motivate and empower learners to change their behaviour and take actions for sustainable development.

Research on the pedagogy behind ESD argues that traditional methods of academic instruction, such as lecture-driven delivery, have inadequately equipped students with the required competencies to make the transition from the classroom to real world problem-solving (Steinemann, 2003; Seatter and Ceulemans, 2017). Against this background, innovative pedagogical approaches which aim to bring real-world learning opportunities into the classroom and encourage critical thinking, social critique, and analysis of local contexts, are needed.

Problem-based learning aims to involve students in the solving of complex issues using an interdisciplinary approach (Steinemann, 2003). Project-based learning links knowledge application with project practice, helping students to consolidate and broaden their understanding, and providing students the opportunity to develop communication, problem-solving and team-working skills (Elshorbagy and Schönwetter, 2002). The two approaches can also be integrated while implementing innovative pedagogic practices. The problem- and project-based learning approaches both aim to formulate solutions through group projects. In these settings, learning shifts from passive to active, whereby students investigate real-world problems and work on solutions/options by engaging in small-group work (Brundiers and Wiek, 2013). The basic principles of these approaches can be summarized as:

- Student-centred and able to motivate and commit students
- Problem-oriented and not subject-oriented
- Focus is on the learning process and finding solutions rather than knowledge recall
- Project-based which involves goals and actions for change
- Exemplarity instead of generality
- Promotes group/team work, social and communication skills (Yasin and Rahman, 2011)

Other commonly used or suggested pedagogical strategies in ESD include (Pavlova and Chen, 2019):

- Role plays and simulations (to gain an in-depth understanding of other people's perspectives)
- Stimulus activities (e.g. watching videos or looking at photos, poems or newspaper extracts to initiate reflection or discussion)
- Debates (to encourage the development of arguments and counter-arguments on a topic)
- Critical incidents (to consider students' personal perspectives and actions in relation to a moral or ethical stance – what they would do, could do and should do)
- Case studies (to develop a holistic view on an issue relevant to their context and to devise a solution)
- Reflexive accounts (to understand the effect of an individual's action on issues/solutions)
- Critical reading and writing (to understand possible motivations of the author and how the author might envisage alternative futures as a consequence)
- Fieldwork and outdoor learning (to link theory and real-world examples, promote active learning and develop the understanding of the complexity of sustainability)
- Modelling good practices (to demonstrate action-taking behaviour such as reducing paper use, turning off lights at the end of the class) (Cotton and Winter, 2010; Tilbury, 2011)

Research on the outcomes of new learning approaches and pedagogical change in TVET in fifteen EU Member States shows significant benefits (Cedefop, 2015). Usually, learner-centred pedagogies are associated with higher levels of student engagement. There are also significant correlations between specific teaching and learning practices (such as group work and interactive learning tasks linked to the future occupation) and learner satisfaction, perceptions of achievement, progression, motivation and likelihood of dropout. Pedagogical dimensions are strongly associated with specific benefits for learners.

However, there is a significant gap between the literature on pedagogical approaches and pedagogical practices in the context of TVET. According to Cedefop (2015):

> 'Too often, learner-centred pedagogies have been advocated, but implementation has not taken place or has not been judged as successful. Barriers to implementation vary and may concern the culture of teachers and schools such as pressure of work, habit and lack of confidence.'

The research collected rich evidence on the innovative pedagogic practices in TVET, allowing the formulation of policy considerations for strengthening the use of learner-centred vocational pedagogies in TVET. These are summarized in the following points (Cedefop, 2015):

- Vocational pedagogy needs to be better integrated into TVET policies including curriculum development, allocation of funding, professional status of teachers, quality assurance and stakeholder involvement
- Top-down and bottom-up drivers of pedagogical change need to be coordinated, for example, curriculum reform and education investment should be informed by pedagogical opportunities. School-based continuous professional development should be informed by national level research and policies

- Curricula have to be designed in a manner to support effective vocational pedagogy
- Teachers and trainers need support through professional development programmes, collaboration with their peers and guidance from their managers to be able to contribute effectively to the design and delivery of local curricula
- Monitoring, evaluation and quality assurance systems are required to guide innovation in pedagogy and professional development at national and institutional levels
- Innovation, investment and collaboration are required to ensure that learning environments and materials are developed and deployed to support all dimensions of learner-centred vocational pedagogy
- Multidimensional approaches to learner-centred pedagogy should be supported by further research, through resource development and professional development

Innovative practice

Innovative practice: School-in-a factory model and the integrated technical education cluster
Institution: Ministry of Education
Country: Egypt

High unemployment, especially youth unemployment, is one of Egypt's most pressing problems. The reasons for this are, among others, rapid population growth, macro-economic problems, inadequate job placement services and a lack of job-market relevance in education and training. In this context, the Egypt Skills Development Vision 2030 for TVET focuses on promoting work-based learning and demand-driven TVET where employers play a key role in. Among other initiatives, the newly developed work-based schools (school-in-a factory model) and the integrated technical education cluster are shifting TVET curricula towards a full competency-based approach that includes acquisition of 21st century skills (e.g. critical thinking, communication and technology literacy) and entrepreneurship education. Both strategies aim to ensure lifelong learning opportunities and quality TVET for all, with a specific focus on girls and women and persons with disabilities.

This school-in-a-factory model requires protocols and collaboration between the Ministry of Education and companies to establish joint schools in the premises (factories or farms) of the cooperating company or as a part of the company-training centre. Although this type of work-based learning model started in 1972 with a limited number of public sector companies, the private sector involvement was introduced in 2008. By 2012, twelve private companies had engaged in the model. In 2017, there were around fifty schools in factories teaching around 8,000 learners.

The integrated technical education cluster aims to promote cooperation between private TVET institutions and the public ones. It provides advanced education services, training and advanced technological guidance with the highest level of quality that fulfils the needs of the labour market. The cluster features a pioneer model for technical education serving different industrial engineering sectors, high quality labs and workshops to enrich the education and training process and faculty staff qualified according to international standards. An integrated innovation and entrepreneurship curriculum developed with international organizations is planned to be offered to all TVET students starting in the 2019-2020 school year.

Additional information can be found at http://www.unesco.org/new/fileadmin/MULTIMEDIA/FIELD/Beirut/images/Education/Egypt.pdf

Use of ICTs in TVET

The implementation of ICT in TVET has been given great relevance in international debates. The recent Qingdao Declaration (UNESCO, 2015), an outcome of the International Conference on ICT and Post-2015 Education in Qingdao, China, set out a collective understanding on how to use ICTs to achieve the educational targets for equity, access, quality and lifelong learning in the Sustainable Development Goals.

The use of ICTs is essential for the development of innovation in TVET. First, innovations in the use of ICT in TVET are seen as important tools for increasing access and enhancing the effectiveness and quality of education provided by the TVET sector. For this reason, the Qingdao Declaration encourages governments, industry partners and all other education stakeholders to join forces and share resources in order to create equitable, dynamic, accountable and sustainable learner-centred digital learning ecosystems. Second, innovations in the use of ICTs in TVET can help learners to familiarize themselves with cutting-edge technology being used in different economic sectors to provide innovative products and services, as well as develop the technical skills necessary in modern processes of innovation development and implementation.

