DigI-Vet

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FOSTERING DIGITISATION AND INDUSTRY 4.0:

EDUCATION – VOCATION - INDUSTRY - FUTURE

NEW OPPORTUNITIES AND CHALLENGES FOR EUROPEAN VET INSIGHTS IN THE DIGI-VET PROJECT

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Ingenious Knowledge

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Abbreviations

AOAA	Asociaţia Oamenilor de Afaceri Argeş, Romania - Argeş County Businessman Association
ARVET	AR Vocational Education and Training Ltd.
BMWI	Bundesministerium für Wirtschaft und Energie - Federal Ministry for Economic Affairs and Energy
BMBF	Bundesministerium für Bildung und Forschung - Federal Ministry of Education and Research
cf	cited from
DigI-VET	Project - "Fostering Digitisation and Industry 4.0 in vocational education and training"
EMPH	Private Institute Emphasys Centre
Ibid.	abbreviation for the Latin word ibīdem, meaning ´in the same place´
IK	Ingenious Knowledge
IO	Intellectual Output
IoT	Internet of Things
IT	Information Technology
Ltd.	Limited
MOOC	Massive Open Online Course
sMOOC	small Massive Open Online Course
OER	Open Educational Resources
UPB	University of Paderborn, Chair Business and Human Resource Education II
[illegible]	vocational education and training

Introduction

In the last few years digitisation is becoming more and more important. This goes hand in hand with trends towards intensive use of the internet, social media approaches, smart solutions in enterprises and mobile learning. There is nowadays a Smart Industry market and there are several indicators that show that this market is increasing and developing at a rapid pace with regard to new opportunities and the use of IT solutions. The companies are following a trend of highly individualized products. This is accompanied by highly flexible products and network solutions as well as data processing. Digitisation creates added value to business processes and offers high quality services and innovative products for customers and society.

This book is based on the results of the Erasmus+ project DigI-VET. Core idea of this project was to address new and innovative ways of learning and teaching in VET with regard to the age of digitisation and Industry 4.0.

Current Industry 4.0 approaches focus on a symbiosis between production and new IT technologies to enhance industry and gather adequate data. Here, digitisation is a key to handle these approaches. Nevertheless, this does not only mean changes in industry and production this also means changes and challenges in the field of VET. Digitisation and Industry 4.0 usually stands for the fourth industrial revolution. This means digitisation of products as end-to-end digitisation. The discussion on Internet of Things (IoT) is just one aspect in this huge puzzle.

This includes the expansion of existing products but also requirements for new competences. For VET teachers the core challenge is to gather information about the rapidly changing environment and to find adequate ways to deliver this new information to the learners.

Digitisation is no longer only a topic for industry but also for schools and especially VET schools and all other VET learning centres. They deal with open educational resources (OER) and can use the internet for teaching and learning. Often the technical equipment is discussed here. However, only the provision of digital environments or technical devices does not include digitization in education. Teachers have to be aware of the changes in companies and they have to be aware about the changes, the opportunities and challenges.

This is the point, where the DigI-VET team and this book step in. We try to provide teachers and an interested audience in the topics of digitization and industry 4.0 as well as in results developed in our innovation project. The aim is to foster teachers

with additional information and to broaden the perspectives and ways to deal with digitisation in VET. Change in the world of work means always that there has to be a change in VET, too. This is, because digitization is not only digitization of teaching processes but also the change of topics at school due to new processes and ways to create and develop greater customer benefits in business.

This book should be a guide through the different aspects of topic and helps the reader to establish their own position with regard to the current developments.

Enjoy reading and always think about which aspects could apply to your own situation and environment.

Marc Beutner
Paderborn, April 2021

Part A - Digitisation and Industry 4.0 in Europe – A first glance

1. What is Digitisation? A first approach to similarities and differences to digitalization and digital transformation

Marc Beutner

In times of transformation, many aspects and processes are changing in social life and economy. Mar Negreiro and Tambiama Madiega from the European Parliamentary Research Service – EPRS describe this with the following words:

"A digital revolution is transforming the world as we know it at unprecedented speed. Digital technologies have changed the way businesses operate, how people connect and exchange information, and how they interact with the public and private sectors. European businesses and citizens alike need an adequate policy framework and appropriate skills and infrastructures to capture the enormous value created by the digital economy and make a success of digital transformation."
(Negreiro / Madiega 2019, p.1).

In the digital strategy of the EU, the European Commission states that "we are at a crossroads in the development of the European Union. The medium-term challenges facing Europe include globalisation, climate change, demographics and digitalisation." (European Commission 2018)

Currently, there are huge discussions on the impact of digitisation in companies and the field of IT. Nevertheless, there are not huge changes in society and economy, but also in the educational sector. "Digitisation is no longer only a topic for industry but also for schools and higher education and has a strong connection to daily life." (c.f. Beutner 2019, p. 7)

Within the EU priority "A Europe fit for the digital age. Empowering people with a new generation of technologies." (European Commission 2020a), the Commission explains that "Digital technology is changing people's lives." (European Commission 2020a) and that a crucial aspect will be shaping Europe´s digital future (c.f. European Commission 2020b).

However, in recent years ´digitisation´ has become a buzzword in both industry and

education and is addressed by a number of European programmes and measures (c.f. Beutner 2019b, p. 59). Also, in the context of the discussion about the so-called ´Industry 4.0´ the aspects of digitisation are emphasized again and again. In some European countries, e.g. in Germany there seems to be just one word to address these aspects (in Germany people just use ´Digitalisierung´/´digitalisation´), while in other countries like UK we can find a differentiation between ´digitisation´ and ´digitalisation´.

Therefore, it is important to have a closer look, at what is addressed and what are the differences in the approaches to understanding the different discussion threads and to have a common understanding for this book and the work in the DigI-VET project, which will be addressed in this publication.

In the very general interpretation of the BMWI, the German Federal Ministry for Economic Affairs and Energy, digitalization influences "the way we live, communicate, work and do business - and will do so even more in the future" (BMWI 2015, p. 1: Original in German: „die Art, wie wir leben, kommunizieren, arbeiten und wirtschaften – und wird es künftig noch stärker tun").

Also, a very general approach is the view that digitalization is the "Integration of digital technologies into everyday life by the digitization of everything that can be digitized." (c.f. IGI Global 2020 with regard to Ochs / Riemann 2018).
Sometimes digitalization is seen as a phenomenon.

"A trend phenomenon that moves the economy from the era of the physical world to a virtual world based on digitization technologies (mainly internet, "Big Data," and mobile devices)" (c.f. IGI Global 2020 with regard to Romdhane / Loukil / Kammoun 2020).

While digitization in the sense of the English ´digitisation´ can be interpreted as a process in which information is converted from a physical format into a digital form, digitization in the sense of the English ´digitisation´ addresses processes that lead to the improvement business processes (cf. Burkett 2017). Digitisation in the first sense therefore focuses primarily on the change from analogue to digital data and formats (cf. Beutner 2019c, p. 5). In contrast, digitisation in the second sense focuses in particular on the effects of the new digital world and the possibilities of IT and the Internet on people and work (cf. Timico 2018).

Timico explains this with the following definitions:

> "Digitisation is the conversion of changing the analogue to the digital."
> (Timico 2018)

and

"Digitalisation is how this new digital world will impact people and work." (Timico 2018)

With regard to the description in Gartners IT Glossary Bloomberg points out:

"Digitization is the process of changing from analog to digital form." (Bloomberg 2018).

To get a general description of the process view on digitization the definition of Technopedia can be helpful:

"Digitization is the process of converting analog signals or information of any form into a digital format that can be understood by computer systems or electronic devices. The term is used when converting information, like text, images or voices and sounds, into binary code. Digitized information is easier to store, access and transmit, and digitization is used by a number of consumer electronic devices" (TECHNOPEDIA 2019, n. p.).

Particularly in the field of education, new challenges have arisen as a result of digitisation processes (cf. BEUTNER 2019b, p. 4; cf. KMK 2016, p. 3). Keywords such as digitization and industry 4.0 are more present than ever before (cf. SLOANE ET AL. 2018, p. 2). With regard to different approaches to specify the definitions we were able to find the following six approaches in the context of digitisation within the DigI-VET project when we did our research all over Europe:

• "Digitisation is the process of converting information into a digital (i.e. computer-readable) format.
• Digitisation is the process of converting economic processes from an analogue to a digital way of work.
• Digitisation is the process of digital change in society and the digital transformation, which is recognized as the digital revolution.
• Digitisation the digital modification of instruments and tools.
• Digitisation means to compress data lossless or lossy.
• Digitisation means optimisation of Business processes using information technology." (Beutner 2019d, p. 4)

While digitization is of crucial importance to data processing, storage and transmission and is in general a more technical term, digitalisation is closely associated (see as well Brennen / Kreiss 2014) and focuses the impact.

"Digitalization means turning interactions, communications, business functions and business models into (more) digital ones which often boils down to a mix of digital and physical as in omnichannel customer service, integrated marketing or smart manufacturing with a mix of autonomous, semi-autonomous and manual operations."

(i-SCOOP 2020a)

This shows that digitalisation focusses on the social implications of digital tools and increased IT assistance. The way of dealing with what sometimes is called new media is getting more challenging and the importance of communication platforms in the fields of social life, economy and culture is increasing, too.

While digitisation focusses on the dematerialisation and maybe to the loss of information due to sampling and information transfers, digitalisation addresses linkages, connections and communication aspects. A convergence of different aspects of life comes into view when we are focussing digitalisation aspects. This can go along with additional decisions and new ways of decision-making. In addition, aspects of collective action can be brought into view. At some points, mentoring, coaching and additional surveillance can be discussed. All in all, a discussion on transparency is sometimes directly related to a focus on digitalisation.

An increased digitalisation has influenced various business activities in the last years and is currently going on. And this brings us to a last term which is always mentioned has to be addressed in this brief overview as well and this is digital transformation.
According to i-SCOOP digital transformation is "the cultural, organizational and operational change of an organization, industry or ecosystem through a smart integration of digital technologies, processes and competencies across all levels and functions in a staged and strategic way." (i-SCOOP 2020b)

Therefore, digital transformation focusses a more organisation view on the change. It is the process of creating new business processes which goes hand in hand with new customer experiences, new services and culture when organisations use digital technologies within such processes of change. The three main areas of digital transformation are of characterised with regard to the different business processes, the change of culture in the organisation and society, the changing business requirements and the change in customer relations. Therefore, is focusses on the implementation of digital technologies in organisational contexts. This means that data and technology systems have to be addressed with regard to the market, the customers and the company culture. Concerning the acceleration of change the three aspects digitisation, digitalisation and digital transformation often go hand in hand and cannot be seen as independent. The transformational opportunities of applying digital technologies for organisations are huge and businesses have to accommodate to reality and the current changes to survive in the future years.

The COVID19 crisis has brought about years of change in the way companies in all sectors and regions operate. According to a new McKinsey Global survey, the share of digital or digitally enabled products in their portfolio has accelerated by a shocking

seven years.[1]

These changes show that digitisation, digitalisation and digital transformation has put pressure on companies. They have to reflect on their current strategies and future activities. Moreover, the companies have to explore new business opportunities, which consider the new technological chances. This has to be done in a systematic way and as early as possible. At the same time, these digital changes put also pressure on people and staff members because new competence profiles are needed and here DigI-VET can offer insights in necessary competence profiles and ways to deal with the new requirements.

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[1] Find more information on the Internet under: https://www.mckinsey.com/business-functions/strategy-and-corporate-finance/our-insights/how-covid-19-has-pushed-companies-over-the-technology-tipping-point-and-transformed-business-forever. Access date. 02.05.2021.

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2. Industry 4.0 an introduction to the ideas and new possibilities

Marc Beutner / Jennifer Schneider

In direct connection with the terms digitisation, digitalisation and digital transformation a fourth aspect has become very prominent: Industry 4.0.

The term ´Industry 4´ or, how the German original was called ´Industrie 4.0´, was coined by Henning Kagermann, Wolf-Dieter Lukas and Wolfgang Wahlster in 2011. It was first introduced to the public at the Hanover Fair in 2011 where the industry 4.0 initiative was presented and it was used in their text "Industrie 4.0: Mit dem Internet der Dinge auf dem Weg zur 4. industriellen Revolution"[2] (Kagermann / Wahlster 2011). Industry 4.0 was a term used in a high-tech strategy. The core issue of the project was to transform German industry and manufacturing. The transformation process focussed on bringing together the work with the Internet of Things and cyber-physical systems with a further focus on production, people, environment and security. In their final report to the initiative which they presented in 2013 Kagermann / Wahlster and Helbig described Industry 4.0 this way:

„In addition to optimising existing IT-based processes, Industrie 4.0 will […] also unlock the potential of even more differentiated tracking of both detailed processes and overall effects at a global scale which it was previously impossible to record. It will also involve closer cooperation between business partners (e.g. suppliers and customers) and between employees, providing new opportunities for mutual benefit" (Kagermann / Wahlster / Helbig 2013, p. 18).

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[2] Own translation of the title into English: ´Industry 4.0: With the Internet of Things on the way to the 4th industrial revolution´.

However, the discussion about industry 4.0 is much bigger. In addition to the aspects mentioned in the definition above, the keywords on the topic of Industry 4.0 are numerous. People are talking about the IoT - the Internet of Things-, cloud computing, big data analysis, intelligent machines, intelligent services, fully networked maintenance and repair, artificial intelligence, virtual models' smart products as well as real-time production.

The Boston Consulting Group specified this and could identify nine technologies that transform industry production:

1. "Autonomous robots
2. Simulation
2 Own translation of the title into English: ´Industry 4.0: With the Internet of Things on the way to the 4th industrial revolution´.
3. Horizontal and vertical system integration
4. The industrial Internet of Things
5. Cybersecurity
6. The cloud
7. Additive manufacturing
8. Augmented reality
9. Big data and analytics" (Gerbert / Lorenz / Rüßmann / Waldner 2015).

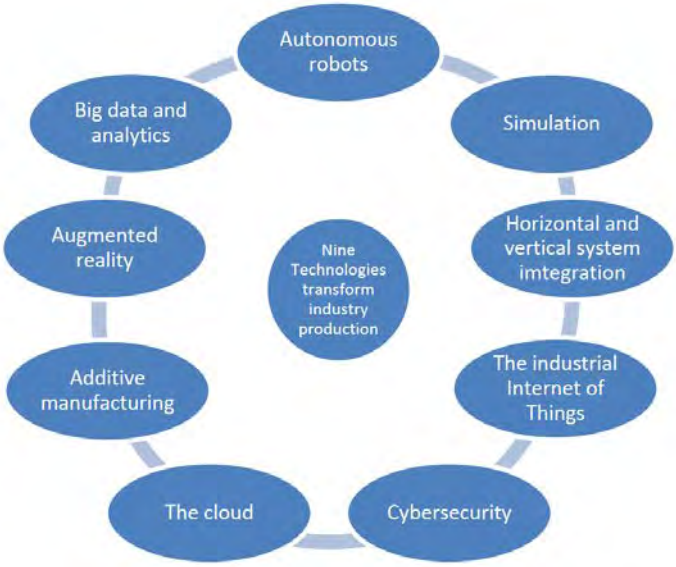

Figure 1: Overview on the nine technologies that transform industry production according to BCG. Own graphic based on Gerbert / Lorenz / Rüßmann / Waldner 2015.

Meanwhile, organisations, politicians and societies all over the world are discussing the topic of industry 4.0. Sometimes the discussions are using also terms like smart industry (see e.g. i-scoop 2020, or Haverkort / Zimmermann 2017), smart manufacturing (c.f. Davis / Edgar / Porter / Bernaden / Sarli 2012 or Kusiak 2018), smart factory (c.f. Schumacher / Geissler / Sihn 2016).

In addition to smart factory, the terms advanced manufacturing, internet of things or internet of everything and industrial internet are some of a kind of all the possible naming for Industry 4.0 aspects (cf. Schlaepfer / Koc 2015).

Smart industry is often seen as a complete synonym for industry 4.0. Nevertheless, there are some slight differences in the terms. I-SCOOP who are usually providing consulting and services in this field and who are also providing several publications on the topics try to explain the similarities and differences as follows:

"Smart manufacturing has been defined as the fully-integrated, collaborative manufacturing systems that respond in real time to meet changing demands and conditions in the smart factory, in the supply network, and in customer needs. Smart industry is a synonym for Industry 4.0 or industrial transformation in the fourth industrial revolution within which smart manufacturing de facto fits." (I-SCOOP 2020)

Concerning Smart manufacturing Davis / Edgar / Porter /Bernaden Sarli addressed already in 2012, the importance of the application of networked information-based technologies.

"*Smart Manufacturing* is the dramatically intensified and pervasive application of networked information-based technologies throughout the manufacturing and supply chain enterprise." (Davis / Edgar / Porter /Bernaden / Sarli 2012, p. 145)

In a modern manufacturing process the adoption of digital models in production workflows is crucial. With regard to the so-called Internet of Things, the manufacturing process changes:

"[..] with the Industrial Internet of Things, more devices—sometimes including even unfinished products—will be enriched with embedded computing and connected using standard technologies." (Gerbert / Lorenz / Rüßmann / Waldner 2015).

Bosch Rexroth Peter explains the connection between industry 4.0 and smart manufacturing as follows:

"Smart Manufacturing implements the idea and the potential of Industry 4.0 in reality." (Translation by the authors. Original text in German: "Smart Manufacturing setzt die

Idee und das Potenzial von Industrie 4.0 in der Realität um.“ Bosch Rexroth 2020)

The basic requirement of industry 4.0 highlighted by Bosch Rexroth are:
• “Human being as an actor
• Distributed intelligence
• Fast networking and flexible configuration
• Open standards
• Real-time virtual image
• Digital life cycle management
• Secure value networks” (Bosch Rexroth 2020)

With regard to elements of a smart factory Schumacher / Geissler / Sihn pointed out the basic technologies of industry 4.0 which are related to communication, Sensors and actuators, embedded systems, standards and norms, Human-machine interface and Software and system technology (cf. Schumacher / Geissler / Sihn, p. 15)

According to them elements of a smart factory within industry 4.0 are based on internet technologies and consist of:

• a technical system,
• embedded systems, which are Integration of hardware and software components in a technical system (cf. Schumacher / Geissler / Sihn, p. 17)
• cyber-physical systems, which is the fusion of physical objects (e.g. a machine) with the virtual world (e.g. a system for planning company resources)
• cyberphysical-production systems which focus on the whole value chain within production and services,
• the smart factory itself which takes also the proximity to consumers into account. (cf. Schumacher / Geissler / Sihn, p. 16)

With specific regard to industry 4.0 Lasi / Fettke / Kemper / Feld and Hoffmann point on the triggers and they identify here the general social, economic, and political changes, which they sum up under the following five aspects:

1. Short development periods
2. Individualization on demand
3. Flexibility
4. Decentralization
5. Resource efficiency (cf. Lasi / Fettke / Kemper / Feld / Hoffmann 2014)

As already mentioned, the term ´Industry 4.0´ which is sometimes also referred to as the ´fourth industrial revolution´ became publicly known, when an initiative called ´Industry 4.0 where an association of representatives from business, politics, and academia promote

the idea as an approach to strengthen the competitiveness of German manufacturing industry (cf. Hermann / Pentek / Otto 2015). Now, not just for the German industrial sector, which has one of the most competitive manufacturing industries in the world and acts as global leader in manufacturing equipment sector, the industrial sector gets important to every country´s economy and remains the driver of growth and employment (cf. Kagermann / Wahlster / Helbig 2013). Outside theGerman-speaking area exist comparable ideas and denomination for Industry 4.0 mentioned before as well, like cyber physical production systems (CPPS), which use the globally available information and communication network for an automated exchange of information and in which production as well as business processes are matched and integrated (cf. Adolph et al. 2016). Before having a closer look at specifications, characteristics and features of Industry 4.0, it is important to have a look at the history of technical revolution until the fourth industrial revolution. Beutner pointed with regard to the development described in the final report from 2013 of Kagermann / Wahlster and Helbig concerning the industry 4.0 initiative on the difference between the three industrial revolutions which are focussed by historiography and industry 4.0 which is called the fourth industrial revolution but from a political and not form a historical perspective. The conceptual definition of Industry 4.0 is an interpretation of digitalisation that is due to the industrial revolution. Historiography has so far marked three industrial revolutions with (a) the development of the steam engine and the introduction of mechanical production systems, (b) the introduction of mass production, with the help of electrical energy and (c) the automated mass production with the help of electronics and information technology (Beutner 2019, p. 60).