The fact that ICT applications are available for teaching and learning is well established and examples of how ICT can enhance access to quality TVET programmes include:

- **Distance education** is now virtually synonymous with e-Learning or online learning. ICT appliances have great storage, retrieval, transmission and processing capacity. They offer rich virtual environments and their interactive capacities enable learner-teacher and learner-learner interaction and collaborative learning
- **Open learning** uses methods and technologies of distance education but emphasizes the idea of open access to knowledge that is crucial for a free and open society
- **Blended learning** combines face-to-face teaching or activity-based learning in different settings (e.g. classroom, community and the workplace) and computer-based or online learning
- **Flexible learning** enables learners to control where, when and how they should develop their study, according to their needs and circumstances
- **Mobile learning** is delivered to anywhere that has a mobile signal. The fact that an increasing amount of people have access to mobile devices is changing the way people live and learn
- **Open educational resources and Open courseware** are teaching and learning materials, course modules and courses in digital formats that are placed in the public domain or online and are openly licensed. These resources are 'developed in any medium - digital or otherwise - that reside in the public domain or have been released under an open license that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions' (Paris OER Declaration, 2012)[6]
- **Massive open online courses** are open educational resources and open courseware accessible online and designed for the unlimited participation of learners worldwide. In addition to online resources, many also provide interactive courses with user forums to support community interactions among students and teachers, as well as other feedback mechanisms
- **Virtual reality** enables learning from 3D models of machines and equipment in safe, more convenient and better-controlled environments
- **ICT-based simulations, games and role plays** are used to model certain situations and enable learners to learn by trial and error and conduct experiments
- **3D printing technology** enables learners to download and develop 3D digital designs, print them out and remake if necessary
- Technologies such as **augmented reality** and **artificial intelligence** are expected to have a great impact on teaching and learning practices in TVET. For example, augmented reality can easily provide access to digital information, designs and prototypes from learners' tablets and smartphones. Artificial intelligence is currently being used in education in the form of customizable content through adaptive learning programmes and software, tracking and monitoring diagnostics, automation of grading and even AI tutors

During the virtual conference, participants stated that innovations in the use of ICT in TVET can be seen as tools for increasing access to TVET and enhancing the effectiveness and quality of education and training. The development and integration of ICTs into TVET have been facilitated in previous years because ICT tools become increasingly accessible and interactive. However, digital transformation in society and at the workplace requires corresponding changes in TVET teaching and learning. There is a common understanding that learning in TVET is less likely to improve if the use of ICTs is still based on traditional methods. What is required today are approaches which enhance the interaction between TVET teachers and learners and provide opportunities for TVET learners to experience life-like situations. Participants also highlighted different initiatives and tools available to support the use of ICTs in TVET.

6 https://unevoc.unesco.org/up/OER-in-TVET.pdf

Initiatives and tools available to support the use of ICTs in TVET:

UNESCO's Competency Framework for Teachers
https://unesdoc.unesco.org/ark:/48223/pf0000265721

The *SAMR* model
https://www.schoology.com/blog/samr-model-practical-guide-edtech-integration

Four C's of 21st-century learning
http://www.battelleforkids.org/networks/p21/frameworks-resources

Open Educational Resources in TVET
https://unevoc.unesco.org/up/OER-in-TVET.pdf

List of OER resources for TVET
https://unevoc.unesco.org/go.php?q=Open+Educational+Resources+in+TVET

the SELFIE tool created by the European Commission
https://ec.europa.eu/education/schools-go-digital_en

Innovative practice

Innovative practice: Livecanvas
Institution: Hälsingland Education Association
Country: Sweden

The Halsingland Education Association (HEA) is a public and regional non-commercial collaboration between three municipalities in the county of Hälsingland (Bollnäs, Söderhamn and Nordanstig). In the HEA, the municipalities cooperate on education and training on various levels, from the secondary level to adult education, post-secondary TVET and higher education. The municipalities within HEA organize education and vocational training for about 5000 students per year. HEA makes it possible for the municipalities to offer a broad spectrum of courses that each municipality by itself would not be able to offer due to financial reasons. Since 2015, the municipalities have participated in numerous projects funded by the European Union and the European Social Fund related to lifelong learning in rural areas.

The LiveCanvas project of the HEA develops learning content and digital tools to foster the acquisition of entrepreneurial skills of geographically disadvantaged adults by bridging digital storytelling and business modelling. The skills for understanding the enterprise business model is vital especially for people living in geographically isolated regions and rural areas, where the difficulties of creating a viable business are often more complex than for other entrepreneurs. The project was concluded in 2018 and included activities such as training material development, rural entrepreneurs' business model exploration, and planning and testing of training programmes for setting up innovative businesses and the development of transversal skills for sustainable enterprises.

In Sweden, the project reported an increment in the capacity of people to develop entrepreneurial activities, and especially an improvement of entrepreneurial and language skills of immigrants interested in starting up businesses. Furthermore, the project also led to the implementation of different rural entrepreneurial practices and their use as training tools, training programmes, methods and materials. The project also developed an online learning space that provides a high-quality learning environment for entrepreneurs, start-ups and unemployed adults in rural and isolated areas, and thus promoting and supporting equality and inclusion in the learning process. Finally, the project also produced a set of recommendations containing the feedback of the pilot sessions, adaptations, suggestions for practical use of the LiveCanvas learning results.

Additional information can be found at http://live-canvas.eu/

Innovative practice

Innovative practice: Mega Model Skill Academy
Institution: Skills Development Institute
Country: India

In line with the Government of India's objective of reducing the gap between demand and supply of skilled manpower, the Skill Development Institute (SDI) of Bhubaneswar is the first skills academy set-up in the hydrocarbon sector tasked with empowering young Indians with internationally accepted job-specific skill sets. The SDI Bhubaneswar is supported by the public oil sector and managed by the Indian Oil Corporation Limited, under the aegis of Ministry of Petroleum and Natural Gas.

The SDI Bhubaneswar is a research and technology hub that aims to develop and promote sustainable livelihood in the tribal areas through entrepreneurship and upskilling, creating a pool of skilled youth with the right skills in trades related to hydrocarbons and local industries. The SDI Bhubaneswar's Mega Model Skill Academy is a one-of-its-kind model skills academy that includes courses on industry 4.0 and the use of immersive technologies. The 46,000 acres campus will also have incubation and entrepreneurship centres, as well as residential facilities for staff and students, including a world-class sports complex and language labs. The campus is also designed to achieve higher green and sustainability standards. For example, the use of solar energy will meet almost twenty per cent of the overall power requirement. The academy will offer courses in industrial welding, industrial electrical work, fitter fabrication, and Solar PV installation. Additionally, the SDI Bhubaneswar will offer a three-month non-residential programme on computer data applications exclusively to female candidates.

The academy aims to have 50,000 students in the next few years. Furthermore, a Memorandum of Understanding was signed between the SDI Bhubaneswar and three industries to support with the establishment of a Centre of Excellence. Further Memorandums were signed with stakeholders to implement the training according to the dual system.

Additional information can be found at https://www.sdibhubaneswar.in/upcoming-mega-campus/

Entrepreneurship education

Entrepreneurship education can be defined as a method whereby students practice creating, finding and acting on opportunities of creating value (Neck, Brush and Greene, 2014). Entrepreneurship education in a school generally consists of a nested set of activities, including in the normal curriculum, co-curricular activities and research efforts. Entrepreneurial learning might cover issues such as generating innovative business ideas, business and strategic planning, finance, marketing, and the use of ICTs to achieve better business results.

The literature on entrepreneurship in TVET has benefited vastly from the development and implementation of new initiatives.

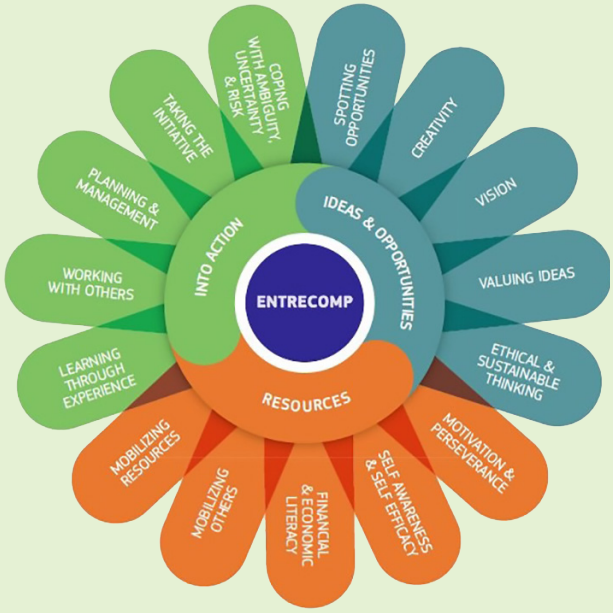
According to a study developed by the World Innovation Summit for Education, entrepreneurship education also varies across different audiences:

> For instance, programmes focused on youth (primary and secondary school) may focus on the desirability and feasibility of business start-ups in order to influence the students' intentions. At the college or university levels, the programme may focus more on skills and competencies associated with developing venture ideas, pathways into entrepreneurship, market testing and building a business model. In the community college and local training area, curricula might focus on ways to launch a small firm, become self-employed or to buy a franchise (World Innovation Summit for Education, 2017).