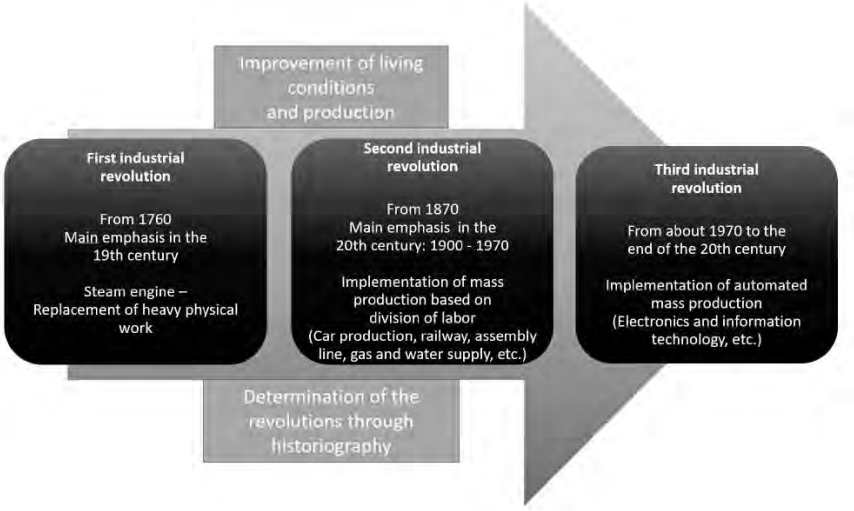

Figure 2: The three industrial revolutions with regard to historiography (similar to the German original of Beutner 2019, p. 61).

Now, for the first time, society is determining a change as a possible industrial revolution, which is contrary to the previous approach based on the subsequent historical interpretation of significant changes and is therefore at least to be classified as worthy of discussion.

The term Industry 4.0 has actually been introduced as a term for a future project for the comprehensive digitisation of industrial production. In this respect, there is also a series of critical discussions on this conceptual setting (cf. Bornemann 2016).

Figure 1 already showed the core aspects of each historic industrial revolution. Nevertheless, we provide in the following paragraphs a more detailed insight to get a better impression about the changes which happened. The cycles of industrial revolution which entered the literature as the first, second, third industrial revolution had specific characteristics. Certain characteristics related to the predominance of specific energy resources, technical achievements with major effects in economy, means of public transport developed as well as modernized (cf. Prisecaru 2016).

One of the most distinguished turning points in human history appears in the timeline between 1750 or 1760 and 1840 and is called the **First Industrial Revolution** (cf. Haradhan 2019). In this era, the first mechanical loom was put into operation in the year 1784 and characteristic the picture of the state of the art. In this revolution mechanical production based on waterpower and steam power are characteristics and features of this stage. For the society in Europe and the United States this advancement includes a progress from single hand production methods to machines, new chemical manufacturing and iron production processes (cf. Landes 1969). Notably for this era, too, is the textile industry, which is the dominant industry of the first Industrial Revolution. This industry uses the modern production methods and has impact on many terms of e.g. employment, the increasing value of output and the new dimensions of capital investments (c.f. Ibid.).

The **Second Industrial Revolution** began around 1870 and had the most important focus in the early 20th century during the introduction of conveyor belts and mass production. Pioneers of this century are the innovators Frederick Taylor and Henry Ford. The American engineer and inventor Frederick Winslow Taylor was born in 1856 in Philadelphia, Pennsylvania, U.S. is known as the father of scientific management. He influenced by his system of industrial management the development of virtually every country enjoying the benefits of modern industry (c.f. Mee 2020). By his standardisation of work processes in combination and interaction with time, he optimized work processes and revolutionised this century of Industry.

Henry Ford understood the theory of Taylor's system of industrial management and converted the automobile industry from an expensive high-class good into a practical

conveyance good. His mass production and assembly line work of the Model T automobile revolutionized transportation and American industry.

The **Third Industrial Revolution** started in the late 1960s until 1990s. Some authors define the third industrial revolution from 1970s some from 1990s. This period was influenced and defined by the country the business is located and individual, organisational attitude and acting with innovations. The focus in this revolution, which is labelled as green industrial revolution, efficiency revolution and a fundamental transformation towards green capitalism is fundamental influenced by the computer, the internet and the benefits of interconnectivity (c.f. Jänicke / Jacob 2009). At the World Economic Forum in Davos, 2016, economic and social theorist Jeremy Rifkin, explained even in this best- selling book "The Third Industrial Revolution: How Lateral Power Is Transforming Energy, the Economy, and the World" (Refkin, 2013), that our community and business are in front of the third industrial revolution and just high-performance companies, communities and societies made the step through the fourth industrial revolution (c.f. Prisecaru 2016). Rifkin defined five pillars of the third industrial revolution, which describes a change with energy converging with the internet and creating new businesses and employments (c.f. Refkin 2013).

5 pillars of the Third Industrial Revolution				
Renewable energy:	Buildings as micro-power plants:	Energy storage technologies in all buildings:	Internet as a technology:	Fuel-cell vehicles:
as a greener and more sustainable energy source	leveraging local renewable energy	to fit local supply of energy & demand for energy	to manage global supply of and demand for energy via a global grid	transporting energy to various points of the continental grid

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Table 1: Pillars of the Third Industrial Revolution according to Rifkin 2013 and 2016.

According to Rifkin´s bottom line, the third Industrial Revolution will be about the Internet of Energy. Some global leading IT companies are already building the required infrastructure. Therefore, the IBM initiative smart planet is one of the most famous examples (c.f. IBM 2020). Moreover, in 2009, the campaign Smart Cities, a comprehensive approach to helping cities run more efficiently, save money and resources,

as well as to improve the quality of life for citizens, were launched, too (Ibid.)

The **Fourth Industrial Revolution**, which is labelled as Industry 4.0, refers to the next phase in a digitisation of the manufacturing sector where the Internet of Things (IoT) looks to play a huge role and that have the potential to feed information into and add value to manufacturing industry to realize a low-volume, high mix production in a cost-efficient way (cf. William 2014). It also involves the management and organisation of the entire value chain process of the manufacturing industry. Various organisations have been advocating the Internet of Things and Industry 4.0 concepts to create smarter factories (Kagermann / Wahlster / Helbig 2013). Meanwhile, according to the idea of Industry 4.0 a wide variety of devices, from smartphones, gadgets, televisions and watches to household appliances, which are becoming ever more flexible and intelligent are included (cf. Kuka 2016). The rise of autonomous robots, contemporary automation, cyberphysical systems, the internet of things, the internet of services and industrial robots, which are one of the key drivers in Industry 4.0, have evolved considerably since the last decades of the 20th century (c.f. Bahrin et al. 2016). The devices becoming more productive, flexible, safer and collaborative while creating an unprecedented level of value in the ecosystem. The heart of the third industrial revolution are smart factories, which bring higher level of automation and digitisation as well as an evaluation in the supply chain and production line Ibid.). Therefore, machines use self-optimisation, -configuration and even artificial intelligence (AI) to complete complex tasks in order to deliver superior cost efficiencies, better quality goods and services. The authors Bahrin et al. defines the fourth industrial revolution as:

"[…] a new area where the Internet of things alongside cyber-physical systems interconnect in a way where the combination of software, sensor, processor and communication technology plays a huge role for making "things" to have the potential to feed information into it and eventually adds value to manufacturing processes" (Bahrin et al. 2016).

In addition to that, industry 4.0 is defined on the ´Plattform Industrie 4.0´ as follows:

"The term industry 4.0 stands for the fourth industrial revolution, a new stage of the Organization and management of the entire value chain over the lifecycle of products. This cycle is oriented towards increasingly individualised customer wishes and extends from the idea, the order, the development and production, the delivery of a product to the end customer, to recycling, including the recycling of the product related services. The basis is the availability of all relevant information in real time through the networking of all instances involved in the creation of value and the ability to use the data to create the optimal value creation flow at the right time. By connecting people, objects and systems, dynamic, real-time-optimized and self-organizing systems are created, Cross-company value creation networks that can be optimized according to various criteria such as costs,

availability and resource consumption" (Plattform Industrie 4.0 2016).

As already mentioned, the horizontal and vertical system integration among companies, departments, functions, and capabilities will become much more cohesive, as cross-company, universal data-integration networks evolve and enable truly automated value chains.

Therefore, IoT will enrich more devices with embedded computing and interconnected using standard technologies (cf. Bahrin et al. 2016).

So, field devices can get in communication and interaction, to encourage a centralized control of devices processes and structures (c.f. Ibid.). Machine data and functionality will increasingly be deployed to the cloud. This enables more data- driven services for production systems and increasing data sharing across sites and company boundaries. The big data and big data analytics offer the collection, comparing and comprehensive evaluation of data from many different sources and customer to support for example real time decisions, optimisation of production and quality of production, to save energy and to improve equipment services (c.f. Ibid.).

Nevertheless, additive manufacturing methods, like 3D printing- complex, lightweight designs, will also be widely used in the fourth industrial revolution. Besides, augmented-reality-based systems can support a variety of services. This includes for example selecting parts in a warehouse or sending repair instructions over mobile devices like smartphones (c.f. Ibid.).

Above the previous technologies in Industry 4.0, robots have to be focused, too. They become more and more autonomous, flexible, cooperative and interact with one another and work safely side by side with humans and learn from them (Ibid). The benefits to work with robots are especially high because after purchase and integration in the business processes they can have a great range of capabilities even in quality and productivity compared with those used in manufacturing today.

2.1 State of the Art of successful system adaption to Industry 4.0

The authors Salkin, C. et al. explained three features that should be considered for successful system adaption to Industry 4.0 (Salkin et al. 2017).
The first point is the (1) horizontal integration via value chains. Horizontal integration Horizontal enhance the entire value between organisations. It improves product life cycles by using information systems, effective financial management systems and benefits from improved material flow (c.f. Acatech 2015).
The second aspect is (2) the vertical integration and networking of manufacturing or

even service systems. Therefore, vertical integration requires the intelligent cross-linking and digitalization of business units in different hierarchal levels within the organization and enables preferably transformation to smart factory in a highly flexible way (c.f. Salkin et al. 2017). Moreover, the production of small sizes and more customized products with acceptable levels of profitability will be enabled. Smart, innovative machines create a self-automated ecosystem that can be dynamically subordinated to affect the production of different product types (c.f. Ibid.).

At least a huge amount of data, even big data is processed to operate the manufacturing processes easily, too (c.f. Salkin et al. 2017).

In summary the horizontal and vertical integrations in businesses enhance the productivity in resource allocation, interactive and coherent working business units and accurate planning which is crucial for connected devices in the term (c.f. Ibid.).

At least, the third prediction (3) is the end to-end engineering of the overall value chain (c.f. Wang / Wan / Zhang / Zhang 2016). This means, that the end-to-end engineering assists product development processes by digital integration of supportive technologies consider customer requirements, product design and maintenance as well as recycling proposals and improvements (c.f. Ibid.).

The following figure presents an overview of the vertical and horizontal integration of technologies and devices under Industry 4.0:

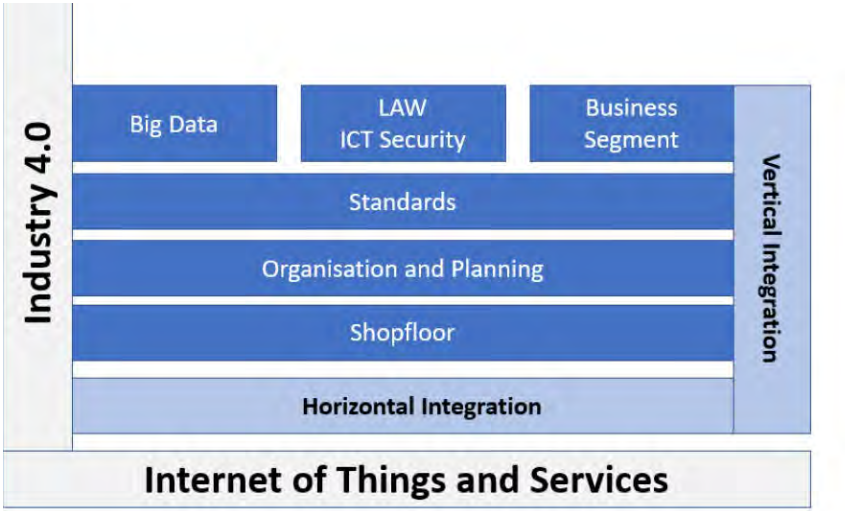

Figure 3: Vertical and horizontal integration under Industry 4.0, diagram by author, based on graphic by [VDI-Wissensforum], translated from German: c.f. Gerke 2015.

2.2 Best Practice Examples for Businesses & Industry 4.0

To show how businesses integrate the benefits and new possibilities of technologies of Industry 4.0 the DigI-VET consortium create an online tool where amongst others, VET teachers can find information of practical examples of digitisation and industry 4.0.

The tool provides insights into real existing showcases and offer pictures and videos of best practices examples. Moreover, a description of the enterprise and how the use digitisation it provided together with contact data. In total there are at least 25 showcases in the observatory (every partner provides 5 examples). To find the online observatory tool please visit:

http://digivet-platform.eduproject.eu/

The online observatory tool is structured as follows and demonstrate in the next screenshots: The homepage can be used very intuitive and has a clear structure for the user. There is a search/ look- up field to search business, which are listed in the observatory. In addition, there is the opportunity to select the "business category" e.g. health and life science, services, habitat conservation, IT, education, catering, food and so on and the opportunity to select the years in business (see screenshot: DigI-VET Online Observatory; highlight 1).

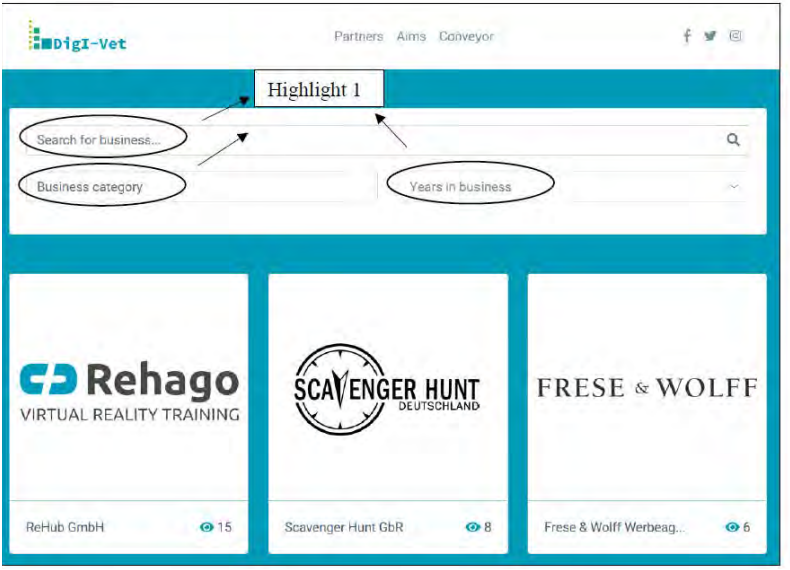

Figure 6: DigI-VET Online Observatory. 39

After customizing the search items in the look- up fields, the user gets a list of business, which fit to the research needs of the user.

As an example for businesses in the category ´Health and Life Science´ which are one year in business, the tool presents the Company ReHub GmbH, which develops Virtual Reality Trainings for people with hemiplegia, e.g. after a stroke (c.f. ReHub 2020). The interested reader can click on the business logo and will be forwarded to a detailed description (see: Highlight 2).

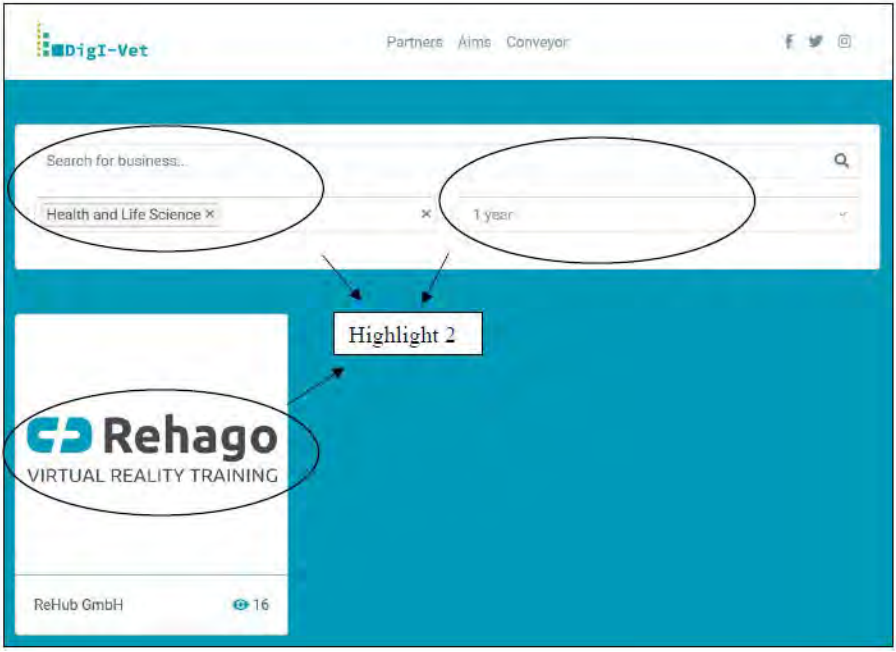

Figure 5: Screenshot II: DigI-VET Online Observatory.

The detailed description contains basic information like business category, years in business, link to the website and views (see highlight 3) and in-depth information like description of business and digitisation, years in business, size of business, supports to set up your business and digitisation, pitfalls and challenges, opportunities and plans for the future (see highlight 4) (c.f. Business ReHub 2020).

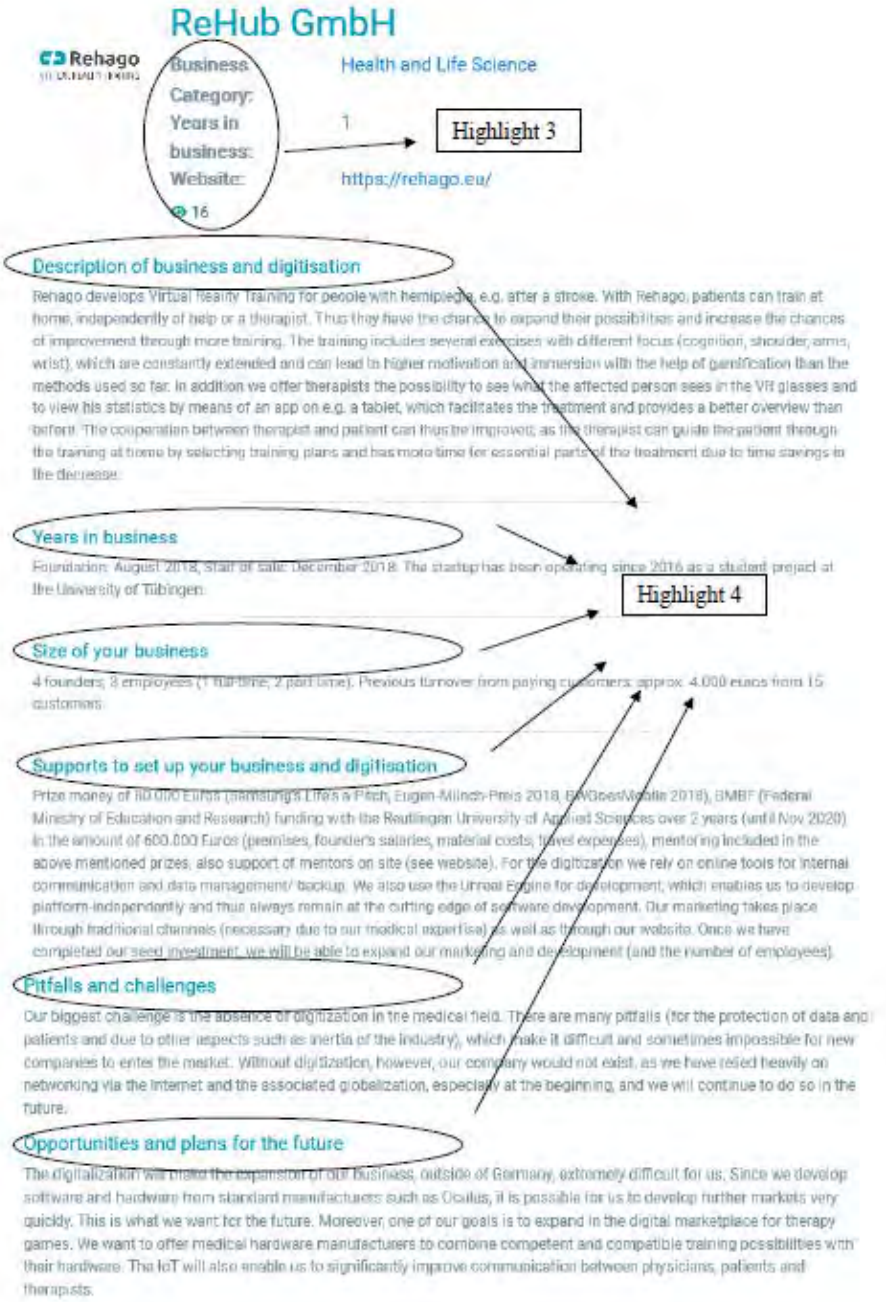

Figure 4: Screenshot I: DigI-VET Online Observatory.

All 25 showcases and best practices can be seen in the DigI-VET Online Observatory. To find the online observatory tool please visit the following link and feel free to poke around the observatory.

http://digivet-platform.eduproject.eu/

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Part B – The DigI-VET project

3. Importance of Digitisation for education and Industry – From smart data and smart services

Gelija Tamulyte / Rajesh Pathak / Daniel Crisan

3.1 Introduction

Digital development is forming a modern informed and an advanced nation ready to adapt to new reforms and changes both in the Education and Industrial sector. While the continuous process of digitisation is advancing, miscellaneous aspects of our daily life is gaining motion in the right direction along with some disadvantages. While establishment of educational resources keeps amplifying, the process of digitizing the educational aspects itself is slower compared to the rate it is increasing. Digitisation provides variety of new opportunities and easier learning techniques for younger generation. For the older generation, the process of modernisation remains questionable. Technological advancement has not only affected the education sector, it also has created challenges and opportunities in the industrial field. This fast-moving pace monitor services and creates an environment which would be easily adapted to changing needs of staff members, pushing the process of learning more accessible, but mainly – reduces operational costs (c.f. Cisco 2016).

Before divulging into a detailed discussion about the importance of digitisation in Education and Industry, it is valuable to go back to the definition of digitisation itself. Digitisation is an umbrella term that states the process of reforming different types of information (e.g. video) into digital language. An image can be printed or modified using certain software or textual pictures can be made to make its contents available in the internet cloud. This whole process attracted the attention of European Union making its main focus in EU 2020 educational development program. Discussion provided below will explore and evaluate the impact of digitisation on the Education and the Industry.

3.2 Education

Re-coursing the methodology of learning process by the involvement of technologies has changed the life of many students, especially the ones coming from third world countries. In India, there is a shortage of teaching professionals and the quality of the provided material is not as good as in first world countries. The digitisation provides the students an access to worldwide accepted educational material and an ability to use digital information as a source of learning material. "Digital education is generating new learning opportunities as students engage in online, digital environments and as faculty change educational practices through the use of hybrid courses, personalized instruction,

new collaboration models and a wide array of innovative, engaging learning strategies. Furthermore, a 21st century view of learner success requires students to not only be thoughtful consumers of digital content, but effective and collaborative creators of digital media, demonstrating competencies and communicating ideas through dynamic storytelling, data visualization and content curation" (Himmelsbach 2019). Thus, it is important to teach younger generation from the beginning to gain skills of competence in relation to technologies.

Professor of Institute of Law for Women located in India published a research providing pros and cons of digitisation in education that are related not only to India but in general to the application of digitisation in every country (c.f. Kaur 2019). According to the article, adding digitised sources into the learning process increases productivity. It makes documents more accessible and reduces learning time, increasing efficiency. It is more cost beneficial since less paper is being used for printing the teaching materials. Not only it is cost efficient but also environment friendly. Students or teachers can access documents any time, does not matter in which time zone they are as long as there is a stable internet connection. Given example is optical character recognition which provides accessing data in time efficient way. Moreover, it is more secure since online documents are easy to track. It is safer to store them in the internet cloud and the chances of losing it are minimal. While the printed copies are fragile e.g. damaged by water, however, documents uploaded online can be accessed by devices having the right log in information. Nevertheless, not only documents became accessible, but the online tours can be taken ensuring even better education (c.f. Coad 2019).

There are contradicting views on the affect digitisation has on students learning skills. The time that the learners tend to spend on laptops increases and they are more challenged to be focused while studying from laptop instead of paper books. University of Durham provided a research based of teaching methods stating that they should not be substituted with digital technologies. The best result is attained when students are using technologies during certain periods of time. As the research states, if students use too much time using technologies it has a negative effect on their processing abilities (c.f. Cisco 2016). It provokes students to browse different websites to find the answer in an easy way instead of trying to conduct a thorough research thus it boosts poor studying habits (c.f. Kaur 2019).

Not only does it affect the students, but it carries an impact on teachers as well. Not all teachers are trained and qualified to be able to use technologies successfully, it takes time to transform set of teaching methods. Frequently, technological error such as internet connectivity issue might arise leading to learning and teaching difficulty.

Despite the challenges brought up by freshly introduced technologies, new platforms provide numerous chances to acquire information. In the recent years, different types of

new platforms appeared providing students an access to online information. One of the many is Khan Academy gathering more than 150 teachers together in order to spread four of its main principles: information should be free, people should take advantage of the maximum capacity of modern technologies, there has to be an individual approach to each person, and learning process has to be comfortable (c.f. Khan Academy 2020). One of the best practises of digitisation together with prominent technology – Massive Open Online Courses (MOOCs). MOOC platforms include Coursera (Coursera 2020), Edx.org (c.f. Edx 2020) and others. These platforms have big amounts of data provided by different universities giving access to attain best quality education. The challenge that arises to compute the prior knowledge of people entering the course. Current statistics show that only ¼ of enrolled learners complete surveys after finishing the course (Reich 2014). Those surveys would prove to be beneficial to evaluate how much information the learners manage to acquire during the course period.

Another example of digitisation is Learning Management Systems such as Blackboard that is vastly used in universities. It is a virtual learning platform that is used by professors to store the data and facilitate student learning (c.f. Vilberg / Mavroudi 2019). Using the Blackboard, teachers are able to connect with students and hold lectures online.

These discussed opportunities and challenges that the society comes upon due digitisation leads to another topic – how new technologies change Our Industry?

3.3 Industry

21st century led by many innovations challenged not only the education but the industry as well. However, said that, challenges can lead to greater good of society. Industry often works along education; thus, digitisation affects both sectors at the same time. It could be said that digitisation brought the industry and education closer together. Cisco and Intel launched partnership with University of Melbourne (Australia) in 2008 to identify skills that students need to succeed in their future careers and teach them. Thus, the partnership (ATC21S – Assessment and Teaching of 21st Century Skills) focuses on making the students acquire skills needed for 21st century this increasing the knowledge of younger work generation. Another example is the Energy Biosciences Institute (EBI) which is a partnership created in 2007 to overcome energy problems (c.f. Edmondson 2012). Over 300 researchers gather with the same goal to reduce impact on fossil fuels, leading investigation using technologies, digitised data. It was supported by BP providing a 10 years $500 million grant. This is another example portraying how industry works together with education along with continuous process of digitisation (c.f. Edmondson 2012).

However, despite the mentioned advantages, the main dilemma when it comes to industry and digitisation is the maintenance of human labour force. As mentioned before, digitisation affects industry by making it cost efficient. However, there is a risk

of technologies taking over human labour force. Current statistics show that the issue arises not because robots or machines change human labour but because individuals do not have the skills to work the machinery. According to European Commission in ICT (Information Technology) sector will be around 756.000 unfulfilled job vacancies (Milano 2019). Current statistics show that digital sectors contribute to big percentage of GVA (Gross Value). In 2015, over 7% in UK's GVA was from digital sectors amounting to around £118 billion (c.f. Great Britain. Department for Digital, Culture, Media & Sport 2017). These numbers show the importance of employees providing trainings for staff members to provide set of needed skills to work with newly introduced technologies. Thus, number of spare job vacancies would decrease and the GVA could have higher rate.

3.4 EU involvement

EU started new development program created in 2014 (Cisco 2016). Its main goal is to integrate technologies in learning process. This should help students at the higher education institutions to not only gain experience of learning set of facts but it focusses on their logical thinking as well. Currently, technologies provide teachers with an opportunity to provide lectures online enabling the professor to be in charge of monitoring the efficiently of learning online, time frame for how much the student spends time on certain exercise. It enables to reduce paperwork. Exercises, notes are being provided on software programs making it an easy access for students and easier for the teachers. Instead of printing out many copies they can upload a shared file that can be accessed by students online. This is a good impact on EU and in the world in general since reduced paperwork leads to reduced needed supplies of paper. Looking from a big perspective, leading to environmentally safe and stable environment. Following this pattern, Erasmus+ Programme Co-funded by European Commission keeps introducing university partnership programmes such as EDUC European Digital UniverCity connecting international students and strengthening the relationship between research and education (European Digital UniverCity – EDUCE 2020).

Another consequence influenced by digitisation will assess the UK/EU approach reports on 3D Bioprinting Regulations. The technological boost led to breakthrough of 3D printing that proved to be useful for regenerative medicine and tissue engineering. Under ATMP Regulation 1394/2007 imposed by European Commission, regenerative medicine and tissue engineering are both considered to be an advanced therapy (c.f. European Digital UniverCity – EDUCE 2020). Therefore, the regulation applies to 3D printing as well. There are other EC Regulations that apply to 3D printing such as EC Tissues and Cells Directive, ruling on standards of the work quality using human tissues and cells (c.f. Official Journal of the European Union 2004). There is still a lack of clarity when it comes to bio printing since bio printing is just a sub-category of 3D printing and different policies apply (c.f. Li / Faulkner 2017). This is not just a statement of several factors regarding EU legal position on 3D printing. It shows

that the new innovations (technologies) bring challenges as their implementing takes time and it takes time for EC to decide on the right approach to deal legally with the use of those technologies. However, the fact that EC issued regulations on this shows the improvement and the help that together with technologies and the knowledge of human being, great results regarding human medicine can be achieved.

UK moves along with digitisation as well keeps increasing its partnerships to boost education using technologies (c.f. Thompson 2014). In 2004-2010 UK worked on JISC programme to digitize scholarly materials carrying the value of cultural heritage (c.f. Jisc 2020). In 2011, British Library settled collaboration with Google to make 250,000 books available to students to access online for free. The books that were used dated back to 1700-1870 providing valuable historical information (c.f. The Telegraph 2020). UK position regarding digitisation of transport is challenged by lack of investments and time period of adaptation. However, UK had taken actions to move forwards towards successful implementation of technologies into daily life. Customer experience for UK transport customers had been improved by providing easy accessibility of mobile payments and possibility to purchase tickets on the spot with a light touch of credit card. However, rail experience still lacks investments into providing better customer experience. Paper tickets still remain leading not only to time inefficiency but paper costs. 'EasyJet' Airlines had started using 'Digital Railway' programme to track passenger information and keeps the data of more than 300 aircrafts (c.f. Techuk representing the future).

UK industry of vehicles is being affected by digitisation and currently described as moving towards a shared vehicle ownership. The graph below implying the changes in the sector of auto vehicles implies that the digitisation changed the perspective of mobility. Currently, in UK, the use of apps such as Uber is increasing and the ways of controlling vehicle keeps changing to more an autonomous way of driving. The right word to describe it is EVOLUTION. The transport system is currently in the process of this phenomenon and it is surprising how many changes keep happening in the sector every day.

Some other European countries such as Romania still have a slow rate of digitisation even the rate of internet users reach over 11 million (c.f. BR Business Review- Where Rumanian talks business 2020). However, the government starts implementing more operational changes boosting the digitisation process in the country. On 13 February, the government released decision with following objectives that included the digital transformation of the economy (c.f. Lexology 2020). Currently, the Romanian government is working on connections between technology and energy, transport, telecommunications. The aim is to contribute to EU Digital Single Market. The framework for copyrights was updated to boost opportunities of digital environment for creators and Romanian Presidency took an action in shaping the EU's framework for

the research Horizon Europe which is supposed to take place between 2021 and 2027. This shows that even this country was behind others in the process of digitisation, it is currently quickly moving towards the successful adaptation of technologies into the fields of energy, mobility and security (c.f. Romania2019.eu 2019).

3.5 Conclusion

Sensible use of modern investments benefit education and carries many more pros than cons. However, it is valuable to keep in mind that technologies should be used as a tool and it is not meant to work as an alternative for teaching provided by an acknowledged individual (professor) in a classroom. It is essential to use those tools sensibly and avoid over consumption. The same perspective goes towards technology used in industry as well. If the labour force is equipped with the skills needed to use the technology, it can lead to great changes in society.

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4. DigI-VET – Aims, structure and core ideas

Marc Beutner

In recent years, digitization has become increasingly important. But, not only digitisation is mentioned in this context but also a word which sound pretty similar – digitalisation. However, while digitisation can be described as the process that converts information from a physical format into a digital setting, digitalisation is the process of leveraging digitisation to improve business processes (cf. Burkett 2017). This means while digitisation only focusses in the change from analogue into digital, digitalisation focusses on the impact of the new digital world and the possibilities of IT and the internet on people and work (cf. Timico 2018). And this is directly connected to the ideas of Industry 4.0 (cf. BMBF 2013) which goes hand in hand with Smart Industry (cf. Euromicron 2019) which focus on intelligent production processes and new business models (cf. BMWI 2019). Industry 4.0 approaches focus on a symbiosis between production and new IT technologies to enhance industry and gather adequate data. Here, digitisation is a key to handle these approaches. Nevertheless, this does not only mean changes in industry and production this also means change and challenges in the field of VET.

4.1 The DigI-VET partners

The Erasmus + project DigI-VET - "Fostering Digitisation and Industry 4.0 in vocational education and training" focuses on these new challenges. The project is coordinated by Ingenious Knowledge GmbH (IK), Germany, a team of eLearning and digitalisation experts from Cologne who creates innovative solutions for companies and schools in the field of VET, youth and adult education. The University Paderborn, Chair Business and Human Resource Education II (UPB), is a German partner in the project and is responsible for concept design, curricular basis, for the structures of the design of teaching and learning materials in a modular way as well as for the evaluation of the project and its results. With a combination of scientific research and practical experiences, UPB offers a variety of competences in the field of digitalisation and Industry 4.0. The chair is involved in several activities in VET and higher education like the work on curricular solutions for VET, design of teaching resources and eLearning settings as well as the design of classroom response systems via smartphones to offer modern teaching in the modules and lectures. The chair connects its teaching work to research and project work to sustain its activities. AR Vocational Education and Training Ltd. (ARVET) is the UK partner in the DigI-VET team and a team of educational experts situated in London.

ARVET focuses on developments in UK and the integration of IT solutions and digitisation in the Anglo-American educational systems and VET systems. It also focuses on VET training as well as on youth, education and training solutions. ARVET together with its sister organisation ELN aims to progress with its 3E philosophy - With 3Es they aim to Embrace diversity, Enhance knowledge, Empower people and this guides the trainers, teachers, coaches and mentors in their daily delivery of innovative, educational and life skills programmes. The Cypriote partner Private Institute Emphasys Centre (EMPH) focuses on the integration of new media and digitisation in southeast of Europe and is an expert on IT courses and VET trainings. The «Emphasys Centre» operates as an «ICT Educational and Vocational Centre» and a «European Research Centre», that cooperates closely with various organisations in Europe for the implementation of EU projects, while it has continued to operate as an «ICT Software Centre». The Romanian partner in the DigI-VET consortium is Asociaţia Oamenilor de Afaceri Argeş, Romania (AOAA). This Argeş County Businessman Association is an NGO, which was constituted in 2003, and has at the present time over 160 members (from this number about 70% are SMEs) which have a total turnover of 2 billion Euro and over 20.000 employees. Arges County Businessman Association is located in Pitesti City, Argeş County, South-Muntenia Development Region – Romania. Argeş County Businessman Association organizes business events, training/educational courses and services for employees to step up their adaptability to change. AOAA promotes entrepreneurship and innovation, support for self-employment and business start-up. In cooperation with local universities, AOAA provides trainings and internships to students and also offers counselling in order to help them start their own business.
The DigI-VET and all partners involved have a specific look at new and innovative ways of learning and teaching in times of digitisation and Industry 4.0. The partner consortium creates awareness of the need to take digitisation and Industry 4.0 into account in the context of vocational education and training (VET). This means that VET educators are in charge of actively promoting it. The development of a corresponding curriculum and teaching and learning materials for digitization are core aspects of the project. This goes hand in hand with the design of an innovative sMOOC for teachers and learners in the field of vocational training, in which the most important aspects of this current topic are presented and conveyed.

4.2 Aims and objectives

The European ERASMUS+ project DigI-VET fosters teachers and trainers in the field of VET as well as the learners with adequate information on the current changes in industry and the world of work related to the use of IT, digitisation and digitalisation. Moreover, the project aims to create Digital Competence Profiles for VET as well as learning resources and an online best practice site with showcases.

The objectives of DigI-VET are to gather information about Digitalisation in Europe and about the new trends in Industry 4.0 to provide an adequate information basis (cf.

Beutner 2018). Therefore, the aim of DigI-VET is to do qualitative and quantitative research in the partner countries to provide an information platform for VET on our website. A goal of the project consortium is also to create a book with background information and didactical hints for VET teachers and trainers. Therefore, DigI-VET addresses the challenges of the rapidly changing environment in economy and transfer this into pedagogical settings. The VET schools have a need for information in different vocational fields, like business administration, production, and marketing as well as in IT. The teachers have to face the new situation and they have to provide the learnings with new learning scenarios, which have to be created. However, such a creation is only possible, if teachers and trainers are aware of the current change. Consequently, DigI-VET has a strong focus on creating awareness to provide a first step towards new approaches in VET.

In DigI-VET the partners will create the already mentioned book, which you are currently reading, in English language. It focusses on digitization and Industry 4.0 and the influences to VET. It provides the survey results and the results of the desktop researches. It also comes with additional checklists and hints for teachers and trainers. DigI-VET includes only two intellectual output focussing the quantitative and qualitative research on the topic and the design of the DigI-VET book.

The DigI-VET Online Observatory is also one of the core ideas of DigI-VET. It offers information about best practices of companies in the field of digitisation including company descriptions. To get to the online observatory just click on the link below. You will find the DigI-VET Online Observatory website directly on the net to be used by everybody free of charge as an OER (cf. Beutner / Pechuel 2019):
http://digivet-platform.eduproject.eu/

4.3 The Intellectual Outputs of DigI-VET

DigI-VET comes with five Intellectual Outputs (IOs) (cf. Beutner / Pechuel 2018). The following figure provides and overview in the five outputs of the project:

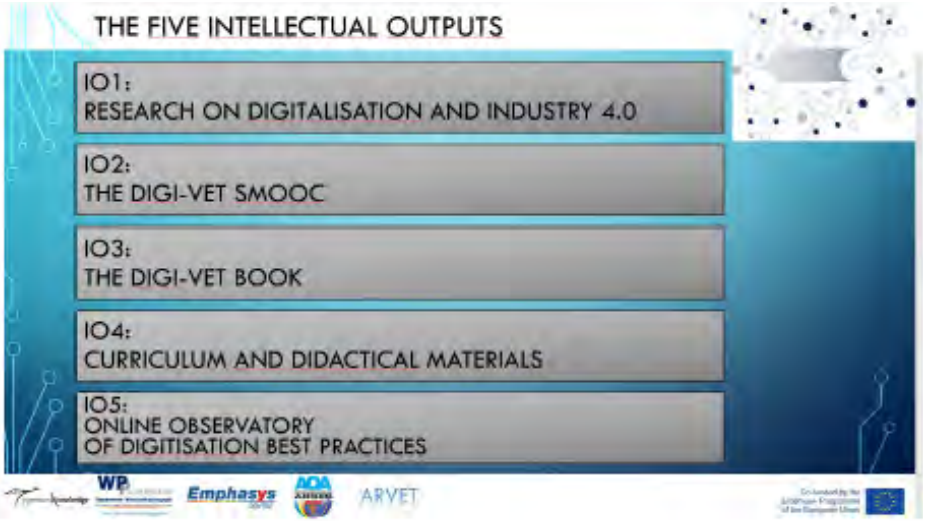

Figure 7: The five outputs of DigI-VET.

IO 1 focusses on Research on Digitalisation and Industry 4.0 and in conducts research that combines desktop research with empirical research.

Within the desktop research all partners in the various partner countries will do a literature review on digitization, digitalisation and industry 4.0. Data will be gathered and best practices will be selected by the researchers.

The empirical research pays attention to the topic in in two ways: (a) with a quantitative study based on multi-language questionnaires and (b) with a qualitative interview study at Industry 4.0 and digitalisation users and providers. Therefore, the creation of questionnaires adjusted to the needs of the target groups have to be created and also interview guidelines have to be designed. Both, quantitative research and qualitative research has to be conducted in this first IO. All data are gathered and this leads to a research report and a best practice database with showcases on the website.

IO 2 has a strong focus on the DigI-VET sMOOC (small massive open online courses). The DigI-VET sMOOCs run on MOOC platform which is called MOOC-IT (c.f. Beutner 2019). It offers the information on the results and the current situation in

digitisation to a broad audience and can be used in VET-courses and VET schools as well. It offers a combination of Graphics, texts, interactive tasks, videos and audios and provides an overview for teachers and learners. Therefore, it is transferable to different parts of the VET system and it is also interesting for enterprises. The MOOC of IO2 is available in all partner languages of the DigI-VET project. The impact is usually huge in this field and it is the idea of IO2 to reach more than 250 users already during the project. The sMOOC also guarantees sustainability after the end of DigI-VET.