The European Commission's publication on Entrepreneurship education: A road to success[7] compiles evidence on the impact of entrepreneurship education strategies and measures. According to the study, entrepreneurship education in Europe is not only supporting higher rates of start-ups and creating successful ventures. Entrepreneurship education in Europe also shows several impacts at the individual level, such as boosting career ambitions, higher employability, entrepreneurial skills and attitudes and protecting individuals against social exclusion. The study also found that entrepreneurship education has relevant impact at the institutional level, such as a stronger entrepreneurial culture as well as higher engagement from teachers and other stakeholders (European Commission, 2015). After reviewing policies for entrepreneurship education and their outcomes, the study was able to draw some important policy lessons:

- The effects of entrepreneurship education accumulate over time and are higher when students make several consecutive entrepreneurial learning experiences
- Training on entrepreneurship should be tailored to age groups and educational sectors. One size (training) does not fit all. Approaches to entrepreneurship education need to be adjusted to age groups, subjects and educational sectors
- Entrepreneurial training programmes are gender-sensitive. Evidence suggests that male students often benefit more from 'conventional' training programmes than female students
- Entrepreneurship is taught best through methods that include learning under real-life conditions
- Teachers are key actors. Students become inspired by role models such as teachers and mentors. Awareness-raising activities for teachers need to be followed up by tailored training offers
- Institutional change towards entrepreneurial education is most effective when both management and teaching staff are 'on-board'
- To fully achieve economic impact, entrepreneurship education should be embedded in a conducive ecosystem. Students' entrepreneurial intentions will be more sustainable if entrepreneurship education is complemented by guidance, access to funding, business networks, etc. that support their plans and ideas
- Networking and mentoring are important means of support
- Support and guidance is of crucial importance, especially in the initial stage
- Entrepreneurship education should be an indicator that is part of schools' and universities' official quality assurance procedures

Learn more



EntreComp is a comprehensive, flexible and multi-purpose reference framework designed to help institutions understand what is meant by entrepreneurship as a key competence for lifelong learning and to be able to use this in their work. It intendeds to support and inspire actions to improve the entrepreneurial capacity of European citizens and organizations and was launched in 2016 as part of the New Skills Agenda for Europe. EntreComp creates a shared understanding of the knowledge, skills and attitudes that make up what it means to be entrepreneurial – discovering and acting upon opportunities and ideas, and transforming them.

See more in: http://publications.jrc.ec.europa.eu/repository/bitstream/JRC109128/jrc109128_entrecomp_into_action_-_final.pdf

7 http://ec.europa.eu/growth/content/entrepreneurship-education-road-success-0_en

Innovative practice

Innovative practice: Entrepreneurial Desks and Centres
Institution: Durban University of Technology
Country: South Africa

The Durban University of Technology's Strategic Plan for 2015-2019 focuses on promoting excellence in learning and teaching, technology transfer, applied research, and collaboration and partnership with external actors that promote innovation and entrepreneurship. Along this line, in March 2018 the university established the Midlands Entrepreneurship Centre and Student Desk (MEC), a newly established department under the Office of Research, Innovation and Engagement. The MEC offers both theoretical and technical entrepreneurial learning support and activities to students based in Midlands, the neighbouring community and local entrepreneurs. It aspires to become a Centre of Excellence that produces entrepreneurs and business leaders who build striving and sustainable enterprises by focusing on technology, food processing and arts sectors. The MEC provides students with support, mentorship, and helps connect/match them with appropriate industrial or corporate partners.

For example, 'Classic Food' is one of the successful businesses setup by students from the MEC. The company is specialized in processing fruits and vegetables using organic preservatives. It aims to serve pure, healthy and long-lasting food that is free from artificial preservatives. The company invests in the community by buying directly from excelling local farmers, and by packaging the products in a sustainable manner. By working with local communities, the Durban University of Technology helps to increase both youth and adults' skills and helps the institution to respond to the needs of the region. The DUT Midlands Entrepreneurship Centre and Student Desk is now an important part of the regional skills ecosystem, with increasing support from other institutions in the region.

Additional information can be found at https://www.dut.ac.za/mec/mildlands-entrepreneurship-centre-our-offerings/

Products and services offered by TVET

This dimension refers to the development and provision of products and services (e.g. skills development, applied research and consultancy) to external actors such as students, companies and governments. Literature shows that there are different types of services and products provided by TVET systems, networks and schools that can enhance the regional and national capacity to generate and implement innovative practices, creating value and benefits for external actors.

The types of products and services offered by TVET can be divided into traditional and non-traditional activities. Traditional products and services are, for example, the different types of courses a TVET institutions offers as part of its normal curriculum. Its main objective is to equip the workforce with relevant skills through training. Non-traditional products and services include new types of offerings related to technology diffusion and the development of applied research.

Learn more

Technology diffusion involves the dissemination of technical information and know-how and the subsequent adoption of new technologies and techniques by users…In many cases, diffused technologies are neither new nor necessarily advanced, although they are often new to the user (Shapira and Rosenfeld, 1996).

Innovative practice

Innovative practice: Educational computer programmes for children with autism
Institution: Federal Institute of Alagoas
Country: Brazil

Autism, or autism spectrum disorder, refers to a broad range of conditions characterized by challenges with social skills, repetitive behaviours, speech and nonverbal communication. For many people on the autism spectrum, access to affordable assistive technologies is a prerequisite to being able to exercise their basic human rights and to participate fully in the lives of their communities. Assistive technology, such as mobile apps, can be tailored for use and training, reducing or eliminating barriers to the participation of autistic people in education.

The Federal Institute of Alagoas in Brazil develops a series of computer programs designed for children with autism in partnership with the Association of Friends of the Autism of Alagoas. The software and applications are based on the idea that autistic individuals are visual learners. With the goal of assisting the learning process of children with autism through fun activities, the researchers develop the software and application using the Treatment and Education of Autistic and Communication Handicapped Children (TEACCH), a method developed in the late 1970s at the University of North Carolina.

The Federal Institute of Alagoas produced four new applications available for download from the App Store or Play Store: ABC Autism Animals, 123 Autism, ABC Autism Fruits, and ABC Autism Transportation. Each app has four difficulty levels, forty interactive phases, and are translated into five languages (Portuguese, English, Spanish, Italian and French). By 2019, the apps have been downloaded more than 100,000 times worldwide.

Technology diffusion and applied research are ways in which TVET can and should serve as a catalyst and leader in resolving practical issues. In the case of Australia, recent work done by the Australian National Centre for Vocational Education Research (NCVER) shows that TVET institutions can act as an intermediary between companies and services to enhance technology transfer and information exchange. A simple example can be found in the initiatives of TVET teachers and managers to promote the use of schools as venues for vendors of equipment and software to demonstrate their wares to local business, helping to create bridges between companies, TVET institutions and students. Another example refers to TVET institutions providing technical expertise to small- and medium-sized enterprises. These types of non-traditional products and services seem to be more important in regions without universities or other public science and research agencies because these regions often present a gap of capacity in developing research and transferring knowledge and technology. These activities are especially vital for small- and medium-sized employers that lack the capacities and connections to effectively adapt to commercially available technologies and proven innovations (Toner, 2005).

While diffusing technology and developing applied research, TVET centres act as comprehensive mechanisms of innovation development, which is similar to the concept of entrepreneurial community colleges (Grubb et al., 1997). Entrepreneurial community colleges have three specific functions: two of these (workforce and economic development) focus on economic and occupational goals, while community development addresses a broad variety of social, cultural and egalitarian objectives. Workforce development refers to the provision of education and training by adapting traditional schedules or content to the needs of local employers. Economic development refers to a vast range of activities such as organizing industry clusters, transferring technology to small- and medium-sized companies, developing applied research, fostering local business leadership, scanning the economic environment, participating in local economic policy-making and attracting employers to a local region. Finally, community development refers to the promotion of the local community well-being in political, social, or cultural areas.