IO3 focuses on the DigI-VET book that you are currently reading. In this IO the book and its structure were created, designed, written and checked. All partners agreed on the structure of the book and wrote it in cooperation. The book provides information about digitalisation and industry 4.0. It addresses VET teachers and VET educators and provides insights into the topics. Therefore, it comes with (cf. Beutner / Pechuel 2018):

"- an overview on the current situation
- definitions of digitisation and Industry 4.0
- elements of digitalisation and how to handle them
- elements of industry 4.0 and how to handle them
- Integration of digitalisation reflections in VET
- Integration of Industry 4.0 into courses and VET-schools
- Research Results of the DigI-VET Research
- Challenges and Opportunities
- Insights into best practice
- Future developments in the field" (Beutner / Pechuel 2018)

IO4 is the supporting IO for VET teachers and trainers. The core topic of this IO is the DigI-VET curriculum and the didactic materials. The partners create a curriculum structure to integrate digitisation and Industry 4.0 in VET-courses within this IO. The curriculum contains modules and offers insights into the current developments. Moreover, the curriculum goes hand in hand with didactic materials and resources for teachers who want to integrate it in their own teaching and course structures.

IO5, the last IO of DigI-VET provides additional help for teachers, trainers and learner in VET. The partners create an online tool, where VET teachers can find information of practical examples of digitisation and industry 4.0 (cf. Beutner / Pechuel 2019). The tool provides insights into real existing showcases and offer pictures and wherever possible also videos. Moreover, a description of the enterprise and how it uses aspects of digitisation or digitalization is provided together with contact data as an open educational resource.

4.4 The DigI-VET results

DigI-VET offers the innovative new world of work and IT to VET educational contexts and the curriculum helps teachers to integrate these new challenges into their daily teaching (cf. Beutner / Pechuel 2018). All results including the curriculum and the learning / teaching resources are provided as OER under the creative commons licence. "The fifteen core results of the project DigI-VET are:

(1) the DigI-VET Curriculum
(2) the DigI-VET Learning and Teaching Resources
(3) the DigI-VET Online Observatory with best practice information and videos
(4) the DigI-VET Book on Digitisation and Industry 4.0 in European VET
(5) the DigI-VET sMOOC
(6) the DigI-VET research report
(7) the DigI-VET dissemination materials (posters, leaflets, brochure, cards, pens, flyer)
(8) the DigI-VET Website with Blog
(9) the DigI-VET Checklist for VET educators and teachers
(10) the DigI-VET videos (integrated in the website and the online observatory)
(11) the DigI-VET OER strategy
(12) the DigI-VET digitisation concept for VET
(13) the DigI-VET publications, newsletter and press articles
(14) the DigI-VET sMOOC Concept
(15) the DigI-VET evaluation report" (Beutner / Pechuel 2018).

The DigI-VET project also included Multiplier workshops in each partner country and international conferences / meetings of the developing and implementing partners.

The DigI-VET consortium is happy to have achieved the result and is able to provide good quality. Meanwhile the OER of DigI-VET are listed in the EU-StORe database for OER which fits to the quality criteria of EU-StORe. This ensures, that the results are both sustainable and good quality which is a crucial basis for their use in VET.

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Part C - General Aspects of Digitisation at Companies

5. Digital transformation in industry

Jennifer Schneider

The 21th century is driven by many economic challenges, which are pushed by technological and societal developments. Businesses, especially industrial enterprises improve their agility and responsiveness in order to gain ability to manage whole value-chain and require assistance of virtual and physical technologies (c.f. Akdil / Ustundag / Cevikca 2017). The combination of physical and digital technologies, such as sensors, embedded systems, cloud computing and Internet of Things (IoT) and even more technologies, characterize this century and the fourth industrial revolution (c.f. Onar / Ustundag 2017).

Besides, even our daily, individual and social life goes digital, too. For users, consumers and producer's e-commerce, mobile internet and social media and many other technologies, are part and parcel of our everyday life (c.f. Bouée / Schaible 2015). To sum up, now, digital transformation can be part of every conceivable area and can permeate every link in the industrial value chain: from logistics through production even to individual service provisions (c.f. Ibid.).

But what is meant by digital transformation in industry nowadays?

Several researchers have tried to define the terms and features digital transformation addresses. Common definitions involve properties like value- added, autonomously, data exchange, Internet of Things, communication and interaction in real time, horizontal and vertical integration and even more buzzwords.
The authors Bouée, C.- E. and Schaible, S. (2015), explained digital transformation as follows:

"[…] digital transformation as the seamless, end-to-end connectivity of all areas of the economy, and as the way in which the various players adapt to the new conditions that prevail in the digital economy. Decisions made in connected systems affect data exchange and analytics, the calculation and assessment of options, the initiation of actions and their consequences. In line with Schumpeter's principle of creative destruction, these new tools will bring fundamental change to many established business models and value-

added processes." (Bouée, C.- E., CEO Roland Berger Strategy Consultants; Stefan Schaible, S., CEO Germany/ Central Europe Roland Berger Strategy Consultants, 2015)

In summary, this creates tremendous new opportunities for Europe and the economic environment. More efficient production and new business models are highly promising and improving value. Almost gapless communication and information chains are needed if European industry is to remain competitive (c.f. Ibid.).

On the other hand, businesses have to struggle with new challenges like changes in organisation structures and higher costs for employee teaching and training in digital transformation. The impact of new data, connectivity, automation and the digital customer interface are challenging existing value chains, too (c.f. Ibid.).

That leads to
1) new products and skill set for companies,
2) improving digital maturity to recognize new opportunities and
3) develop suitable offerings, to get them to the market quickly (c.f. Ibid.).

So, it is fact, that the digital transformation opened up by new technologies and structures which contain major changes to European businesses. This is also because of the ability of added value in manufacturing platforms and standardized software solutions which are shifting, too. Simultaneously, new competitors and players are threatening to replace incumbents at the interface to customers (Ibid). For this reason, businesses have to rethink their strategies, processes, structures and products and also their company cultures (c.f. Ibid.).

Concurrent to this, there is a

change from rigid value chains to dynamic value- added network

This can be explained be looking at the value- added: There will be no longer added sequentially and/ or subject to time lags, but a network of units that allows constantly communication and interaction with the business partners, suppliers and other involved person responsible for business processes (c.f. Ibid.).

5.1 Four levers of digital transformation

The last chapter explains the term of digital transformation for industry and business, but what business and especially the employees have to change, adopt and modify in their actual business processes and structures to profit from the benefits and new opportunities the digital transformation in Industry 4.0 have for the future of businesses?

The first challenge businesses have to struggle, is to understand the logic of digitization and digital transformation. Therefore, the authors Bouée, C- E. and Schaible, S. developed a four levers model to explain the influences and effects of digital transformation (c.f. Bouée / Schaible 2015):

The first lever is **Digital Data:**
The influence of digital data improves forecasts and business predictions as well as opportunities to make decisions. Therefore, the digital data has to be captured, processed and analysed.

The second lever is **Automation:**
The combination of traditional technologies and artificial intelligence increase the rise to systems that work autonomously. This leads to the benefits of self- organisation, too. Moreover, this reduces high error rates, speed up and decrease operating costs.

The third lever is **Connectivity:**
Synchronizing the supply chains, decreasing production lead time and increasing innovation cycles are the results of interconnecting the entire value chain via mobile and fixed- line high- bandwidth networks.

The last (fourth) lever is **Digital Customer Access:**
Digital transformation offers new kinds of services and enable a transparency in presenting organisation structures by giving the customers direct access through the internet. The
1) "availability of digital data,
2) the automation of production processes,
3) the interconnection of value chains and
4) the creation of digital customer interfaces is transforming business models and reorganizing entire industries" (Bouée / Schaible 2015).

Pioneer industries such as media, music, retail and tourism industry show how far the transformation have reached our businesses. As one example retail businesses use online department stores and digital speciality retailers. Similar distributive changes are already seen in the automotive as well as logistic sectors, too (c.f. Ibid.).

5.2 Internet of Things

Digital transformation of industry includes the Internet of Things (IoT), a high-quality broadband network and the increasing automation and autonomy of production (cf. Bouée / Schaible 2015).

So, IoT are highly connected and more than familiar to the digitalisation and digitization of Industry 4.0. In 1999 the concept was coined by a member of the Radio Frequency

Identification (RFID) development community. During the last more than 20 years the topic gets more and more important due to the fact of the growth of mobile devices, embedded and ubiquitous communication, cloud computing and data analytics (c.f. Ida 2020). But what means Internet of things or short IoT in general. The authors Patel, K. and Patel, S. discuss in their abstract about "Internet of Things" different perspectives and definitions about this topic (c.f. Patel / Patel 2016). One common definition is defining IoT as a network of physical objects. This means, that the internet is not only a network of computers, but has evolved into a network of special devices of all types and sizes. This includes "vehicles, smart phones, home appliances, toys, cameras, medical instruments and industrial systems, animals, people, buildings, all connected, all communicating & sharing information based on stipulated protocols in order to achieve smart reorganizations, positioning, tracing, safe & control & even personal real time online monitoring, online upgrade, process control & administration" (Sintef / Friess 2013).

To get a more characterful and clearly arranged overview of the different aspects which are included in the term of IoT Patel, K. and Patel, S. generated three subcategories which defines IoT. So, the Internet of things is an internet of three things:
"(1) People to people,
(2) People to machine /things,
(3) Things /machine to things /machine, Interacting through internet" (Patel / Patel 2016).

The idea of IoT is a new revolution of the century of Internet. It is based on the general idea of all general things, especially of our daily and everyday objects, which not include only the electronical devices. These objects are readable, recognisable, locatable, addressable through information sensing device and/or controllable via the Internet, irrespective of the communication means (Sintef / Friess 2013).

Moreover, they include all objects as food, clothing, chair, animal, tree, water, vehicles, etc. food, clothing, chair, animal, tree, water etc. (c.f. Ibid.).

But what is the main innovation in this part? "The Objects make themselves recognizable and they obtain intelligence by making or enabling context related decisions thanks to the fact that they can communicate information about themselves. They can access information that has been aggregated by other things, or they can be components of complex services" (Patel / Patel 2016).

So, the main goals of IoT is to enable things to be connected anytime, anyplace, with anything and anyone ideally using any path/network and any service (c.f.

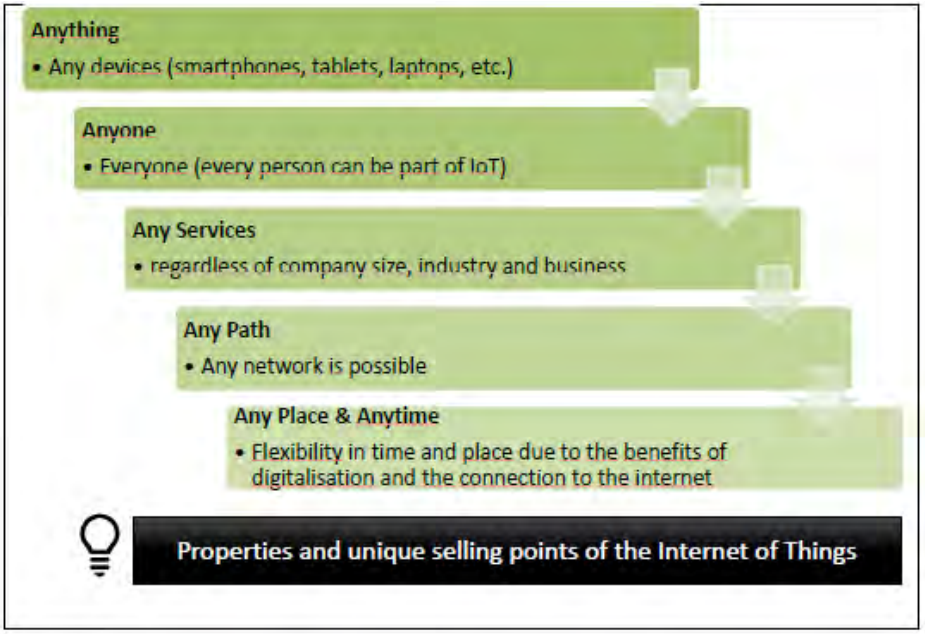

Figure 8: Properties and unique selling points of the Internet of Things.

Besides the goals of IoT there are 7 fundamental characteristics that are defining the Internet of Things (c.f. Sintef / Friess 2014). This includes, among others, especially interconnectivity, which means that everything can be interconnected with the global information and communication infrastructure.

Another characteristic is the things- related service, such as privacy protection and semantic consistency between physical things and their associated virtual things and heterogeneity. Heterogeneity understands the devices that are heterogeneous on the base of different hardware platforms and networks. The goal between this interaction is the hardware, platforms and networks can communicate through different networks. The next trait is the dynamic change. The devices can change dynamically as well as the state of it. Therefore, a high number of devices need to be managed and communicate with each other even through the internet. This sector sums up characteristics to enormous scale. The last two traits are safety and connectivity. Even if we profit from all the goals and positive characteristics of IoT we have to focus on safety. Both the creator and recipients of IoT have to focus on all parts of safety, this include safety in personal data as well as safety of our physical well- being. The authors argue that even securing the endpoints, the networks, and the data moving across all of it means creating a security paradigm that will scale, and have to be focus on the sum total (Sintef / Friess 2014).

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6. Opportunities and challenges of Digitisation and Industry 4.0 in companies

Nicholas Moudouros / Andrianna Georgiou

The concept of Industry 4.0 refers to the fourth industrial revolution. This involves the digital transformation of the industry with the integration of digitalisation in all industrial processes (c.f. IOTSENS 2020). The fourth industrial revolution refers to how technologies such as Artificial Intelligence (AI), autonomous vehicles and the Internet of Things (IoT) are merging with humans' physical lives. The technological advancement impacts on the lives of individuals, companies and governments and leads to a total transformation of society (c.f. CNBC 2019).

Unlike Industry 3.0 which focused on the automation of single machines and processes, Industry 4.0 focuses on the end-to-end digitisation of all physical assets and integration into digital ecosystems with value chain partners (PwC 2016). Industry 4.0 in companies refers to the embedment of digitalisation procedures in business operation processes and machine-to-machine communication.

Some of the examples of the benefits of integration of Industry 4.0 in companies are the following (c.f. Wire 2020):

- Achieve data consistency for remote maintenance via the cloud
- Web server for section-based commissioning and accelerated maintenance
- Generate comprehensive information directly from the signal conversion level
- Online management of documents e.g. google forms
- Data acquisition of production objects (c.f. I-Scoop 2020)

This chapter is concerned with the impact of Industry 4.0 on businesses, providing substantial information on the opportunities and the challenges that arise. The chapter will firstly present the advantages of Industry 4.0 in order to gain a substantial view of what Industry 4.0 can offer. Secondly Chapter 6 will examine the challenges and opportunities that thrive in companies, using a case study of the manufacturing sector.

6.1 Advantages of Digitalisation and Industry 4.0

'If you go back to 1800, everybody was poor. I mean everybody. The Industrial Revolution kicked in, and a lot of countries benefited, but by no means, everyone', Bill Gates stated in Times in 2014 (c.f. TIMES 2014). What does this statement signify and what are the advantages of Digitalisation and Industry 4.0?

Industry 4.0 offers a plethora of benefits for organisation and business' development when these choose to integrate the revolution of digitalisation into their operation procedures. Primarily, Industry 4.0 provides a greater productivity and better management of resources. All data about operations processes, process efficiency and quality management and operations' planning are available real-time, supported by augmented reality and optimised in an integrated network, leaving behind the traditional procedures. Secondly, it offers effective decision-making processes based on real information as well as new digitised products which focus on completely integrated solutions. Thirdly, the integration of digitalised services can importantly reduce manufacturing time both in the design of new products and in the merchandising of these. Prototypes in manufactories can be tested in a virtual way and the assembly lines can then be optimised. Additionally, Industry 4.0 impacts on the evolvement of digital business models and on a better customer access identifying individual preferences and needs.

Among the dynamic elements of Industry 4.0 are IoT platforms, location detection technologies, advanced human-machine interfaces, authentication and fraud detection, 3D printing, smart sensors, big data analytics and advanced algorithms, multilevel customer interaction and customer profiling, augmented reality, cloud computing and mobile devices. All of these, offer the opportunity of digital transformation in the industrial sector. Companies are nowadays under constant pressure to improve and sustain their product quality and competitiveness in the market but also to enhance safety, security and profitability of their business. The automation of services is a fundamental advantage of the Industry 4.0 where it enables businesses to increase their productivity and performance in the global competitive market (c.f. Ericsson 2020).

The strengths of Industry 4.0 lie on the enhancement of optimised manufacturing processes by the automation of the services. This automation enables for the opportunity to work faster through data-driven decision making which aim to boost efficiency, revenue increases and improved customer service. Also, better asset utilisation is increased and labour productivity is strengthened. Moreover, the integration of digitalisation in businesses increases the reliability in supply chain management and influences the effective and consistent performance. Finally, the connected equipment in field service is helping to improve the levels of customer service (c.f. Hitachi Solutions 2020).

Industry 4.0 offers the fundamental opportunity for business to evolve and sustain in the market providing efficiency in their services by addressing successfully the rising and changing customer needs.

6.2 Opportunities of Industry 4.0 in Businesses

Industry 4.0 possess a number of opportunities as well as challenges in companies. This chapter will focus on defining the opportunities of Industry 4.0 in businesses arising in

economic, political, social, organisational and environmental fields.

6.2.1 Economic Opportunities

The integration of digitalisation in business brings about economic opportunities and development. The automation of manufacturing process which is upgraded with smart autonomous systems that are capable of self-cognition, self-optimisation and self-customisation leads into a revolutionary industrial production (c.f. United Nations Industrial Development Organisation 2018). The main tools include AI which enhances industrial processes by enabling the harmonious collaboration between humans and robots in smart factories for mass customisation. Production systems can this way become more dynamic, flexible, efficient, environmentally sustainable and inclusive through extensive customisation and personalisation. Industry 4.0 creates opportunities that contribute to a more reliable and consistent productivity and better-quality products. The integration of digitalisation in companies result also in economic gains, such as in increased revenues because of lower transaction and transportation costs. Specifically, Industry 4.0 contributes to increased resource efficiency and helps to achieve circular economy models. IoT and e-commerce platforms create new opportunities for Small and Medium Enterprises (SMEs) to provide products and customised services using digital platforms offering the opportunity for SMEs to internationalize networking with other companies across the globe. SMEs benefit from lead firms in global value chains by also creating new products. As a result of the shift to mass customisation the role for SMEs is importantly increased.

PwC (2014) finds that the Industry 4.0 is furthermore expected to add important revenue for the European Union (EU) reaching €110 billion annually over the coming years. The study notes that the digitalisation of the products and services has positive effects on market share and increases global competition.

6.2.2 Political Opportunities

The rise of competitiveness is interrelated with gains in productivity which that in turn depends to a large extent on investments in innovation. In the EU, digitalisation could play a significant role in industries in which the EU has been traditionally leading, such as the chemical industry, mechanical engineering and motor vehicles while these industries at present are characterised by medium-high technology and medium-low skills. Industry 4.0 can therefore significantly boost innovation through the development of new markets and introduction of new competitive products and services (c.f. European Parliament 2016).

Moreover, Industry 4.0 is linked with reduced costs in the production phases. The digitised systems lead into a fully integrated, automated and optimised production flow which that has a direct impact on changing traditional production procedures between humans and machines. The industry 4.0 offers the opportunity for reduced

costs in production and simultaneously results in low labour costs (c.f. Market Watch 2019). Further so, governments gain the opportunity for a transformative shift to global competition (c.f. Tay et al. 2018). Among the benefits within the state, are the development of start-ups, the provision of high value services, high skilled labours as well creating technologies instead of buying (c.f. Abhipedia 2018).

With the high increase of employing high-skilled workers in machines and production facilities, Information Technology (IT) experts and programmers are needed. As a consequence, changes in national education and training systems will need to reflect the needs of the new market increasing high-quality offered education which will boost skills and career progression. Additionally, continuous learning and professional training are necessary to develop the new skills required. Governments are expected to design new training portfolio for new workforce skills requirements to support the digital transformation of companies (c.f. United Nations Industrial Development Organisation 2018). Hence, technical education is centralised and this can impact on the learning opportunities of individuals increasing their chances for career prospects.

6.2.3 Social Opportunities

The integration of digitalisation in companies requires from the labour market to adapt to the new conditions of automation. Despite the risks expected in regards to the low degree of adaptability as we will see in the next chapter, Industry 4.0 provides positive development of human work. The development of new markets with greater quantity and variety of products and services along with the improvement of the existing jobs' efficiency contribute to an increasing demand of goods and services and consequently to a labour demand increase. As displayed in Figure I, the use of new technologies imposes labour demand especially of high-skilled workers who are expected to lead the professions in the digitalised market. That in turn, will affect incomes among high-skilled workers (c.f. Zervoudi 2020).

Figure 9: Opportunities of Industry 4.0 in Labour Market.

A particular example is the information and communication technology (ICT) sector which is driving major transformations in the labour market. Eurostat (2019) finds that ICT specialists in the EU grew by 39.1% in the last decade while 63.1% of specialists completed a tertiary level of education. As OECD (Organisation for Economic Co-operation and Development 2019) explains, digital technologies tend to substitute for workers in carrying out simple cognitive and manual activities following explicit rules ("routine" tasks), while computers complement workers in carrying out problem-solving and complex communication activities ("non-routine" tasks). In that context, new job opportunities are expected to be developed across all industries which embed new technologies in their operation procedures.

6.2.4 Organisational Opportunities

Industry 4.0 transforms the business model where the new model, enables optimised value creation structures and networks. Business model in essence refers to 'a management hypothesis about what customers want, how they want it, and how the enterprise can organize itself to best meet these needs' (c.f. Burmeister 2016). Industry 4.0 business model emphasizes the creation of value from generated data where the central role is assigned to end-users e.g. customers and networks that enable value creation. The improvement of traditional business model is derived from the incremental innovation of value creation and value delivery. Business are required to adopt a new business model based on the main features related to the Industry 4.0 such as real-time capability, interoperability and the horizontal and vertical integration of production systems through ICT systems. The development of changing business models will therefore contribute to succeeding individual demands through provided tailored services and holistic offered solutions. Particularly, the integration of cloud-based management solutions allows for better interactions with suppliers and customers. New disruptive business models attribute to service orientation and specifically to the ability to transfer the new value generated to the customer in the form of new or improved services (c.f. IOTENS 2020).

6.2.5 Environmental Opportunities

Industry 4.0 can play a major role in energy efficiency and environmental sustainability. As Gabriel et al. (2016) explain, through the real-time data collection, optimal control of processes, machines, and resources can be achieved. Real-time data also enables companies to minimize inventory which that enables the safer management of resources. Furthermore, Industry 4.0 allows for efficient energy management because power consumption can be measured automatically by using Smart Meters. Industry 4.0 decreases material resources and energy consumption. The digitalisation of services reinforces the improvement of recycling capacity as a result of embedded digitalised systems that store information. New technologies such as 3D printing use less waste while companies can manufacture products at a lower cost.

6.3 Challenges of Industry 4.0 in companies

Beyond the opportunities defined in the previous chapter, Industry 4.0 possess challenges in businesses which will need to be taken in mind to eliminate the barriers of integrating digitalisation faced by the business sector. This chapter will focus on defining the challenges of Industry 4.0 presented in businesses arising in economic, political, social, organisational and environmental fields.

6.3.1 Economic Challenges

While companies willing to transform the traditional operation procedures into digitalised ones, those who are unwilling to adapt to the changes Industry 4.0 offers are left behind. The changes need to be made towards integration of new technologies such as robotics and artificial intelligence, require massive investments and capital (c.f. Teachutzpah 2020). Such investments eliminate the opportunities of SMEs to transform their current systems procedures, eliminating chances of gaining competitive advantage and sustaining their place in the global digitalised arena. A research by Human Sciences Research Council (HSRC) "Meta-Research" (2018) concluded that 63% of business experts stated that their business future depends on the Industry 4.0 transformation. That in turn, places businesses in the need of establishing standards that will allow their transmission to digitalisation via exploiting large quantities of data as Industry 4.0 requires to.

Therefore, a risk factor for companies is the lack of capital especially for SMEs mainly because these enterprises are not able to access how it will affect their value chains and modernised systems are expensive (European Parliament, 2015). To this extent, governments need to promote policy measures that could facilitate better integration of SMEs into the digitalised transmission as well as companies to increase cooperation with other businesses in order to build a value network which could produce products in a flexible fashion.

6.3.2 Political Challenges

A significant challenge Industry 4.0 needs to address is data ownership and security. Within the context of Industry 4.0, large quantities of data are being collected and shared. Enterprises are required to maintain data privacy and avoid share of data with other enterprises. Cybersecurity, intellectual property and data privacy are among the challenges noted as a consequence of managing an immense volume of data. Businesses need to use systems to analyse data properly, with machine learning and AI. Nevertheless, to address this challenge, governmental and European rules on privacy, data storage and copyright which secures data protection is a perquisite which ensures the successful development of Industry 4.0 in businesses (c.f. European Parliament 2015). Moreover, advanced use of technology leads into the development of legal issues in regard to monitoring and evaluating employees. This assumption is influenced by the use of an autonomous digitised system which links different value networks to

produce a specific product. As previously noted, Industry 4.0 offers the opportunity to individualised product creation however Intellectual property rights (IP) of the design of the product need to be secured. In this respect, the French Council of Economic Analysis has proposed the securing of a balance between the stimulation of innovation by protecting IP and the sharing of knowledge.

6.3.3 Social Challenges

In the social aspect, Industry 4.0 brings about privacy concerns. A study presented in the 21st International Conference on Advanced Communication Technology (ICACT) in 2019 noted that the enablers of Industry 4.0 include AI and Robotics, Augmented Reality (AR), IoT, Cyber-Physical System (CPS), Cloud and Big Data and Blockchain Technology which all impact on data privacy concerns. For instance, the AI and Robotics enables for real-time image processing revealing human identity and leaking personal information. Furthermore, the AR imposes the risk of sharing personal data through the use of cookies or beacons to gather information. Also, CPS can develop privacy revealing information because of interfering with the physical properties of the system and through cyber-attacks. Industry 4.0 possess ethical challenges that need to be addressed specifically through policy measures, regulations and awareness as it stands as a barrier to the many opportunities that it offers and to the its evolution.

On another note, concerns over the impact of technological changes in the digital sphere, connectivity, robotics and big data on the labour market need to be taken in mind. The growth of Industry 4.0 could expose workers at the risk of automation which that could lead into loss of low and medium skilled jobs. The World Bank estimates that the increase in automation will risk almost 57% of jobs in OECD countries (c.f. Zevroudi 2020). Whereas, this impact is interrelated with the educational background of population in each country meaning that the most educated and high-skilled workforce seems to be better adapted to the new technological requirements and increasing salaries, while less educated and low-skilled workers are more exposed to income loss and unemployment. As Prisecaru (c.f. Dimitrie Canterim Christian University 2016) proposes, for the effective adaptation to technological challenges, an emphasis should be given on education and re-education as income distribution is affected and low-income groups could be mostly affected. The role of educational technology to overcome the challenges presented is stressed. Better equipped individuals will secure their places in the digitalised market increasing their career prospects and skill-set. Moreover, creative workers such as strategic planning or research and development are expected to gain important role in filling up positions as a result of the new and innovative business opportunities offered by Industry 4.0 (Deloitte 2015).

6.3.4 Organisational Challenges

In relation to privacy concerns, companies could be exposed to malicious attacks that result in serious financial burdens in addition to immeasurable losses such as data

corruption, system crashes, privacy breaches, prestige, customer, reliability and market losses (c.f. Evrural 2018). Companies need to overcome the challenges regarding cyberattacks which are expected to be inflected due to the expansion of network connections. Cyber-attacks in businesses have already increased over the last decades. The specific situation requires businesses to strengthen their cyber security capabilities and to develop new strategies with technological investments in IT security thus to curb a risk of cyber-attack.

Furthermore, another challenge business could potentially face as an outcome of Industry 4.0, is the lack of high-skilled IT employees. The demand for big data analysts, along with specialisation of analyst roles is expected to be increased. The number of professionals that will provide protection and support for online activity covering fraud and identity theft to social media and reputation management are also to be needed (c.f. Dimitrie Canterim Christian University 2016). Businesses also need to maintain the integrity of production processes. Referring to data protection, data integrity also determines the consistency between customer requirements and the manufacturing of a product based on these needs. In essence, data include relevant product information and either products or individual information cannot be used without managing data properly (c.f. Friedhelm LOH Group 2014). Hence, when data security and integrity is threatened, integrity in production processes is worsened.

6.3.5 Environmental Challenges

One of the main issues of identifying challenges as well as opportunities of Industry 4.0 in environment is the lack of substantial evidence on industry 4.0 and impact on environmental sustainability. Nevertheless, as previously stated, the data transformation brings about efficiency gains and improves productivity and resources are used safely and effectively (c.f. European Parliament 2016). That in turn, has a positive impact on climate change and the environment mainly through the conservation of energy and resources, consumption of renewable and less polluting energy, recycling, minimisation of packaging and reduction of carbon emissions (c.f. AGPR 2018).

6.4 Adoption of Industry 4.0 in the Manufacturing Sector

The German councillor Angela Merkel described the industry as 'the comprehensive transformation of the whole sphere of industrial production through the merging of digital technology and the internet with conventional industry' (c.f. European Parliament 2015). In the manufacturing sector, Industry 4.0 refers to the rapid changes in the design, manufacture, operation and service of manufacturing systems and products. In other words, ´Manufacturing 4.0´ creates changes in the overall operation of the sector including suppliers, plant, distributors and products taken that are all digitally connected, providing a highly integrated value chain. Smart factories, the Industrial Internet of Things, Smart industry and Advanced manufacturing all underlie the sector's digital transformation from the traditional manufacturing processes.

6.4.1 Digitalisation in the Manufacturing Sector

The rapid growth of digitalisation revolutionised the traditional manufacturing processes. The use of digital technologies as mentioned above create opportunities for the introduction of cyber-physical production systems. The following figure displays the development phases of industrial manufacturing:

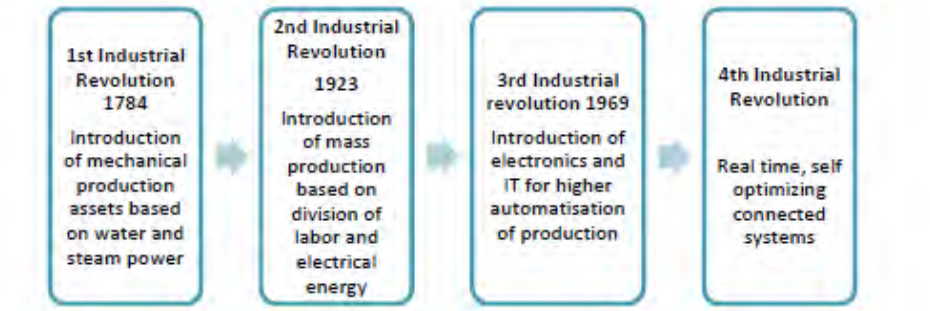


Figure 10: Digitisation in the Manufacturing Sector based on Berger, R. 2016.

Today, Industry 4.0 in the manufacturing sector results in the exploitation of the following digitalised technologies that are widely used. Such paradigms centralize connectivity and automation:

• Hardware Computing: Data storage, In-memory Computing, Embedded systems, Micro Computing

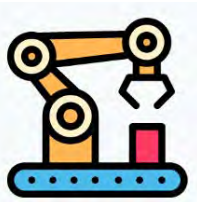
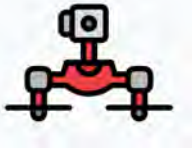
• Software: Real-time data processing, Business process software, database management systems, cloud computing, real-time image processing, advanced algorithms, machine learning

• Production Hardware: Robots, 3D Printing, Traditional Machinery, Automation equipment

• Interfaces: Visual sensors, Biometrics, Magnetic Stripes, Camera and imaging systems, semiconductor-based systems, Traditional Sensors (c.f. Ibid.).

6.4.2 Examples of Industry 4.0 in the Manufacturing Sector

Some of the examples of the integration of Industry 4.0 in the manufacturing sector can be found below:

Factory Robots 	• Found in factories, warehouses and distribution centres • Through 2-D and 3-D vision systems for locating parts or features in space, the system can handle a product family rather than a single item • Force sensing allows control over side loads and accurate assembly work • Collaborative robotics in manufacturing (cobots) use power- and force-limiting technologies and sensors allow humans and cobots work together in assembly jobs
Supercomputers 	• Generate state-of-the art computer graphics imagery and animation to produce motion graphics • Increase quality at the lower cost of production • Supporting innovation of design processes and creation of new products • Allows for optimisation of numerical simulation.
Drones 	• Computer-based technological innovation consists of: > Hardware (aircraft, remote controller, installed payload, local navigation support system, energy supply system and IT); > Software (programmes and algorithms to control flights and communication, navigation system); >Support processes (manual piloting for automatic or autonomous flights, and interpreting the data collected by the drone). • Ability to conduct physical tasks process data • Inspections carried out by drones reduce the amount of labour-intensive work and reduce the need for scaffolding • Using drones for the inspection of hard-to-reach equipment and installations speed up the operations • Replace manual human inspection of hard-to-reach equipment and hazardous areas • Efficient data collection to support layout planning and redesign

Digital Twin 	• Designed to simulate specific complex deployed assets such as jet engines and large mining trucks in order to monitor and evaluate wear and tear to help future design • The digital Twin includes sensors that are distributed throughout the physical manufacturing process and collectively capture data (behavioural characteristics of the productive machinery and works (identifying thickness, colour qualities, hardness, torque, speeds), and environmental conditions) • A digital profile of a historical and current behaviour of a physical object or process that helps to optimize business performance through identifying errors of the twin, opportunity for saving costs, improving quality and achieving greater deficiencies
Pressure sensors and switches in a plane 	• Used in nearly every system of modern aircraft • Managing flight control and indicate flight instrumentation • Monitor the pressure in hydraulic systems used for braking, moving control surfaces, and lowering and raising the landing gear. • Used for the safe operation of the aircraft as they provide information on maintaining the proper pressure or temperature

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Figure 10: Digitisation in the Manufacturing Sector based on Berger, R. 2016.

6.4.3 Manufacturing 4.0 Opportunities

As section 5.2: Examples display, Industry 4.0 plays a major role on the development of the manufacturing sector. Manufacturing 4.0 creates opportunities in the field of resources and processing management, in the assets, in labour, in inventory and quality and in the services provided.

More specifically, it creates opportunities in the smart energy consumption through the use of automated building management systems. Data collected through sensors, actuators and controllers can help to provide weather forecasting and real-time pricing of electricity embodying the safer use of energy and at lower costs. Also, through the use of new technologies monitoring precise product information is enhanced. The networking of industrial assets through sensors, software and wireless connectivity can be used to provide an accurate snapshot of equipment performance to then achieve optimal performance (c.f. Avnet Aracus 2020).

In terms of asset utilisation, the opportunities refer to the ability of companies to address equipment breakdowns and machine flexibility. Remote monitoring and predictive maintenance are promoted through accurate data processing. The opportunities found

in the labour market signify the human-robot collaboration as well as the automation of knowledge which that could lead into changes in the procurement, marketing and customers' services. Flexible production and increased customisation as well as real-time supply chain optimisation lead into the ability of reducing goods in stock and logistics costs as well as enhancing the flexibility of logistics. Industry 4.0 provides opportunities for manufacturing businesses to assess the performance of their products and also to maintain the capability of their products without be physically present.

6.4.4 Manufacturing 4.0 Challenges

Industry 4.0 creates challenges in terms of the employment sector where the role of digitalisation systems is increased and needs for employing high-skilled labour is promoted. Human labour is in a challenging position underlying the importance of technical education. Professions that are expected to find a landscape of opportunities are: robot-coordinators, data scientists, mechanical engineers, technicians, programmers and maintenance jobs. As a result of the new professions to be developed in order to cope with these changes, low-skilled labour will decrease especially in companies which will sooner adjust in the latest industry development (c.f. Tecjitzpah 2019). 91% of European manufacturing companies are already investing in digital factories (c.f. PwC 2020). On the other hand, and in the organisational aspect, Industry 4.0 creates challenges in respect to the identification and correction of misconfigurations, preventions of operational disruptions and securing the network against cyber threats (c.f. Forescout 2019).

6.5 Conclusion of Chapter

This chapter defined the main challenges and opportunities of Industry 4.0 using a case study of the manufacturing sector. Specifically, the rise of automatisation provides challenges and opportunities in economic, political, social, organisational as well as environmental fields.

The increase of productivity through supply chains and also revenue gains are among the most important economic strengths Industry 4.0 brings about in companies. However, companies especially SMEs might face difficulties in terms of lack of access to capital to transform their operation processes. Industry 4.0 importantly results in political opportunities ensuring high investments in innovation and rise of competition. The competition is ensured through the development of start-ups, the increased productivity as well as through the increase in the number of high-skilled workers. With the increased number of highly skilled workers, low-skilled labour is reduced. Consequently, a significant opportunity that arises is restructuring education which will emphasise technology and digitalisation. Moreover, the transformation from manual labour to automation jobs impact on the increase of skills and higher income. In the organisational context, Industry 4.0 proposes changes of business models which will emphasize the creation of value, real-time capability which reinforce demand matching

and therefore succeed in offering improved services.

Nevertheless, in respect to political, organisational and social challenges presented, data security and legal issues are among the most important challenges of Industry 4.0. Data security in turn affiliates with a social threat of personal privacy concerns where companies need to formulate a specific framework of protecting these data. Within organisation, challenges are regarded to IT security issues and the rise of cyber-attacks requiring businesses to strengthen their cyber security capabilities and to develop new strategies with technological investments in IT security & integrity in production processes. This is also well-portrayed in the case study of the manufacturing sector where identification and correction of misconfigurations, preventions of operational disruptions and securing the network against cyber threats are stressed. Industry 4.0 furthermore enhances environmental sustainability and specifically energy and resource consumption as a result of the real-time data collection and optimal control of processes. The case study of the manufacturing sector showed that Manufacturing 4.0 creates opportunities in the field of resources and processing management supporting environmental sustainability and on the other hand, monitoring precise product information. The role of Industry 4.0 in manufacturing is central as it creates opportunities in economic development through production processes, in increasing need for high-skilled professionals and affects the quality and in the overall services provided, to taken that all manufacturing processes are digitally connected, thus providing a highly integrated value chain.

Therefore, the main challenges presented are data security issues and Industry 4.0 effects on the labour market. To address these challenges, companies and governments need to initiate measures which restrict fragility in the data. Moreover, governments need to not only invest in digital business innovation and start-ups development but also in education, restructuring education system, emphasizing technical skills development to equip individuals with all skills necessary for their successful integration in Industry 4.0 high-skilled professions.

Indisputably Industry 4.0 places advantages in companies. This automation enables for effective decision making through data-driven results which aim at the increase of productivity and business performance in the global competitive market.

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Part D General Aspects of Digitisation at Schools

7. Digitisation at School – Supporting tools for organisational issues

Nina Fröhlig / Rasmus Pechuel

An important concern of this publication is not only the development of digital competence for teachers, school leaders and pupils but also the way schools and their infrastructure can profit from digitisation. Schools can use digital support in organisational structures as well as for teaching and learning. This part of the book will talk about the status quo in different European countries and give information on how and where digital support can help in schools.

Pettersson (2017) writes in his literature review on the issues of digital competence in educational contexts that this is also a concern of research. He posited that digital competence should be considered as an organizational characteristic or task that includes various actors and competences as a part of a digitally competent school organization.
Vanderlinde and van Braak's (2010) have conducted a study on the e-capacity of a school. They define it as "collective competence… to implement ICT in a way that is a lever for instructional change" (p. 542). Their model includes critical factors of success such as goals, leadership, policy planning, decision-making, technological infrastructure, technology support, collegiality, professional development, staff's digital competence, and pedagogical use of digital technologies.

Organisational and institutional infrastructure can either hinder or support educational and organisational change. Somekh (2008) postulated that "organisational structures of schooling often make it impossible for ICT tools to be explored and appropriated pedagogically" and that educational systems "can be understood as outdated infrastructures resisting inevitable change" (p. 450).

Blau and Shamir-Inbal (2017) explored the complex and longitudinal process of developing a school ICT culture. They combined factors that predict such development: frequency of teacher's ICT use, development of pedagogy by means of technology, teachers' digital competence, design and use of digital content, teacher-parents and school staff e-communication and pedagogical updates of class websites.
Illomäki and Lakkala (2018) developed an innovative digital school model (IDI), to provide a framework for research as well as a research-based model for schools to reflect on, understand and improve their own practices to achieve sustainable pedagogical improvements with the help of digital technologies. As a conclusion from their study, they suggest that to improve schools with digital technology, all elements of the model should be included in the evaluation and development process.