The College and Community Innovation Programme (CCIP) in Canada is a good example of how TVET contributes to the development of innovation. Within the framework of the programme, colleges and institutes play a leading role in strengthening regional capacity to innovate and work with industry partners to enhance competitiveness in the sectors and communities they serve. The focus is on enhancing the capacity of TVET stakeholders to develop applied research projects with industry partners (especially small- and medium-sized businesses), to provide market-ready solutions, and to improve in technologies, processes, products and services. According to official data for 2017, colleges and institutes in Canada led over 7,300 research partnerships that developed more than 1400 new prototypes, 700 new products, 500 new processes and 350 new services (CICan, 2018).

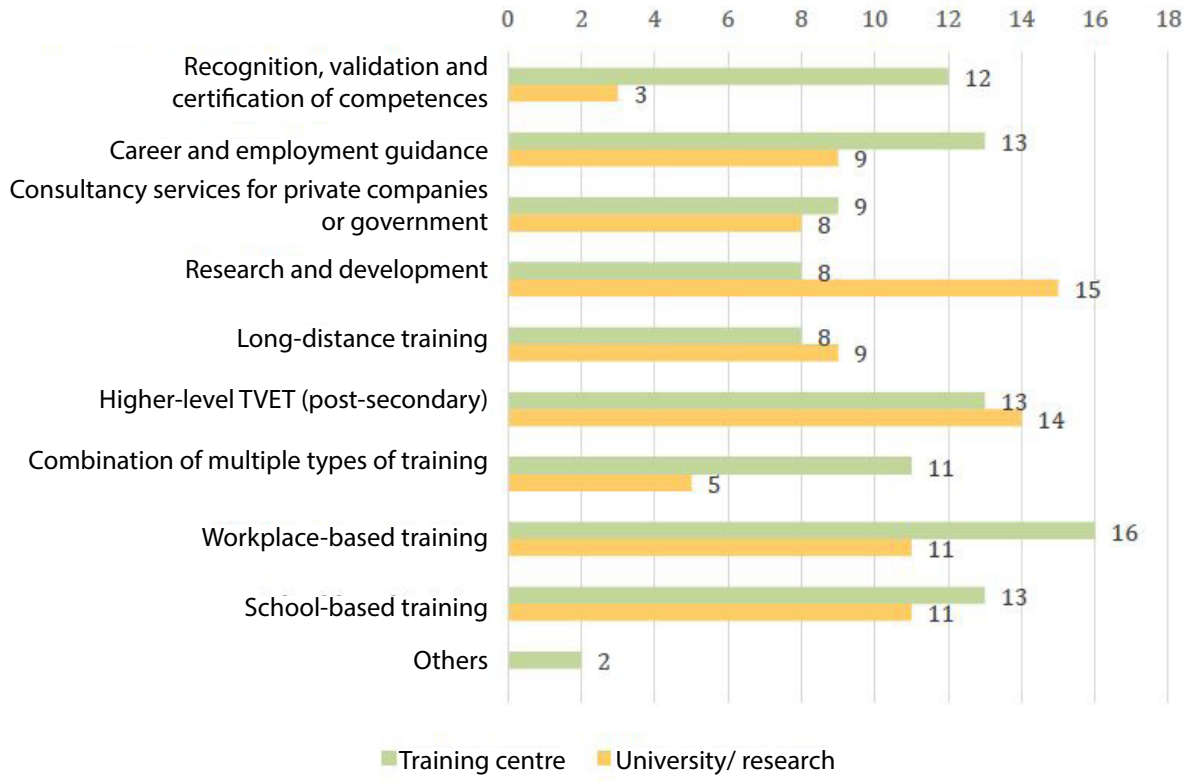
The study questionnaire shows that different types of TVET institutions different products and services such as post-secondary TVET, school-based training, long-distance learning and consultancy services (Figure 7). On the one hand, the results show that training centres have a greater focus on recognizing competences, offering career guidance and workplace-based training. On the other hand, many universities and research centres reported offering research and development as the main service.

Learn more

Denise Amyot, President and CEO of Colleges and Institutes Canada, presented on some examples of non-traditional services in the Canadian TVET system during the virtual conference. Please find the video here: https://youtu.be/dqCyzNtWqpQ

The results show that while training centres still focus more on providing solutions in terms of skills development, universities and research centres are more capable of providing a mix of skills development solutions and applied research. Having said this, training centres and schools in some regions are showing capacity for providing research and development services. The results show that expanding the scope of products and services offered by TVET institutions can enhance the impact of TVET institutions in their local and national skills and innovation ecosystems.

Figure 7 – Products and services provided by TVET institutions, by stakeholder types



Innovative practice

Innovative practice: Green Wheels – Operation, repair and service oh hybrid and electric cars
Institution/Country: European Union wide project

In 2016, there was no Europe-wide TVET curricula to teach repairing and servicing hybrid and electric vehicles. The EU also identified that TVET schools usually lacked electric vehicles for the use in training and that few teachers were prepared, which meant that teaching methods in these schools were outdated and many of the graduates of these schools lacked the basic knowledge needed.

With the mission to enhance the continuing development of TVET in Czech Republic, the National Institute for Education works together with the European Union to implement the Green Wheels project, financed by the Erasmus+ initiative. The project aims to significantly upgrade the curricula of schools and improve the teaching quality in TVET schools in the area of hybrid and electric vehicles.

The project aims to create open learning materials that use innovative teaching and learning methods and approaches such as critical thinking, inquiry-based learning, collaborative learning, flipped classrooms and peer instructions. The project focuses on improving and enriching teaching methodologies through extensive teacher trainings and mentoring, , and develops new curricula. Professional associations and key car industry players are actively involved in the project, providing feedback to the learning materials, and ensuring that the materials include state-of-art technologies and approaches.

The outcomes of the Green Wheels project have been translated into project partner countries' national languages (Slovakia, Hungary and the United Kingdom), and have been pilot-tested in partner schools. Some of these materials include worksheets for students, educational videos, teaching methodology, methodological guidelines and instructions for working with worksheets and videos. Other results attained included the development of a complex online learning management system, e-learning modules, an online picture-based explanatory dictionary in all project partner languages, blended learning resources, as well as the European Credit System for Vocational Education and Training (ECVET) in the automotive industry of hybrid and electric vehicles prepared for use in all project countries.

Additional information can be found at http://www.gwproject.eu/

Innovative practice

Innovative practice: Innovation Hub of Campos dos Goytacazes
Institution: Federal Institute Fluminense
Country: Brazil

TVET institutions in Brazil are introducing innovative practices with the objective of enhancing external relationships with companies, government and other important stakeholders. These changes aim to create a stronger and more supportive sense of community between TVET institutions and different stakeholders. The Federal TVET network and the National Service for Industrial Training are crucial actors in the development of a recent innovation policy that focuses on initiating the Brazilian Association for Research and Industrial Innovation – EMBRAPII. The association operates through a cooperation between scientific and technological research institutions, such as public or private innovation hubs, focusing on the business demands and risk-sharing in innovation. EMBRAPII supports the financing, accrediting and supervising of activities related to research, development and innovation carried out by all innovation hubs.

The implementation of this model depends on a vast network of organizations and partnership. It includes: (i) relationships with different business sectors, Chambers of Commerce and industry with the aim to promote the TVET innovation hubs; (ii) partnerships with the Brazilian Service of Support to Micro and Small Enterprises (SEBRAE) in order to promote entrepreneurship and business incubators; (iii) external consultancy from the Fraunhofer Society, the largest applied research institution in Europe; (iv) creation of new complementary financing mechanisms with the support of public financing agencies; (v) collaborative projects with other innovation hubs; (vi) supervision and evaluation from Federal Ministries; and (vii) dialogue with the community with aims to increase the possibility of finding innovative, practical, and inexpensive solutions to the issues at hand.