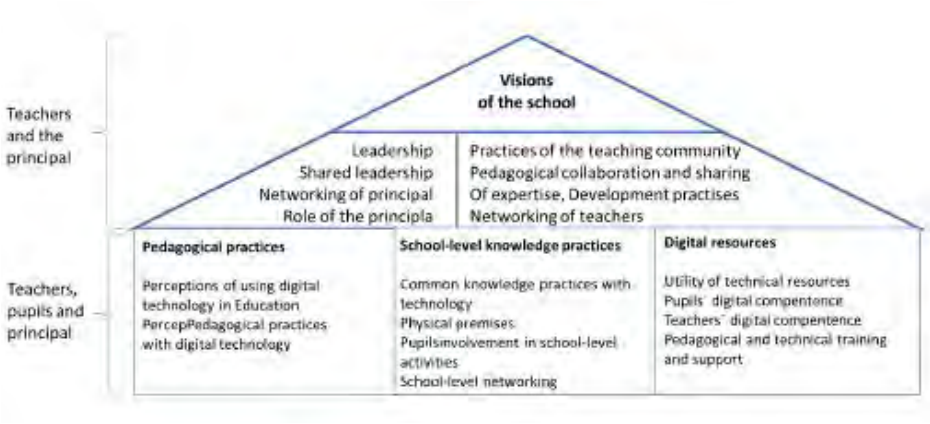

Figure 11: The innovative digital school model: elements of a school regarded as relevant for developing schools through digital technology (Ilomäki 2018) Own graphic based on Ilomäki 2018.

7.1 Situation in European Countries

A large majority of European countries are investing or planning to invest in schools' digital infrastructure. These investments are seen as an important need in relation to digital education and are part of a digital education strategy in many countries. There are relevant differences between countries regarding the national digital environment and the content and scope of strategies. Many national strategies are still quite young and it might be too early to measure their progress and impact.

Many European countries have a specific strategy on digital education, a strategy integrated into a broader strategy or no top-level strategy related to digital education. Most European countries have top-level strategies. Monitoring and evaluation of these is less common. Only half of the countries use these instruments and only eight countries carry them out regularly. This could be improved, because top-level authorities could benefit from more systematic follow-up, especially regarding the rapid changes in digital education, which means that strategic objectives become outdated very quickly (c.f. European Commission et al. 2019).

7.2 Supporting Digitisation in schools

7.2.1 Investment in ICT infrastructure

It stands out that some countries e.g. Finland, Sweden and Denmark currently have no ICT investment plans for schools. These are among the countries with the most advanced digital economies among EU member states. Conversely, Bulgaria, Romania, Greece, and Poland have the least developed digital economy. This could explain why some of the countries with already advanced digital economies do not currently have any top-level policies related to investment in school digital infrastructure.

Another Survey of Schools on ICT in Education (c.f. European Commission 2019) also gives some empirical insight into the availability of IT infrastructure in schools. The survey shows that on average, across Europe, the higher the education level, the more schools are highly digitally equipped and connected: 35 % of schools in primary education, 52 % in lower secondary education and 72 % in upper secondary education. Here are some examples for ICT investment plans for schools in Europe:

• In Germany, the Federation and the Länder have launched a digitalisation pact (c.f. DigitalPakt Schule) in March 2019. The Federation provides five billion euros and the Länder each contribute with a minimum of 10 % of the amount invested by the Federation over a five-year period for digital equipment in schools. The Länder are responsible for the initial and further training of teachers, the revision of curricula, the acquisition of learning software as well as safeguarding and maintenance of digital infrastructure.
• In Ireland, the Digital Strategy for Schools provides a rationale and a Government action plan for integrating ICT into teaching, learning and assessment practices in schools for the period 2015 to 2020. The strategy has committed 210 million euros to support investment by schools in relevant infrastructure, out of which 60 million are distributed in grants to schools.
• In Spain, the policy Escuelas Conectadas (connected schools) is being developed to extend ultrafast broadband access to all Spanish non-university schools. Since 2015, 13 regions have already joined this strategy, which involves the participation of 11 577 schools; 4 170 016 students will benefit from this policy.
• In Poland, the government project of the Nationwide Education Network (Ogólnopolska Sieć Edukacyjna – OSE) aims to reach 30 853 schools and over 5 million potential users (both students and teachers) to overcome digital exclusion and provide equal educational opportunities for all students, particularly those living in low populated areas. Over 372 million euros and 38 million euros per year for project maintenance over 10 consecutive years have been allocated for its implementation (European Commission et al. 2019)

One trend that started more than a decade ago is the 'bring your own device' (BYOD) policy. BYOD makes the process of imparting education cheaper, as schools don't have to install their own technological devices. A Survey of Schools shows that there is a high variance in the reported usage rate of students' own digital devices for learning purposes in different countries. This also depends on the implementation of an official BYOD policy (c.f. UNESCO 2013).

7.2.2 School digital plans

The development of a school digital plan seems to be an important element to emphasise the importance of digital competence as well as innovative teaching and learning methods in a holistic school approach. Teachers are more likely to use ICT in their teaching, and emphasise the development of students' computer and information

literacy if the school is supporting ICT use through a planned and collaborative approach. A European Study found that 31 % of students in primary education, 34 % of students in lower secondary education and 30 % of students in upper secondary education attended schools that had written statements specifically on the use of ICT for pedagogical purposes. Regardless, only a few European education systems include such requirements in their digital education strategies or regulations.

In achieving the integration of ICT and technological solution, the school leader must have a proper digital plan for the school. The plan is a blue print for the school to design and manage ICT programme for teachers and students in a systematic and progressive manner (European Commission et al. 2019).

Petterssons analysis indicates that to build a digitally competent school organization, it is important to develop an environment in which actors and practices are given room to change and evolve. Central components are building digitally competent teams to drive change and development, implementing technical equipment, organising technical and pedagogical support, managing time and budget, and addressing aspects of leadership (c.f. Pettersson 2017).

7.2.3 Specific training for school heads

School heads have an important role in the integration of ICT use in school, as their leadership is an important lever for change. They can motivate staff, set objectives, develop school digital plans, coordinate efforts, and create a climate favourable to innovation.

There are two main approaches towards developing digital leadership in schools: the training of school heads and the appointment of digital coordinators.

Training of school heads is less frequently and less explicitly stated in terms of objectives in current national strategies. Only one-third of the European education systems have, in fact, current measures in this area as part of their current strategy (c.f. European Commission et al. 2019).

Learning the basic of word processing, spreadsheets, presentation software, using web page and the Internet are prerequisite to boost their computer skills. In order to stay ahead and becoming a competitive person, a leader must keep abreast with the recent technology. A school leader must be well informed and technologically conscious (c.f. Adu et al. 2013).

Pettersson emphasises the importance of both internal and external professional development. Some school leaders describe how they arrange "internal seminar series, learning cafés, inspiration blogs, web courses, and web-based materials for staff". Beyond

this, school leaders and educational technologists also argued for external professional development in the form of formal courses, guest speakers, lecturers, or researchers as inspiration (c.f. Pettersson 2017).

7.2.4 Appointment of digital coordinators

In about half of the European education systems, there are policies to support the appointment of digital coordinators in schools. Digital coordinators, known also as ICT coordinators, may be assigned different tasks and responsibilities, but these usually cover both technical and pedagogical aspects. The digital coordinator role is usually assigned to ICT teachers or teachers specialising in digital education (c.f. European Commission et al. 2019)

In gaining ICT expertise and fund raising, leaders can foster good partnership and collaboration with the community, public and corporate sector. Resourceful leaders should explore many avenues for acquiring technology resources in order to increase accessibility and equity of ICT among the students (c.f. Adu et al. 2013).

7.2.5 Parental involvement

Parental involvement in a student's education is widely seen as an important aspect for students' success and behaviour in school. The parents' attitudes and abilities are important in determining whether they can provide effective support for the development of their children's digital competences. However, only a minority of education systems currently report practical measures to involve and support parents in digital education. It is very rare for such measures to feature in the main objectives of digital education strategies.

Hagel and Brown (2005) found that many schools push information to parents but do not provide any means for parents to share information. They suggest that schools need to enable parents to pull information when needed and communicate with the school when needed. Technology allows for this type of communication.

These can include voice-calling systems, websites, email, and parent portals. Voice-calling systems allow parents to keep in touch with the school by having messages sent to their preferred phone number, whether it is a cell phone, work phone, or home phone. Websites, if updated regularly, allow parents access to important news and events about the school. Teacher websites provide parents with homework assignments and class news. Parent portals allow parents to access students' courses, homework assignments, grades, and attendance. The portals allow parents to directly communicate with teachers via email through a direct link if they have questions about their student's progress.

7.2.6. Digital learning resources

Digital learning resources should be part of a school's digital plan as they can facilitate and improve student's learning. These are on the political agenda in many European

education systems. Policies to improve the development and availability of digital learning resources (including Open Educational Resources) are evident in 32 education systems in Europe (c.f. European Commission et al. 2019).

7.2.7 External evaluation of digital education

Of the countries that carry out external school evaluation, only 14 include specific criteria related to digital education in their external school evaluation frameworks. In these education systems, evaluators are required to consider different aspects of digital education including how well digital technologies are integrated into teaching and learning or school management processes, or whether the quality of IT infrastructure meets the required standards (c.f. European Commission et al. 2019).

As the use of new technologies is increasing, the school should anticipate and prepare for an ongoing change. In doing so, leaders can exchange information with other schools, be it in pedagogical methods or managerial styles. They can benchmark schools that have good reputation for having an established ICT system in teaching and learning or using ICT effectively in school management. This will broaden knowledge and ideas in integrating ICT in schools (c.f. Adu et al. 2013).

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8. Digitisation in the Classroom - Learning Tools

Jennifer Schneider

Digitisation has become part of our daily life, even in the environment of our classroom and influences our teaching and learning behaviour. That means that the rise of digitisation in schools is embedded in many parts the ´traditional´ teaching methods and with new technologies, solutions and tools across classrooms.

This chapter shows a detailed overview of classroom and learning tools, which could be used to increase the learning productively and fascination of the learner. Therefore, an extensive online research was carried out to identify a wide variety of different tools (to download or as app version).

The list of results does not claim to be complete or permanent availability of the link address, but rather serves as a selection of potential contact points for the creation of (open) learning and teaching resources. The two main categories which were looked into during the desktop research are

Category I: Online tools for collaborative work in real time; can be used for teaching and learning classes as well as self-learning sessions (synchronous communication)

Category II: Online tools for creating online tasks which can be used afterwards for teaching and learning classes as well as self-learning sessions (non-synchronous communication)

Hereinafter, the overview sums up a selection of the main results of the desktop research:

Online Learning and Teaching Tools	
Category I: synchronous online tools	
Name / Link	Notes/ Descriptions
Quizlet Link: https://quizlet.com	• American online study application that allows students to study information via learning tools like flashcards, games and tests

Kahoot https://kahoot.com/	• Quizzes: user-generated multiple-choice quizzes that can be accessed via a web browser or the Kahoot app • the game-based learning platform, used as educational technology in schools/ educational institutions
Miro Link: https://miro.com/	• Teamworking Tool: Various possibilities, collaborative work, chat and video function
Padlet Link: https://padlet.com	• Creation of mind maps, diagrams, work plans, maps etc. • collaborative work in real time. • Download results
SlideWiki Link: https://slidewiki.org/	• Creation of presentations, • collaborative work / sharing with others • wide variety of charts, various templates • CC license can be selected directly
Category II: non-synchronous online tools	
Name / Link	Notes/ Descriptions
H5P Link: https://h5p.org/	• Create, share and reuse interactive HTML5 content, tasks and interactive Videos (etc.) in your browser
MOOCit Link: https://moocit.de	• Creating Online classes and course for learner and trainer • Everyone can create a course: great explanation video • Create Mini/ Baby/ sMOOCs and big MOOCs: up to your aims and objectives
Timetoast Link: https://www.timetoast.com/	• Create, share and reuse timelines to explain contents • collaborative work with learner and trainer is possible

Powtoon Link: https://www.powtoon.com	• creating videos and presentations for learning and training sessions • Even useable for YouTube
Trello https://trello.com/	• Users can create their task boards with several columns and move the tasks between them. Typically, columns include task statuses like To Do, In Progress, Done.

Table 3: Research / desktop research

8.1 Synchronous online tools

In the next step there will be a more detailed explanation of the functions, benefits and handling of the non- synchronous online tool H5P and MOOCit as well as the synchronous online tool Kahoot!. The Pädagogische Hochschule Freiburg is a German University of Education and offers the platform MOOCit, as a German result to use, create and share Massive Open Online Courses. The next step, is a detailed explanation of this online tools because of their user-friendly handling, quick and uncomplicated login as well as the active use of the tools in the European partner project DigI-VET.

8.1.1 In Detail: Focus on H5P.org

H5P is an online tool to create, share and reuse interactive HTML5 content in your browser and benefits from the advantage, that the tool just needs a web browser and a website with H5P plugin to empower everyone to create interactive, time and space flexible, content (c.f. H5P 2020).

After a quick and easy login everyone has the opportunity to select under a wide variety of all possible content types to create materials. In total H5P offers more than 40 different content types like e.g. multiple-choice tasks, collage, interactive videos and fill in the blank.

Step one: Create an account (highlighted with red circle)

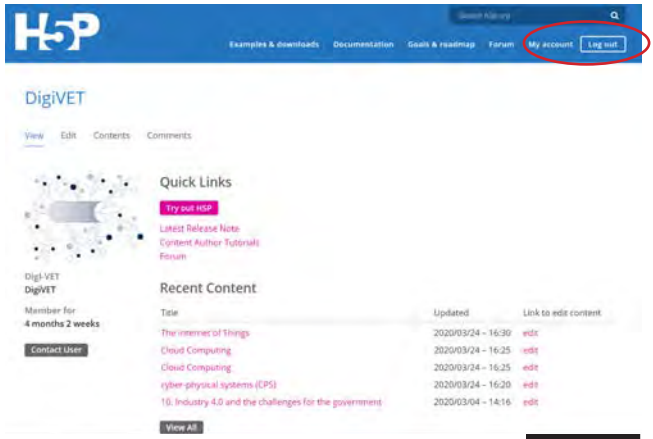


Figure 12: Screenshot: H5P.org. Retrieved from the Internet: https://h5p.org/user. Access date: 23.04.2020.

Step two: Select a content type from -in total- 46 content types. In this example: Multiple Choice tasks.

Then you will be directed to the next page, where you can fill in the blanks your questions, tasks etc.

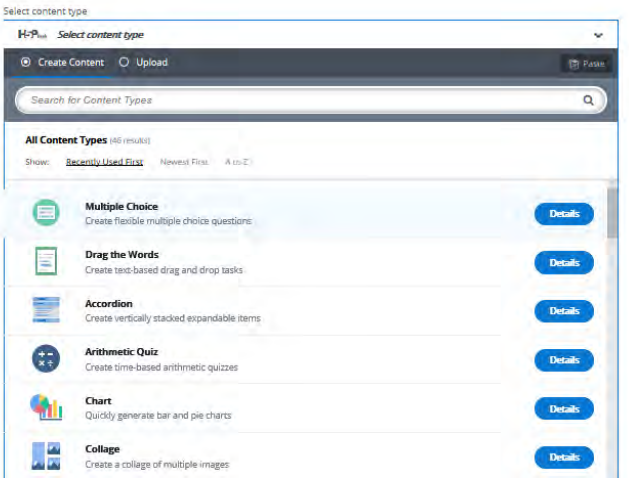
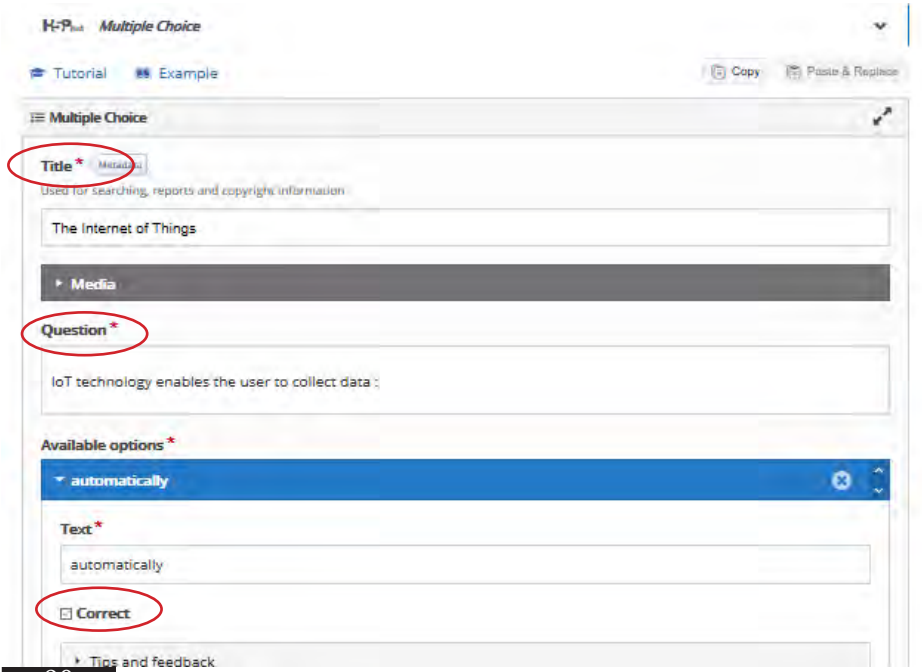


Figure 13: Screenshot: H5P.org. Retrieved from the Internet: https://h5p.org/node/add/h5p-content. Access date: 23.04.2020.

Step three:
Fill in the Multiple-Choice question and answers in the empty spaces. Therefore, you can create a title and different available options. The options can be created as right and wrong answers.



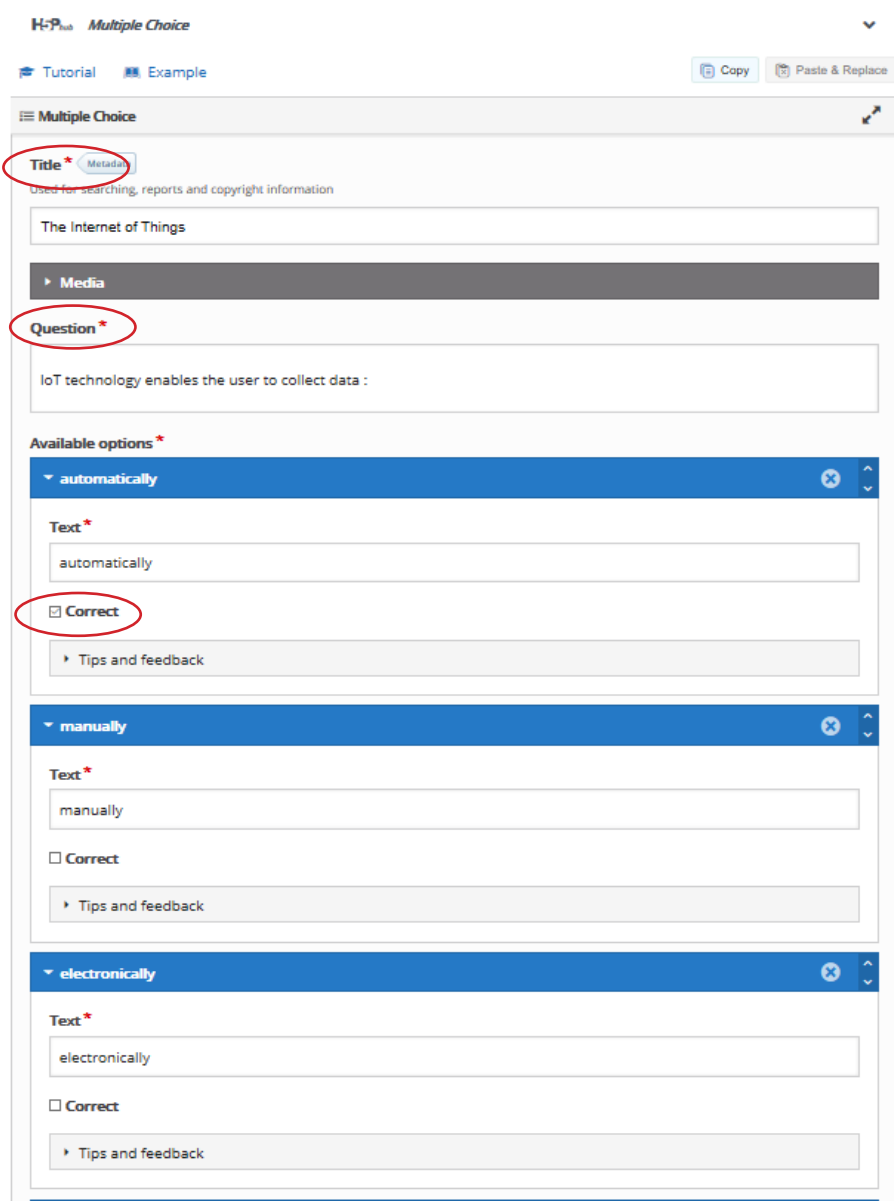


Figure 14: Screenshot H5P.org. Retrieved from the Internet: https://h5p.org/node/760859/edit. Access date 23.04.2020.

Step four:
After the questions and answers have been created (step three), they are displayed as an active task (see Screenshot below). Now the user has the opportunity to embed the tasks as hyperlink in his/ her website, blog, or Moodle etc.

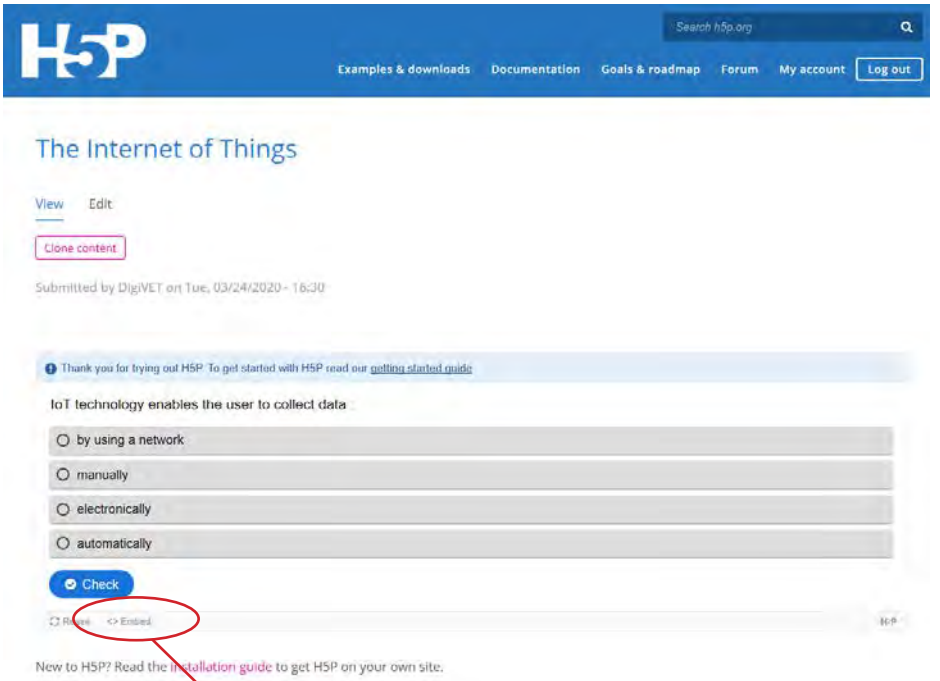


Figure 15: Screenshot H5P.org. Retrieved from the Internet: https://h5p.org/node/760859?feed_me=nps. Access date 23.04.2020.

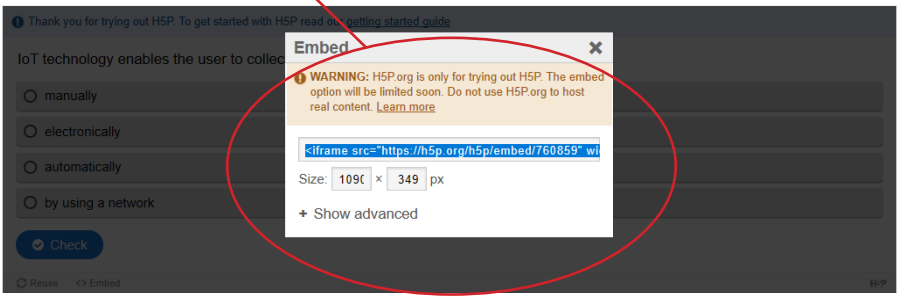


Figure 16: Screenshot H5P.org. Retrieved from the Internet: https://h5p.org/node/760859?feed_me=nps. Access date 23.04.2020.23.04.2020.

Final step five:
The H5P tasks contents can be embedded in any platform that supports embedded content (iframes). Moreover, it also provides integrations for Canvas, Moodle and other systems that support the LTI standards. The figure H5P integrations shows six integrations for LMSs.

Figure 17: Screenshot H5P.org. Retrieved from the Internet: https://h5p.org/. Access date 23.04.2020.

8.1.2 In Detail: Focus on MOOCit

The platform MOOCit is a free offer of Massive Open Online Courses- short MOOCs, for everyone involved in school life and includes Mini Open Online Courses, short Mini MOOCs as well as regular Massive Open Online Courses, short MOOCs. The German Pädagogische Hochschule Freiburg is a University of Education that creates this online platform for learner and trainer to share, create and remix online learn courses. The slogan of the platform says: Online Courses from learner to learner! This means, everyone can be creator, trainer and teacher of a topic and learner of another subject at the same time. The online courses can be used for blended- learning classes and self- learning sessions, too. Therefore, the creators of MOOCit define the following features of the online tool:

- MOOC = Massive Open Online Course (video-supported internet learning course with interactive tasks)
- it = invitation to act or IT (information technology)
- P4P = No university elite course, but by and for students (peer for peer)
- Mini = Small, manageable, feasible topic section (no complex MOOC)

MOOCit offers advanced trainings in MOOCs in education with the most powerful and flexible design. It animates and distribute learner and trainer online courses in a great digital transformation of training activities. At least with the integration of H5P tasks (see In Detail: Focus on H5P.org).

MOOCit has a great explanation and guidelines how to create a MOOC on MOOCit, because of the fact that MOOCit is a German example of MOOC creator the website

is in German language as well as guidelines. Moreover, there is a video that describes step by step the creation of a new MOOC, too. At least, the creator don´t need any skills in programming language: everyone can be creator just by go through the steps and explanations of MOOCit. The following link forwards you to the German guidelines of MOOC creation:

Tap to the link:

https://moocit.de/index.php?title=MOOC_it_-_MOOCs_f%C3%BCr_die_Schule:%C3%9Cber_MOOCit,_P4P_Mini_MOOCs

Step one: Create an account and login
The first step is to create an account and to login. In the next step, you can create a new MOOC

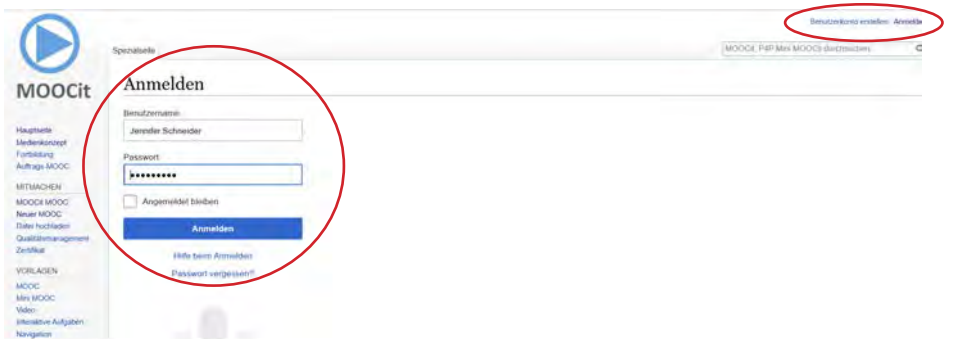


Figure 18: Screenshot: MOOCit. Retrieved from the Internet: https://moocit.de/index.php?title=Spezial:Anmelden&returnto=Benutzer%3. Access date 28.04.2020.

Step two: Create a MOOC
The platform helps to create your own MOOC. Therefore, you get a checklist with hints e.g. how to select a MOOC name:

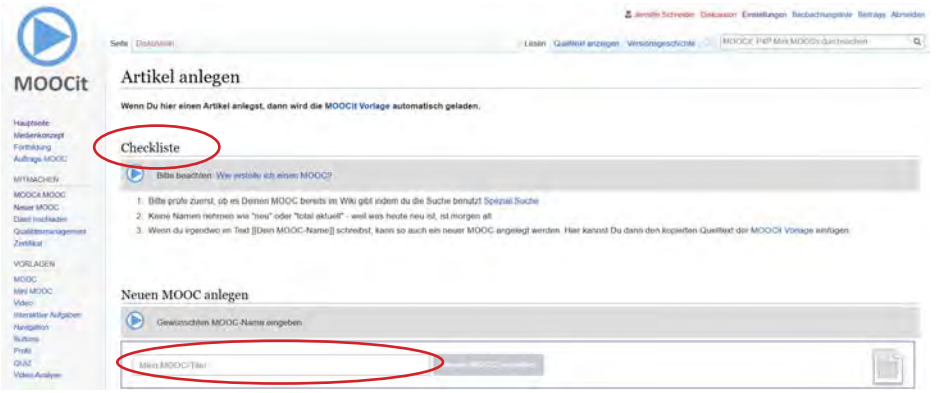


Figure 19: Screenshot: MOOCit. Retrieved from the Internet: https://moocit.de/index.php?title=Artikel_anlegen. Access date: 28.04.2020.

Step three: Follow the instructions of MOOCit

After following the guidelines and instructions of the platform you can create an online course with e.g. iframes. Therefore, you have the opportunity to use YouTube videos, H5P tasks and Wiki tools. The next screenshot shows the project MOOC of the European partner project DigI- VET:

Figure 20: Screenshot: MOOCit. Retrieved from the Internet: https://moocit.de/index.php?title=DigI-VET_-_English_sMOOC. Access date 28.04.2020.

8.1.3 In Detail: Focus on Kahoot!

The game- based learning platform Kahoot! is a user-generated multiple-choice quiz that can be used as web browser version as well as Kahoot! App for mobile devices and tablets. The platform is used by educational technology as well as educational institutions

(see Kahoot!; link: https://kahoot.com/). Therefore, the trainer creates an account and creates a quiz, shares the link and provides the learner passcode to sign in the game.

Step one: Create an account and log in

The first step is to create a user account and log in the platform. The provider will guide you through the website and helps to start the online tool.

Figure 21: Screenshot: Kahoot! Retrieved from the Internet: https://kahoot.com/. Access date: 29.04.2020.

Step two: Discover the Kahoot! platform

The Kahoot! platform has two different main areas:

A) Creation of a quiz and

B) playing a quiz.

The user has the opportunity to select between these two areas. At the frontpage there is a search field to search for quizzes from other creators, too. At least there are more than 30 million public games available, more than 50% of US teacher use the platform and the players are from more than 200 countries of the world (see Kahoot.com).

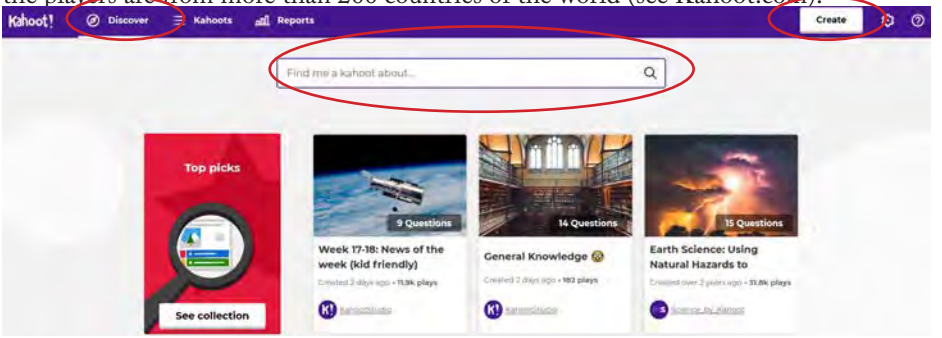


Figure 22: Screenshot: Kahoot!, Retrieved from the Internet: https://kahoot.com/. Access date: 29.04.2020.

Step three: Create a quiz

First of all, -

The user has the opportunity to create his/ her own online quiz. Therefore, the creator goes on "create" (see last screenshot): Then the platform provides the user to the next page, where the new quiz can be created. The user can select between the integration of YouTube links, Images from a library or his own server. Then he/ she can select the answer options as well as time for answering the question. Moreover, the import of spreadsheets is possible, too.

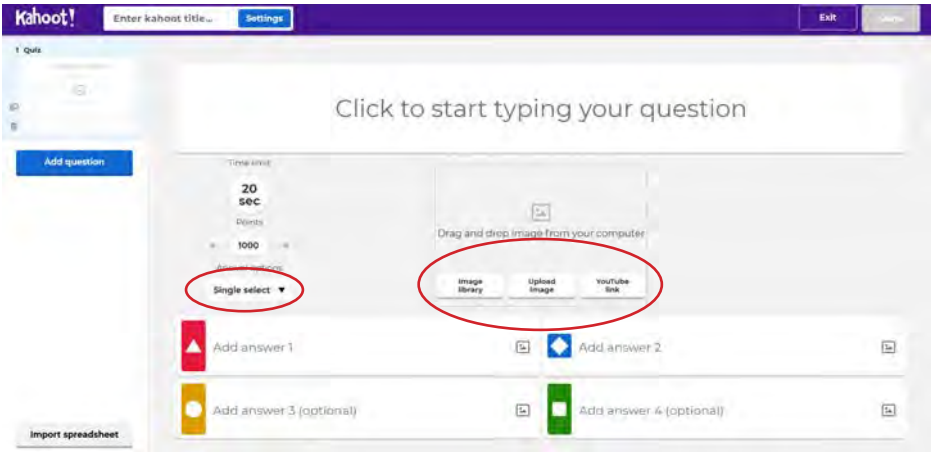


Figure 23: Screenshot: Kahoot! Retrieved from the Internet: https://create.kahoot.it/creator. Access date 29.04.2020.

Second, -

After filling in the answer sheets the quiz can be spread to the potential gamers. In our example for "DigI- VET Book", there is a image from the server and four potential answers. The two correct answer options have to be activated by the creator. Moreover, more than just one question can be created for this quiz: tap on "add question" (highlighted in red). At least the creator has to tap on "done" and the next page guide you to the next step (highlighted in red).

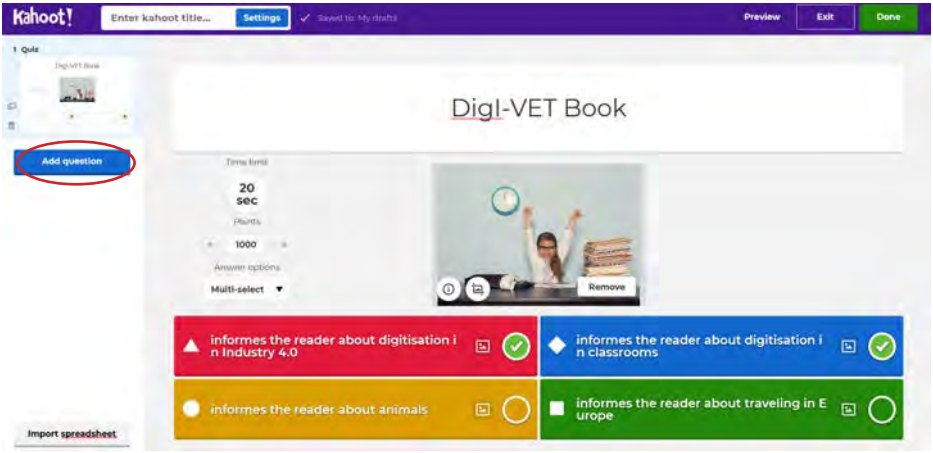


Figure 24: Screenshot: Kahoot! Creation of a quiz. Retrieved from the Internet: https://create.kahoot.it/creator/2874be7c-93ce-48dc-9cf5-f58e78183360. Access date: 29.04.2020.

By tapping on "done" the "finishing touches" has to be entered in the empty spaces: Create a title and optional a short description of your Kahoot! quiz.

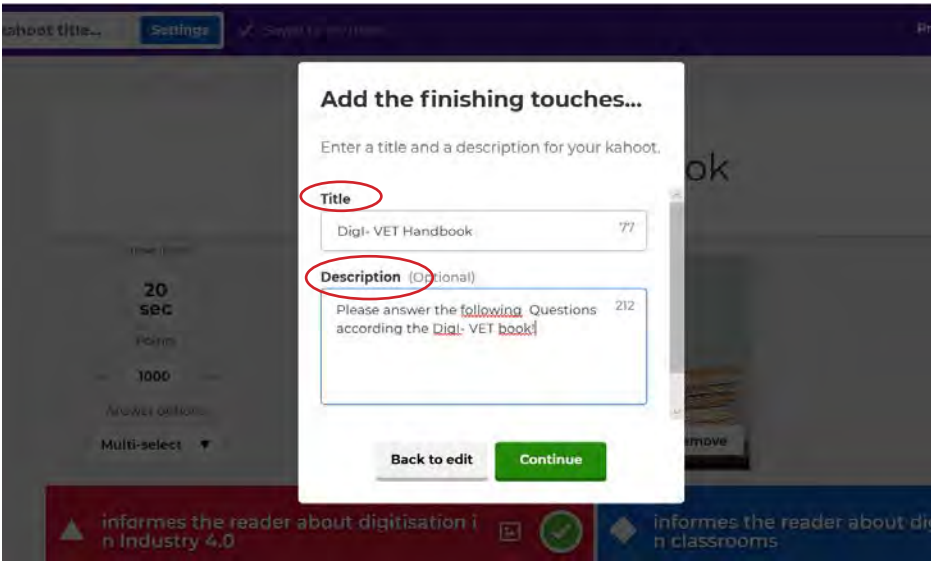


Figure 25: Screenshot: Kahoot! Retrieved from the Internet: https://create.kahoot.it/creator/2874be7c-93ce-48dc-9cf5-f58e78183360. Access date: 29.04.2020.

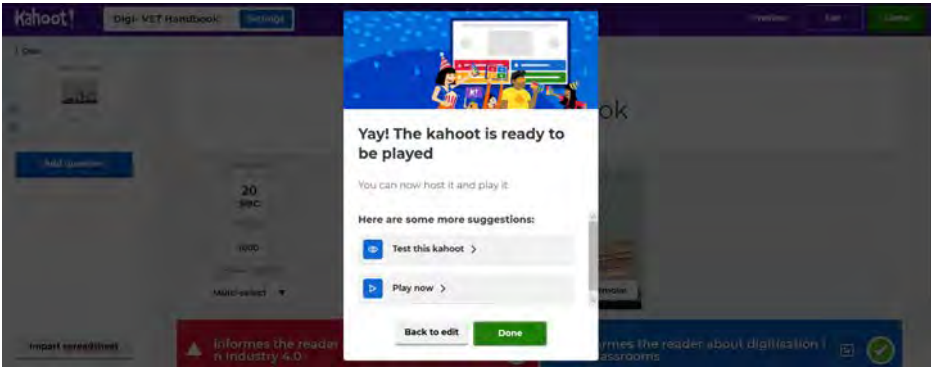


Figure 26: Screenshot: Kahoot! Retrieved from the Internet: https://create.kahoot.it/creator/2874be7c-93ce-48dc-9cf5-f58e78183360. Access date 29.04.2020.

Now you can spread the Kahoot! quiz to your learners. You can find the quiz on your account under ´My Kahoots´ (see Screenshot below).

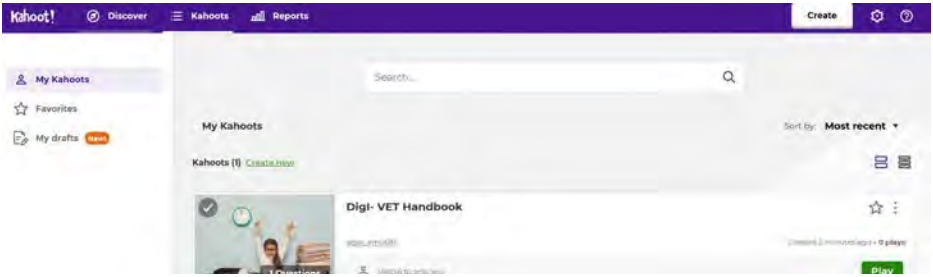


Figure 27: Screenshot: Kahoot! Retrieved from the Internet: https://create.kahoot.it/kahoots/my-kahoots. Access date: 29.04.2020.

At last: instruction to play the quiz.

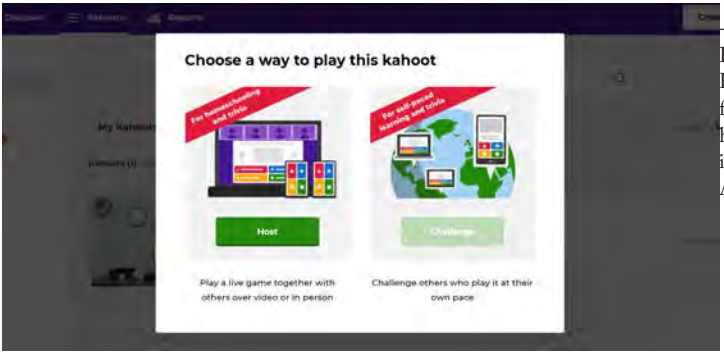


Figure 28: Screenshot: Kahoot! Retrieved from the Internet: https://create.kahoot.it/kahoots/my-kahoots. Access date: 29.04.2020.

8.2 Summary on synchronous online tools

To sum up, the above presented online tools: have a wide variety of different features and functions which can improve your learning and teaching routine. Moreover, because of the digital use and creation, all tasks can be shared quite easily with many learners and interested users. Therefore, the open license of Creative Commons can be very helpful to spread the documents by considering the national and international copyright.