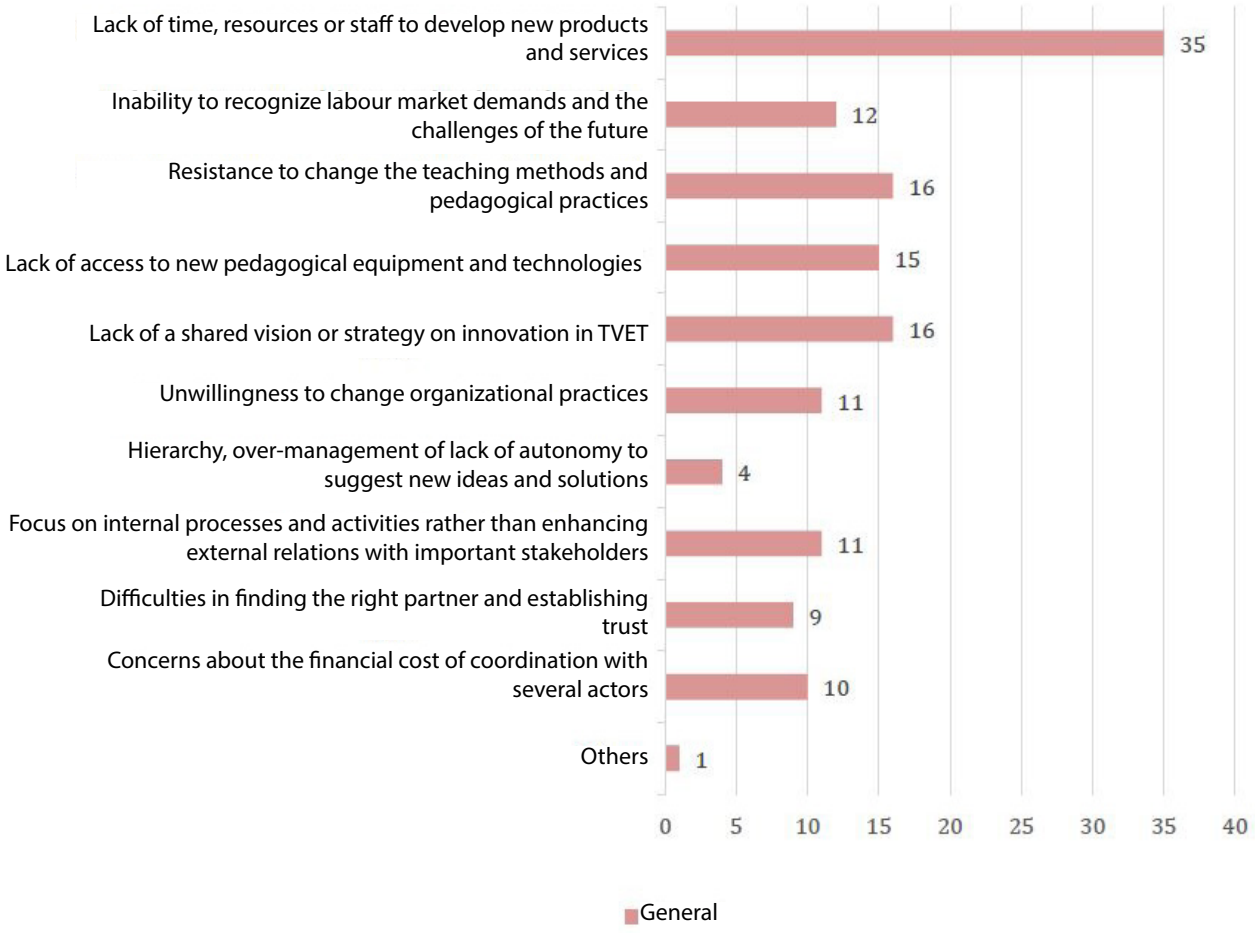
By 2018, EMBRAPII has accredited nine innovation hubs, including the Innovation Hub of Campos dos Goytacazes. The innovation hub has done considerable research and projects in the environmental sector, with a focus on renewable energy. Its projects range from partnerships with low-income communities, such as family farmers, to the development of innovative projects with engineering companies. The technology developed with companies allows for the application of low-cost solutions that can be implemented in low-income communities. For each project, a considerable amount of time is spent laying the groundwork in terms of teaching the basics to the community, identifying leaders and local socio-economic tendencies, and sensitizing the project team to develop suitable solutions for the specific cultural context. Since its establishment, approximately 575 people were directly trained within three years of operation, including in the thirteen EMBRAPII projects executed and two dozen of other research projects.

Additional information can be found at: https://embrapii.org.br/wp-content/images/2018/11/FAQ-EMBRAPII-English-Version.pdf

Barriers to the development and implementation of innovative practices in TVET

While internal and external barriers to innovation should be considered when overcoming obstacles, the study survey put the spotlight on internal hurdles. Survey respondents were able to choose a maximum of three internal barriers. The survey shows that most TVET institutions reported that the lack of time, resources or staff as their main barrier to developing innovative practices in TVET (Figure 8). Secondary barriers include internal resistance to change teaching methods and pedagogical practices, the lack of access to new pedagogical equipment and technologies, and the lack of a shared vision or strategy on innovation in TVET. Participants from the virtual conference also suggested that a significant part of the barriers to innovation in TVET comes from their internal resistance, including the resistance from TVET managers, teachers and students to adopt new learning approaches.

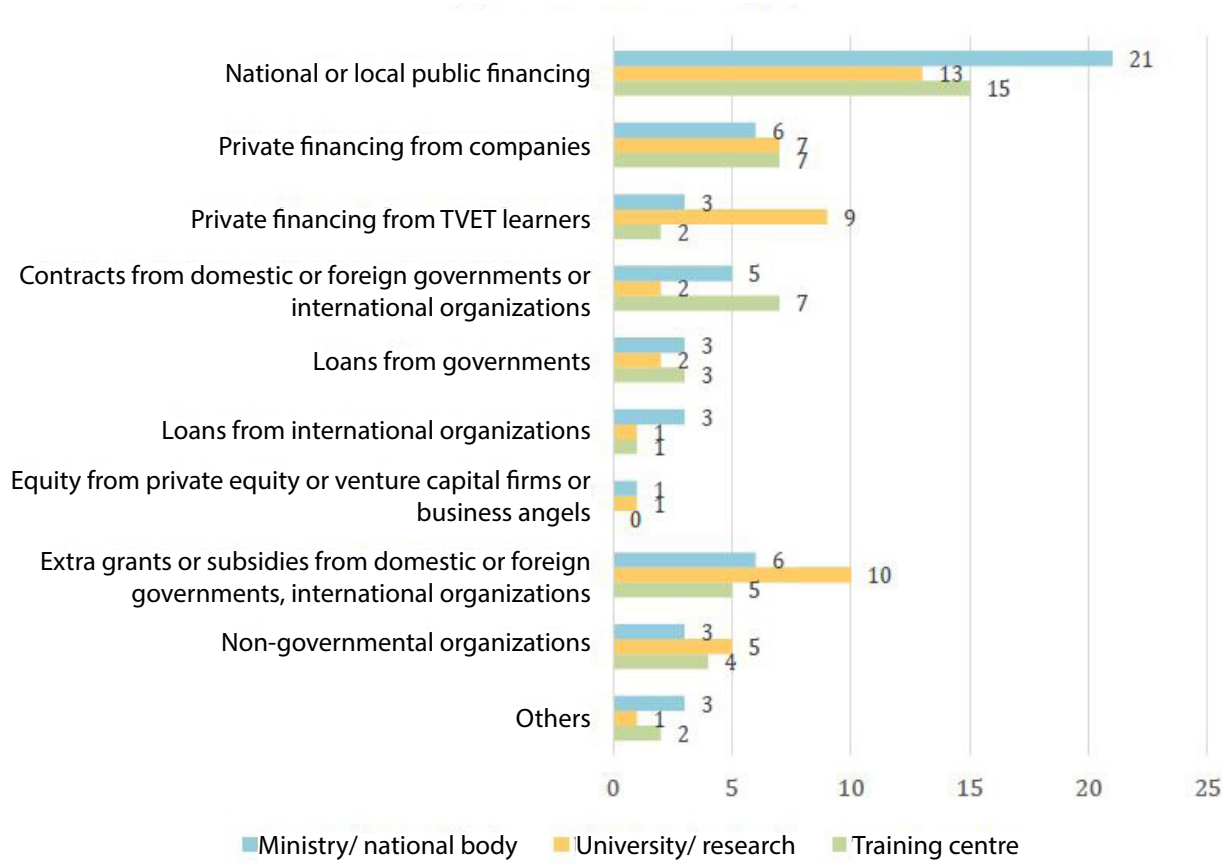
Figure 8 – Main barriers to the development and implementation of innovative practices



The focus on the lack of time, resources or staff can be further explained by the different types of funding mechanisms used by TVET institutions to support innovation in TVET. The results of the questionnaire show that most of the TVET institutions depend on national and local public funding to support innovative practices in TVET (Figure 9). Once again, the differences between the three types of TVET institutions deserve to be highlighted. For example, while less than one-third of the training centres reported using non-public funding structures, more than fifty per cent of the universities and research centres reported using other financing mechanisms, such as private funding from students and extra grants or subsidies from domestic, foreign governments or international organizations.

It is even more important to highlight the low level of the use of other types of funding structures. Only two TVET institutions reported financing from private equity or venture capital firms or business angels (independent individuals who provide capital for the development of a business). Few TVET institutions reported the use of loans from governments and international organizations, as well as financing mechanisms from non-governmental organizations. This scenario suggests that TVET stakeholders are lagging behind in terms of access to other funding structures that are crucial to the development of business and social innovation, as well as innovations in the public sector. Therefore, there is a great need for a broader diversification of funding mechanisms to promote innovation in TVET, and for the need to better understand why TVET institutions are lacking capacity to access new funding mechanisms.

Figure 9 – Funding structure for supporting the innovative practices, by stakeholder types



Conclusions and recommendations

The transition to greener economies, the implementation of digital technologies in the world of work, and the emergence of new forms of entrepreneurship, among other things, are changing the way we work and live. These disruptions are driving TVET systems to innovate and improve their capacity to identify future skills demands and to enhance access to these skills.

UNESCO-UNEVOC's trends mapping study on innovation in TVET aimed to improve the understanding and further clarify what innovation means for the TVET community, taking into account the different stages of development they find themselves at and the different geographic, socio-economic and political contexts. With this in mind, the study presented a general framework that helps to analyse the development and implementation of innovative practices in TVET, including in organizational practices, ecosystem engagement, teaching and learning processes, as well as products and services offered by TVET institutions. The study shows TVET systems, networks and schools assume very different roles in systems of innovation. While TVET acts as a mechanism for skills formation and diffusion in some countries, experiences in other countries demonstrate the possibility for TVET to aggregate more activities and act as a comprehensive mechanism of technology diffusion and innovation development, with an intense focus on applied research and the provision of social solutions to economic problems.

While TVET institutions have the potential to play a leading role in local systems of innovation, external and internal barriers often hamper their ability to act as key nodes. Among other internal barriers, the lack of time, resources and staff, resistance to changing teaching methods and pedagogical practices, and the lack of access to new pedagogical equipment and technologies were mentioned as prevailing barriers. Moreover, developing innovation in TVET institutions requires access to financial resources. Here a difference between different types of institutions can be seen: while training centres reported a lack of access to other financial resources than public funding, universities and research centres seem to be experienced in mobilizing additional sources of funding. While the study gives indications about the factors that can promote and hinder the development of innovation in TVET institutions, the scope of the study requires more work to be done in this area. To this extent, UNESCO-UNEVOC's Skills for Innovation (i-hubs) initiative will help delve deeper and unpack the underlying causes.

Based on the analytical framework developed and the results of the trends mapping, this study offers some recommendations on how to stimulate the innovation in TVET from three perspectives:

- **System level:** macro-level issues that are important for developing innovative TVET systems
- **Policy level:** fostering innovation through policy-making
- **Institution level:** supporting the development and implementation of innovation by changing TVET school's management and governance systems

System level

Systems of innovation rely on the involvement and collaboration among different types of actors. For TVET institutions to play a central role in such systems, they need to be able to identify, engage with and foster relationships with the local skills ecosystem. This study showed that while ministries, national bodies, universities and research centres demonstrated a greater capacity to engage with and foster relationships with external actors, training centres showed that they were less able to (or had less experience in) establish relations with other actors such as applied research institutes, universities, business clusters and large business enterprises. Against this, this study recommends that:

- Platforms should be developed to provide opportunities for TVET stakeholders to engage with other actors. For example, this can be in the form of local associations or councils.
- Support mechanisms should be developed to enable TVET actors, especially training centres, to map and assess the actors in their local skills ecosystem and their potential to act as partners in the development and implementation of innovative practices.

Policy level

The development and sustainability of these systems of innovation also needs the development of policies and strategies that support the day-to-day activities. The systematic introduction of entrepreneurship education and business incubators in TVET, leading to higher start-up and successful venture rates, are just a few examples of how policies, plans and strategies are able to foster the development and implementation of innovative practices. TVET policies that put a focus on innovation can enhance the regional and national capacity to generate and implement innovative practices, creating value and benefits for external actors. However, the trends mapping showed that while ministries, national bodies, universities and research centres had various degrees of experience in developing and implementing such plans, training centres lack experience in this field. Against this, this study recommends that:

- In addition to promoting the use of innovative practices in teaching and learning processes and the diversification of products and services, TVET policies, strategies and action plans – especially those of training centres – should also put a focus on internationalization strategies to ensure an efforts are made to engage with the local skills ecosystem.
- TVET policies should support the development of mechanisms which enable the identification of skills demands, the establishment of Labour Market Information Systems, and the development of up-to-date curricula.
- TVET policies and legislation should support the development of entrepreneurship in TVET by, for example, making it legally possible for institutions to establish incubators or income-generating activities with a focus on entrepreneurial learning.

Institutional level

In order for TVET institutions to develop and implement innovative practices, a number of support mechanisms need to be present. The study shows that TVET management practices such as the development of action plans for innovation and the promotion of team-building processes can support the development of innovation, and help to overcome fears and prejudices against changes. It is also important for TVET institutions to consider comprehensive human resource management approaches that go beyond teacher training requirements and programmes in order to build capacity to develop innovative practices. While TVET institutions reported that training and skills development were considered as essential human resource management practices to support the development of innovative practices, other activities such as recruitment, appraisals, and incentives were significantly less considered. Additionally, internal barriers also hamper an institution's capacity to develop and implement innovative practices. Against this, this study recommends that:

- TVET institutions – especially training centres – should develop and implement specific action plans on innovation. The plan should include clear, practical and concrete priority actions to take the innovation process forward. It is also important for action plans to consider different aspects such as the institution's motives and objectives, the promotion of team-building processes, and the development of indicators to identify and measure innovation.
- TVET institutions need to consider different innovative activities for human resource management practices including the development and adoption of employee recruitment standards that focus on innovation skills, appraisals, and incentives for employee performance in suggesting ideas for innovation or in developing innovations, and promotion and career development opportunities. Furthermore, it is necessary to capacitate and motivate leadership teams to pursue innovative practices within their institutions.
- Staff should be given sufficient time and resources to develop innovative teaching and learning processes, including the development of products and services. Moreover, continuing training programmes should ensure that staff have the capacity to deal with such initiatives.
- Training centres should be supported in the identification and accessing of alternate sources of financing to support the development and implementation of innovative practices (where legally possible).
- Training centres are recommended to implement learner-centred pedagogies and methods such as project-based and problem-based learning with aims of enhancing student engagement and ensuring that programmes also help solve real problems in the local community.
- Training centres are recommended to enhance the use of ICT in courses in order to increase accessibility, effectiveness and quality of TVET. This includes the use of distance learning technologies as well as learning and teaching technologies.

What is the UNESCO-UNEVOC i-hubs initiative?

The Skills for Innovation Hubs (i-hubs) initiative is a fifteen-month global project that is part of the 'Developing TVET institutions for entrepreneurship, innovation and sustainability' initiative implemented by UNESCO since 2017. It is led by UNESCO-UNEVOC and supported by the International Vocational Education City (IVEC) China, with contributions from the German Federal Ministry of Education and Research (BMBF) and the Federal Ministry for Economic Cooperation and Development (BMZ).

The i-hubs initiative is being implemented in ten TVET pilot institutions belonging to UNESCO-UNEVOC's global platform, the UNEVOC Network. The project aims to develop a framework that allows institutions to systematize innovation at the institutional level. Specifically, the initiative supports pilot institutions to identify and document innovate practices in organizational practices, institutions' engagement with external stakeholders, learning and teaching processes, and products and services that can inspire other TVET institutions.

To this end, the project aims to co-develop and test the i-hubs Innovation Framework, which comprises of one process, the Guided Self-Assessment (GSA), and two tools:

1. Balanced Scorecard to assess and document, through quantitative and qualitative data, the i-hub's internal readiness to innovate
2. Skills and Innovation Ecosystem Map to assess and document how favorable to innovation the i-hub's ecosystem is

The results captured by the tools support the i-hubs to consolidate the innovative practices they are already carrying out, and to design an Innovation Action Plan. While the former is used to support the i-hub in building the narrative of an innovative practice chosen to inspire other TVET institutions, the latter aimsto tap opportunities for improvement evidenced by the tools.

This toolbox is supported by a digital environment where pilot institutions are able to share their experiences. Pilot institutions were asked to conduct an initial self-assessment to discuss their previous experiences. The results of the initial self-assessment showed a variety of previous experiences and expected outcomes:

Table 3 – Ten institutions of the i-hubs initative

Institution	Previous experiences	Expected outcomes
TKNIKA, Basque Centre of Research and Applied Innovation in VET, Spain	Tknika works as a service of innovation and support to teachers, TVET centres, and companies in the Basque Country. Tknika has experience in implementing entrepreneurship education and services of applied research. For example, the programme IKASENPRESA uses the creation of start-up companies as a learning tool. In 2014, the programme generated more than 1000 student companies. Furthermore, the programme TKGUNE aims to capacitate local TVET centres to provide technological services to SMEs. In 2017-18, the TVET centres provided services to more than 300 companies, with an income of more than 1.000.000 €	In the next years, TKNIKA and the Basque TVET system will undergo numerous changes. TKNIKA will be in charge of coordinating local initiatives related to innovation. TKNIKA expects to change its structure and areas, develop new projects and provide new services, maximizing the institutions potential to innovate.

Institution	Previous experiences	Expected outcomes
Rift Valley Technical Training Institute (RVTTI), Kenya	RVTTI is an International Centre of Excellence in Technical Training and Research. Previous experiences with innovation projects include calls for innovation, the annual RVTTI innovation exhibition and awards, as well as a training workshop for green TVET champions/ leaders.	During the i-hubs project, RVTTI aims to generate knowledge and skills on the Innovation Action Plan and to support the development of innovative practices. Furthermore, RVTTI expects to share and learn from peers, as well as to define indicators to measure performance and assess the impact of innovative practices.
Seychelles Institute of Technology (SIT), Seychelles	SIT is a national TVET leader in empowering learners with quality knowledge, skills, and values to contribute to national economic development. The institution's experience with innovation projects includes partnership with industry to incorporate innovation and research in TVET, and entrepreneurship. One example refers to the development and the use of special plastic tanks with plumbing components to collect rainwater for usage in the local community.	By participating in the i-hubs project, SIT expects to obtain better financial support for the development of innovations from government and business organizations. SIT also expects to realise its potential to provide training to the youth to venture in small businesses, to offer training to officer in the tourism sector and other establishments, and to support the community with small dwellings for those who need it.
Yaba College of Technology, Nigeria.	Yaba College is one of the leading higher educational institutions in Nigeria. It aims to provide first-class academic, professional and entrepreneurial education to students, to empower them to make a positive impact on Nigeria's technological and socio-economic development. Previous experience with innovation projects include the development of technology-enhanced learning (flexible and blended learning), entrepreneurship education, the creation of new industry linkages and partnerships (e.g. IBM West Africa training in ICT courses), as well as the development of sustainable-based projects (e.g. conversion of waste to edible protein).	Yaba college aims to become an institution of excellence in teaching and an influencer in its innovative ecosystem. It aims to engageg more stakeholders/partners and offer opportunities to staff and students. During the i-hubs project, Yaba College expects to build staff capacity to integrate greening and entrepreneurship in the curriculum and in learning resources, explore renewable energy and biomass used to generate electricity, improve the efficient use of resources, and encourage the development of new learning resources.

Institution	Previous experiences	Expected outcomes
Shenzhen Polytechnic (SZPT), China	SZPT is one of the top TVET institutions in China that aims to serve students' career development with interdisciplinary, innovative and technical skills, and support local and state economic and social development. SZPT has significant previous experiences with innovation projects, including in the development of learning processes in partnership with private companies (e.g. the Huawei School of Network Technology and the Alibaba School of Digital Commerce), the establishment of five research institutes on modern advanced technology, and the development of education. One interesting example refers to the student innovation associations, where member students interact in weekly training offered by former students, and are encouraged to attend technology-based competitions with the guidance of teachers.	In the next years, SZPT expects to obtain professional and systematic guidance on the design, approaches and evaluation of innovative practices. Furthermore, SZPT hopes to have access to the latest TVET innovation ideas or practices, and obtain more visibility, policy priority and financial support from the local and national government.
Malta College of Arts, Science, and Technology (MCAST), Malta	MCAST provides universally accessible vocational and professional education and training, responsive to the needs of the individual and the economy. Over the last five years, MCAST has has been responsible for the national apprenticeship scheme. This includes developing flexible work-based learning programmes and directly involving the private sector as a major stakeholder. Moreover, MCAST has developed a number of Masters degree courses related to entrepreneurship in TVET. Also, the college has recently launched its Research and Innovation Department and set out a new organization structure.	MCAST's expectations from the i-hubs project are two-folded: (1) the institution is prepared to share their experience, knowledge and best practices with other institutions to help them evolve and develop; (2) the institution expects to have better access to best practices from other institutions. Furthermore, the institution aims to further develop the recently established Research and Innovation Department in order to enhance the initiatives on innovation within the college.

Institution	Previous experiences	Expected outcomes
University of Vocational Technology (UNIVOTEC), Sri Lanka	UNIVOTEC aims to be a leading university providing technical and vocational education for all with aspirations to achieve professional excellence. The previous experiences with innovation projects include the development of applied research, the creation of international German patents (WIPO registered innovations), an annual food innovation exhibition, robotic competitions, and research symposium.	During the i-hubs project, UNIVOTEC expects to strengthen its vision and mission with an innovation approach.
Technical Education and Skills Development Authority (TESDA), Philippines.	TESDA is the government agency tasked to manage and supervise technical education and skills development in the Philippines. It provides direction, policies, programmes, and standards towards quality technical education and skills development. The TESDA Women's Center (TWC) is a specialized institute of excellence in empowering Filipino women. Among other initiatives, the TWC is developing a Business Innovation Center partnership with private industry (AboitizFoundation and PilmicoFoods Corporation). Experience with innovation projects also includes teacher training in conducting technology research, developing critical thinking, problem-solving, and new business models.	During the i-hubs project, TESDA aims to acquire knowledge and skills on different innovative approaches/ strategies in entrepreneurship and greening. It also wants to use innovative practices to improve the image of TVET. Next steps include providing capacity-building opportunities to trainers in new and innovative teaching and learning processes, the identification and empowerment of trainers to act as experts and mentors of the innovation hub project, the documentation of promising initiatives, and partnership with external actors.

Institution	Previous experiences	Expected outcomes
OMNIA - Joint Authority of Education in Espoo Region, Finland	OMNIA offers a wide range of services, such as vocational upper secondary education and training, apprenticeship training, as well as corporate training and professional courses. The institution has experience with the use of artificial intelligence in teaching and learning processes (e.g. AI Truck) and the use of robots in teaching Finnish as a second language for migrants.	In the next years, OMNIA aims to develop a series of initiatives on innovation in TVET, including gamification of training with the theme of sustainable development, piloting and evaluating the use of AI and robotics in teaching programmes with a larger audience, as well as offering digital solutions for student guidance and counselling. Within the framework of the i-hubs project, OMNIA expects to learn from other institutions, network in new fields of activities, and develop a concrete action plan for innovation in TVET.
Berufskollegen der Lindenstraße (Bkal), Germany	Bkal is a vocational college that offers different types of TVET programmes in business and administration. The institution aims to raise awareness about sustainable development/business while establishing it in TVET curricula with a holistic approach (hands-on projects). Examples of previous experience with innovations in TVET include the project to become a Fairtrade School, as well as the creation of learning situations within a network of state schools and partners from training companies in the dual educational system (FOENAKO Project).	Bkal is interested in the further implementation of new courses and programmes on sustainable development/ business, as well as in becoming part of the network Schule der Zukunft/BNE (school of the future/education for sustainable development) in Germany. During the i-hubs project, the institution expects to access new ideas and support to facilitate the school's projects.

Appendix

Questionnaire on innovation in TVET

The questionnaire is divided into three parts. Part I intends to collect the general information about the TVET institution. Part II aims to explore the institution's understanding, strategies and management practices for the development and implementation of innovation in TVET. Part III focuses on one specifc innovative practice, with the aims to show case the innovative practices and identify the main barries.

Part I: General information

In this first part, we would kindly ask you to provide some basic information about your TVET institution:

- TVET institution's name:
- TVET institution's name in local language:
- Country:
- Website (if any): Contact name: Contact email:

1. Which level do the activities of your TVET institution mainly address? (one answer possible)

   a. Local
   b. National
   c. Regional
   d. International

2. Type of institution:

   a. Ministry/National body
   b. University/Research
   c. Training Centre

3. *(If answer b or c in question number 2)* What type of services and/or products are provided by your TVET institution? (more than one answer possible)

   a. School-based training
   b. Workplace-based training
   c. Combination of multiple types of training (e.g. sandwich programmes, dual systems)
   d. Higher-level TVET (post-secondary)
   e. Long-distance training
   f. Research and Development
   g. Consultancy services for private companies or government
   h. Career and Employment Guidance
   i. Recognition, Validation and Certification of Competences
   j. Others

Part II: Institutional Strategy

In the second part, we move our attention to the broad set of innovation practices being developed and implemented in your TVET institution. We would kindly ask you to provide general information on the institutional strategy and overall activities for innovation being deployed by your TVET institution:

4. Does your institution have an action plan for innovation? (one answer only)

   a. The TVET institution has no specific action plan for innovation
   b. The TVET institution is currently developing an action plan for innovation
   c. The TVET institution implemented an action plan for innovation in the last twelve months
   d. The TVET institution implemented an action plan for innovation more than twelve months ago

5. *(If answer b, c or d in question number 4)* Was the action plan initiated under any regional, national or local strategy for innovation? (Please give the name of the strategy and describe the initiative's background)

6. *(If answer b, c or d in question number 4)* How is innovation in TVET defined by the action plan for innovation? (open answer)

7. *(If answer a in question number 4)* How does your institution define what is innovation in TVET? (Open answer)

8. Overall, what are the types of innovative practices developed by your institution? *(more than one answer possible)*

   a. Products and services offered to students/clients (e.g. new TVET courses and programmes)
   b. Processes (e.g. new pedagogic practices, introduction of new teaching or pedagogical equipment and technologies)
   c. Organizational practice (e.g. changes in strategic planning, financing, human resources management)
   d. External relations with important stakeholders (e.g. new partnership with companies, development of external consultancy)

9. Who are your main partners in the development and implementation of innovative practices? *(more than one answer possible)*

    a. Large business enterprises
    b. Small- and medium-sized business and enterprises
    c. Business clusters (e.g. business incubators, innovative clusters, industrial parks)
    d. Chambers (Chambers of Commerce, Chambers of Arts and Crafts, Chambers of Employers etc.)
    e. Trade Unions
    f. Government
    g. International organizations
    h. Other TVET schools and training providers
    i. Universities
    j. Institutes of Applied Research
    k. Private non-profit organizations
    l. Other (please specify):

10. What types of activities are deployed by your institution in order to develop and implement innovative practices in TVET? *(more than one answer possible)*

    a. Research and experimental development activities
    b. Infrastructure investments to modernise TVET centres with advanced equipment
    c. Marketing and brand equity activities
    d. Development, introduction or presence of incubators for TVET learners
    e. Intellectual property related activities (patents, trademarks, etc.)
    f. Employee training activities
    g. Software development and database activities
    h. Prospection of financial instruments, including business-education partnerships
    i. Participation in national and international Skills competitions
    j. Development or introduction of internationalization strategies
    k. Other (please specify):

11. What human resource management practices are deployed by your TVET institution to enhance the potential and skills of its employees and support them in the development and implementation of innovative practices in TVET? *(more than one answer possible)*

    a. Employee recruitment policies that focus on innovation skills
    b. In-service training and skills development
    c. Appraisals and incentives for employee performance in suggesting ideas for innovation or in developing innovations
    d. Promotion and career development opportunities
    e. Other (please specify):

12. What types of funding structures are available to support the development and implementation of innovative practices in TVET? *(more than one answer possible)*

    a. National or local public financing
    b. Private financing from companies
    c. Private financing from TVET learners
    d. Contracts from domestic or foreign governments or international organizations
    e. Loans from governments
    f. Loans from international organizations
    g. Equity from private equity or venture capital firms, or business angels
    h. Extra grants or subsidies from domestic or foreign governments, international organizations
    i. Non-governmental organizations
    j. Other sources (e.g. Crowdfunding):

Part III: Innovative practice

The final part of this survey focuses on one specific innovative practice from your TVET institution. We would kindly ask you to describe the innovative practice and provide information on partners, funding, and challenges:

13. Please name and describe the initiative, its objectives and expected outcomes.

14. Please select yes/no if the following element is present in this specific innovative practice in TVET.

    a. Providing people with labour market relevant skills (for upskilling and reskilling)
    b. Providing higher level TVET programmes or developing pathways to higher level programmes
    c. Providing guidance services or validation of prior learning
    d. Establishing business-education partnerships for apprenticeships, sharing of equipment, etc.
    e. Working together with local SME's and providing technical support, sharing equipment, or applied research
    f. Development or introduction of Joint TVET curricula together with other TVET stakeholders
    g. Development or introduction of innovative teaching and training methodologies
    h. Development or introduction of innovative transversal competences (e.g. entrepreneurship)
    i. Development or introduction of project-based learning that brings inter-disciplinary approaches to solve real work problems/challenges
    j. Development or introduction business incubators for TVET learners
    k. Investing in the continuing professional development of teachers and trainers

l. Development or introduction of internationalization strategies to foster trans-national mobility of TVET learners, teachers and trainers.
m. Acting as or supporting innovation hubs and technology diffusion centres
n. Supporting the attraction of foreign investment projects
o. Participating in national and international Skills competitions
p. Developing sustainable financial models that combine different types of funding

15. Please describe how the elements selected in the last question contribute to the development and implementation of this specific innovative practice in TVET (open answer).

16. What types of sources of funding are used to support the development and implementation of this specific innovative practice in TVET? *(more than one answer possible)*

a. National or local public financing
b. Private financing from companies
c. Private financing from TVET learners
d. Contracts from domestic or foreign governments or international organizations
e. Loans from governments
f. Loans from international organizations
g. Equity from private equity or venture capital firms, or business angels
h. Extra grants or subsidies from domestic or foreign governments, international organizations
i. Non-governmental organizations
j. Other sources (e.g. Crowdfunding)

17. What types of sources of funding are used to support the development and implementation of this specific innovative practice in TVET? *(more than one answer possible)*

a. National or local public financing
b. Private financing from companies
c. Private financing from TVET learners
d. Contracts from domestic or foreign governments or international organizations
e. Loans from governments
f. Loans from international organizations
g. Equity from private equity or venture capital firms, or business angels
h. Extra grants or subsidies from domestic or foreign governments, international organizations
i. Non-governmental organizations
j. Other sources (e.g. Crowdfunding)

18. How would you describe the main challenges facing the development and implementation of this specific innovative practice in your TVET institution? (open answer)

19. Please share any websites or online information that helps explain your innovate practice.

20. What are the main barriers to the development and implementation of innovative practices in TVET? (Select maximum three answers)

a. Lack of time, resources or staff to develop new products and services
b. Inability to recognize labour market demands and the challenges of the future
c. Resistance to change teaching methods and pedagogical practices
d. Lack of access to new pedagogical equipment and technologies
e. Lack of a shared vision or strategy on innovation in TVET
f. Unwillingness to change organizational practices (e.g. strategic planning, financing, human resources management)
g. Hierarchy, over-management or lack of autonomy to suggest new ideas and solutions
h. Focus on internal processes and activities rather than enhancing external relations with important stakeholders
i. Difficulty finding the right partner and establishing trust
j. Concerns about the financial costs of coordination between several actors
k. Unwillingness to interact with other stakeholders because of loss of control over strategy or valuable knowledge
h. Others (please specify):

21. Can we contact you to find out more about your innovative practice?

a. Yes b. No

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