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9. Perspectives from Web 2.0 authoring tools in company, teacher and learner training: H5P and POWTOON

Paolo Ravalli

From October 5th to 7th, 2004, O'Reilly publishing house and the company MediaLive International host a conference at the Hotel Nikko in San Francisco. The conference was attended by executives from innovative start-ups and industry titans such as Jeff Bezos, Mark Cuban, John Doerr, Mary Meeker, Craig Newmark, and dozens more. For three days they held discussions on the subject of "The Web as a Platform".

During a brainstorming session with Dale Dougherty and Tim O'Reilly in preparation for the conference, the term ´Web 2.0´ emerged, which quickly became an overarching term for a new generation of web services. With this term ´Web 2.0´, a new business model was created that focused on openness, cooperation (Tim O'Reilly spoke of "architecture of participation" at the conference) and network effects in order to provide customer benefits, profit and prosperity for society to generate.

During a brainstorming session with Dale Dougherty and Tim O'Reilly in preparation for the conference, the term ´Web 2.0´ emerged, which quickly became an overarching term for a new generation of web services. With this term ´Web 2.0´, a new business model was created that focused on openness, cooperation (Tim O'Reilly spoke of "architecture of participation" at the conference) and network effects in order to provide customer benefits, profit and prosperity for society to generate.

Some time later, O'Reilly clarified his thoughts on the subject and listed some features for Web 2.0.

• Web 2.0 as a continuous process of interaction between software and its users (´The Eternal Beta´).
• Web 2.0 as a platform where content is open to reuse and, if possible, can be further combined by others (´small pieces loosely connected´).
• Web 2.0 not as an application that is located on a client or server, but as an API, as an interface that is located in the area between devices. (´Software above the level of a single device´).
• Web 2.0 as a platform for open software instead of proprietary and closed solutions (he also noted: "However, this does not mean that the idea of a competitive advantage

disappears!").
• Web 2.0 as a place where technology or content is not central, but where data becomes a competitive advantage ("Data is the Intel Inside"); (Presentation files of the Web2.0 conference can be found at: http://conferences.oreillynet.com/web2con/).
Since then, the discussion about Web 2.0 and the related applications, platforms and technologies has sparked and the term has increasingly become a buzzword in the media and social debate. Sébastien Tran, who a few years later drew a first balance sheet on the subject of ´Web 2.0´ and tried to define the core issues contained in the discussion about Web 2.0, summarized the results of his analysis as follows:

"Notre revue de littérature souligne d'abord que le Web 2.0 ne peut se résoudre à une simple dimension technologique. Même si l'on peut associer le concept à certaines innovations technologiques, le plus important réside dans le caractère très transversal des technologies, tant au niveau des usages (échange de données, communication synchrone, capitalisation des connaissances, génération et enrichissement de contenus par les utilisateurs...) que des technologies à proprement parler (mondes virtuels, blogs, wikis, flux RSS...)." (Tran 2011, p. 21).

This shows that the debate about Web 2.0 is not a simple technical discussion about Internet technologies and software standards, but rather a discussion about the role of users, their participation in the creation of content, the definition of common rules and theirs Embedding in (social) structures and systems.

In this regard, Kerres (2006) speaks of a shift in borders through Web 2.0:
User vs. Authors. Users turn from passive consumers of content and information to active authors and curators (consider the scenarios of a mashup). Local vs. away. The line between local and remote data storage and processing is blurring. This also affects the issue of access and control over one's own data, and in some cases complete control over remote data is no longer possible. Private vs. public. Private matters are increasingly becoming public. This breaks and changes the usual social rules of communication and inevitably leads to the emergence of a "third dimension", that of the "social profile", which is decisive for an online social community.

In fact, it is difficult to define exactly what Web 2.0 means because it covers such a wide spectrum: from applications, including blogs, mashups, wikis and feeds, to social bookmarking, social networking and media sharing sites. At this point, however, we can highlight some of the features of Web 2.0 that are relevant to adult education.[3]

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[3] The film The Truman Show from 1998 offers an interesting portrayal of a life where there is no longer any boundary between private and public to document the life of a person from birth and to present it to viewers via live broadcast on television.

Web 2.0 is essentially a participatory web that evolves through the participation and interaction of its users. Web technologies are becoming more and more open and accessible due to the availability of "free" or "open source" software: high-quality digital cameras, electronic devices and smartphones enable the creation, automatic tagging and distribution of content (such as videos, photos). Users create their own content that previously required a range of experts, skills and specialized paid equipment.

Chris Anderson (2006) emphasizes:
"the motives to create are not the same in the head as they are in the tail'. People are driven by monetary motives at the head, but the coin of the realm at the lower end of the tail is reputation." (Anderson, p. 73)

The quality of the content does not result from the examination by a recognized and central authority, but from collective and cooperative work. Paul Anderson (2007) calls this the "power of crowdsourcing". Web 2.0 acts here through its technologies and social practices as a kind of binding agent for the work of individual individuals, who together produce a common result (consider here that the user community plays a considerably large role in the development of projects such as WordPress, Moodle or H5P plays).

This effect, the network effect, is considerably increased by Web 2.0: not only does the added value of a network increase the more nodes and users it has, but its quality also increases through the cooperative work and improvement by its actors.

A final feature is (as defined by Tim O'Reilly in the Web 2.0 conference) the so-called ´long tail´ of Web 2.0. In short:

The force of many: 1 million sites with 1000 users is far larger than 100 sites with a million users.

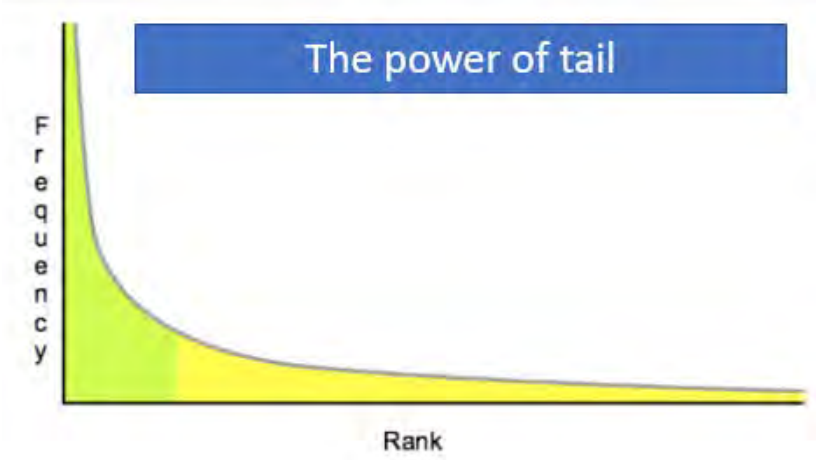

Figure 29:
The power of tail, based on Anderson 2007.

If you look at the content of some top websites and their use (left side of the graphic), you can see that only some content (in green) can show intensive use. You can see in the diagram that the function of the frequency of use runs asymptotically towards zero (each more you go to the right in the graphic). The content in yellow shows a significantly lower usage.

In Web 1.0, the content on the left would then be considered. However, by breaking through the entry barriers in the creation of content and the inexpensive storage options provided by Web 2.0, the ´rat tail´ (on the right) is in principle infinite. This means that niche content, which previously would have received little attention, is enjoying increasing success in the age of Web 2.0.

Web 2.0 increases their number enormously, and accordingly their total, so that they make up ⅔ of the total. O'Reilly comments in the conference presentation in 2004:

The force of many: 1 million sites with 1000 users is far larger than 100 sites with a million users. But this not only changes the amount of content on the Internet: Web 2.0 increases the capillarity of knowledge and information, as other target groups are addressed.

Relevance and potentials of Web 2.0 for adult education

Web 2.0 in its diverse forms, such as wikis, blogs, podcasting, social tagging and social channels, is not only relevant for marketing, business management, organizational theory and information technology, but also for learning - especially for learning in a business context.

An important factor is the changed age structure of the employees as well as their expectations in terms of knowledge absorption. Looking at demographic change, it can be said that millennials and Generation Z now make up the largest proportion of the workforce, and that their proportion will continue to increase.

These target groups have different demands and expectations of the design of information exchange processes than the Baby Boomers generation (born in the 60s). A study by TECH Smith from 2017 showed that 47% of the surveyed participants watched at least two information videos per week and 28% of the respondents watched an instruction video at least twice a week. Information videos were seen as videos in which facts, ideas, news and descriptions are presented. In an instruction video, on the other hand, certain instructions are conveyed, often in the form of tutorials with step-by-step instructions. Not least because of the increasing private use of YouTube or similar video portals that offer a ´video-on-demand´ function, expectations and habits have changed permanently. YouTube enables uncomplicated, self-directed and individual information acquisition. This means that information and learning processes are increasingly changing.

Digital natives have shorter attention spans and fewer opportunities to think about topics. Instead, they have greater visual ability, the ability to focus on different media simultaneously, and the ability to monitor changes and make inductive discoveries. [...] What is new is the special combination and intensity. We now have a new generation with a completely different mix of cognitive skills than its predecessors - the digital natives (c.f. Franklin / Harmelen 2007, p. 19).

The use of Web 2.0 tools and platforms opens up some potential for adult education. On the one hand, the learner can actively participate in the process of learning and knowledge building and actively construct his knowledge. Koper and Sloep (2002) speak of learning networks and "agents / actors" to emphasize their character as protagonists. Learning is not a passive process of absorbing information, but rather "The autonomy of the learner is taken as the starting point, rather than a design based on particular instructional principles. Through the users' learning behaviour, inductively learning 'principles' emerge." (Koper / Sloep 2002, p. 21)

On the other hand, learning with Web 2.0 technologies can be strongly linked to social networks: the ´Communities of Practice´. The learner is seen as an active participant in a social structure instead of an anonymous consumer of knowledge resources.

After all, participating in such social communities is also a source of commitment and motivation. Mutual social recognition and participation in collective activities is a factor that promotes the building of ethical relationships between people involved in a community of practice. The importance of networks for generating new knowledge (and learning) can also be found in some more recent learning theories. Siemens (2004) founds some of the basic ideas of his connectivism in this type of connection, where cognition and social affairs are strongly intertwined. Learning and knowledge are based on diversity and differences of opinion. Maintaining and maintaining connections is necessary to enable continuous learning. The ability to recognize relationships between fields, ideas and concepts is a core skill in learning.

Choosing what to learn and what the meaning of incoming information is seen through the lens of a changing reality. Searching, linking, combining and evaluating knowledge are more important than any individual knowledge.

9.1 Potential for use in in-company training and further education

We would like to make a few comments here, especially for the operational context. Individual and organizational learning are important elements for the ability of a company to adapt to its environment and to establish itself successfully in the long term. "Creating, preserving, and utilizing information flow should be a key organizational activity. Knowledge flow can be likened to a river that meanders through the ecology of an organization. In certain areas, the river pools and in other areas it ebbs. The health of

the learning ecology of the organization depends on effective nurturing of information flow." (Siemens 2004, p. 6)

In this context, Web 2.0 instruments are a helpful means so that individual knowledge from social networks is fed into organizations and institutions and in turn flows back into the social network so that it is still available to the individual.

Web 2.0 tools are important and effective aids in this context. They enable the rapid creation of digital content. By shortening product life cycles and the increasing speed with which new trends and innovations spread on the market and among consumers, web 2.0 authoring tools enable the creation of almost eLearning offers. Fast eLearning does not only mean cost-effective creation, but also fast consumption (quick effect) and fast adaptation (quick adaptation): The basic idea of "constant beta - the simple change and adaptation" comes into play here. Such offers undoubtedly require a change in the classic ´eLearning 1.0´ (c.f. Kerres 2006) paradigm: content becomes microcontent, small units of knowledge (´knowledge pills´) with reduced learning objectives that can be easily integrated, distributed and exchanged on existing platforms.

Web 2.0 creation improves creativity, intuitive, associative and analogical thinking and the combination of individual and social interactions (Saffron / Helic / Gütl 2007). The use of Web 2.0 tools has two other important consequences.

Firstly, it removes barriers for many technical experts. The direct creation of micro-content and the collaboration between subject matter experts give the content immediate practical relevance. Micro-content bundles knowledge that is not consumed in a specific situation (´the training room´), but rather when needed (´moment of need´) and thus enables the learner to apply it directly and transfer it to everyday work.

Secondly, there is scope for many topics that were not possible in classic eLearning production (internally or by external providers) due to a lack of financial and time resources (´the power of the long tail´). Where previously maximum centralization and a maximum cost-benefit ratio were in the foreground in the selection of topics for eLearning projects in order to reach the broadest possible audience. Today Web 2.0 tools can create a basis for niche topics and specialist knowledge and distribute knowledge in a capillary manner within the company.

9.2 Web 2.0 authoring tools in action: the example of POWTOON and H5P

Authoring tools are playing an increasing role in the collaborative creation of specialist content in companies. But what exactly are Web 2.0 authoring tools? Web 2.0 authoring tools (c.f. Hielscher 2012) are defined as applications and platforms that make it possible to create digital learning modules (´learning objects´). These can be combined, exchanged, changed and reused as small, multimedia and interactive learning content,

modularly.

In the further course of this study we want to consider the practical use of Web 2.0 tools in a specific operational context. The "Web 2.0 tool landscape" contains various models from open source projects to freemium models or offers that are subject to a fee. In this study we will look at two common tools and their use in the Basecamp project at MediaCom GmbH: POWTOON and H5P.

9.2.1 POWTOON

POWTOON is a web-based animation software from the company of the same name from the UK, which was founded in 2012 and with the help of which the user can create animated presentations.

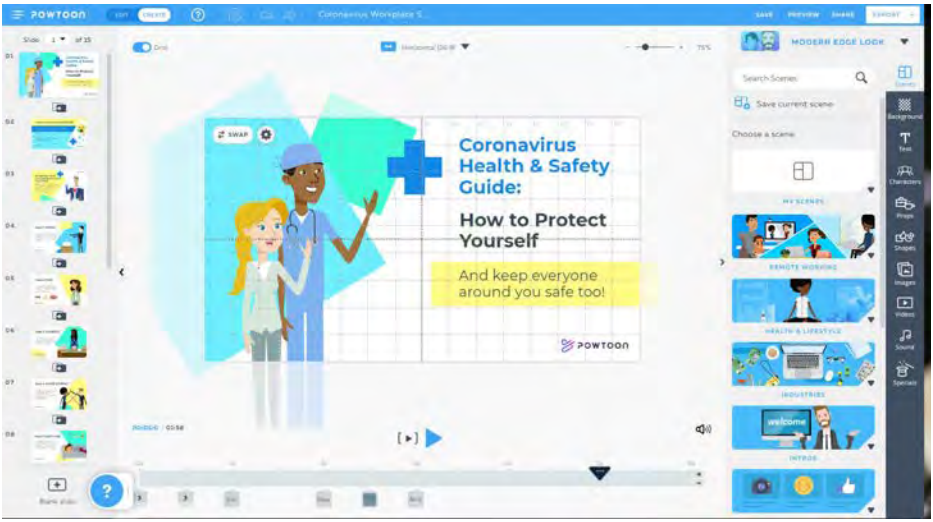

Figure 30: POWTOON-Studio user interface.

POWTOON provides various pre-animated objects, graphics and characters that can be inserted into a project and used to create a video. The program includes a character editor with which
characters can be adapted to the content of the story, as well as a tool with which the user can create different scenarios and environments (office, park, street, different living rooms, etc.).
This can be used to create short explanatory videos as well as animated presentations and video training. Several external multimedia resources (videos and pictures from 3rd party providers or your own video, audio, music and pictures) can be uploaded and easily integrated. A voice-over can be recorded live and incorporated directly to explain the

content of the slides.

The possible uses are diverse, as instructions, step-by-step instructions, research reports, as well as short stories and promotional videos can be created. The result can be exported as an mp4 file or linked directly to various platforms (Facebook, Twitter, YouTube, Vimeo, LinkedIn, etc.).

POWTOON offers its own tutorials to make it easier to get started with video creation, as well as many ready-made templates that can be adapted to the relevant learning scenario with just a few clicks. Another option is to use work-life or office scenarios to demonstrate key concepts. Instructors can also embed animated infographics in their reports to demonstrate statistics. The use of POWTOON shows a significant increase in the motivation and commitment of the participants in the training (c.f. Makarius, 2017).

9.2.2 H5P

H5P is an open source software, with the help of which interactive content for the web can be created, further processed and used again.
In 2013, the project was first introduced in Norway as an authoring system for schools, and was then further developed by Joubel. H5P has also been available as a commercial solution since 2019. With the software, for example, learning content such as multiple-choice tests, drag and drop tasks and interactive videos can be created. This makes it extremely easy for everyone to develop learning content without any programming knowledge and to integrate it into your own website.

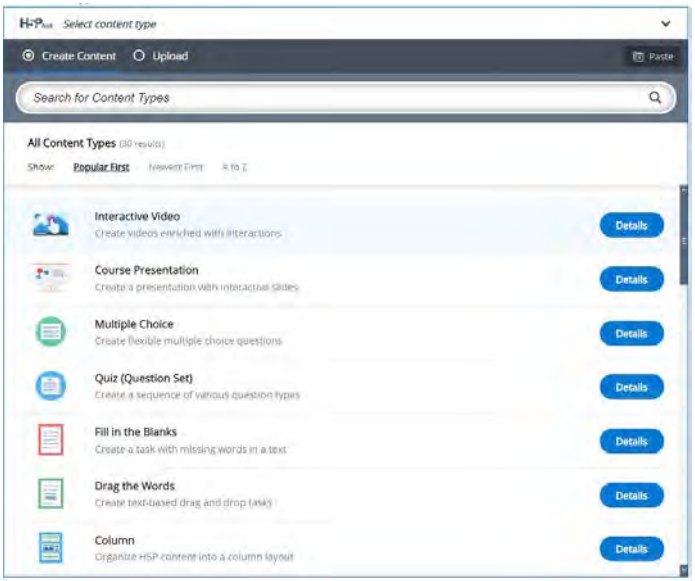

Figure 31: H5P Editor interface (H5P 2020).

H5P has many advantages for those involved in the design and creation of digital learning resources:

Ease of use: H5P is very easy to use and does not require any programming knowledge. Everybody can participate.

Mobile responsiveness: Even on smaller devices such as smartphones or tablets, the content is well presented and user-friendly. This point is also an important prerequisite in the future, as the portability of the learning offers between different display sizes will play an increasingly important role. You not only learn in the office on the PC, but also in the home office on the tablet, on the way to work or while waiting for the next subway on the smartphone.

Technical flexibility: H5P content can be created on the central platform and then integrated on other websites and on your own platform (such as YouTube videos). Didactic flexibility: H5P has a very large library of content types - more than 40 currently - which cover almost everything that can be used didactically. Some examples of the content that can be created (c.f. Ravalli 2019):

• Quizzes in multiple formats, such as single choice, multiple choice, true / false questions
• Word problems such as mark the words, drag the words, fill the blanks
• Essay (you can have your own text automatically checked and rated according to specified criteria / keywords)
• Course Presentation (offers the possibility to design slides or pictures interactively with multiple choice questions, fill in the blanks and other types of interactions)
• Image Hotspots (this can be used to add hotspots to images. Hotspots can display texts, images or even videos when clicked) Drag and drop images or texts • Image Justaposition is a very exciting tool with which the user can interactively compare two overlapping images using a slider
• Flashcards as Dialog Cards - Guess the answer: text-based cards with a question on one side and the answer on the other side.
• With Virtual Tour (360) questions, texts and interactions can be inserted into several 360 environments. It is possible to take real 360-degree photos with the Google Street View app, which is available free of charge for Android and iPhone.
• Interactive Video: Interactive elements such as multiple-choice content, fill in the blanks or popup texts can be added to an existing video (also on an external video platform such as YouTube) or video decision trees can be created (branching scenarios)

The use of H5P has intensified significantly in recent years.

9.3 Collaboration and content creation using H5P and POWTOON at MediaCom Agentur

The BASECAMP project

BASECAMP is the name of the knowledge cooperation project that MediaCom started in 2018. BASECAMP is a knowledge platform on which MediaCom employees from different areas store their knowledge, make it searchable for others using a dedicated search engine and share it with colleagues.

MediaCom is Germany's leading media agency: with a billing volume of 1.9 billion US dollars (source: COMvergence, June 2020), MediaCom is one of the leading specialists in media communication. More than 650 employees work in Germany in Düsseldorf, Berlin, Frankfurt, Hamburg and Munich. The agency employs around 8,000 people in 125 offices in 100 countries worldwide. The customer base includes u. a. adidas, Coca-Cola, NBC Universal, Katjes, Opel, IKEA and Sony.

The concept of BASECAMP is similar to an in-house Wikipedia, with a community of subject matter experts and authors who create knowledge articles and readers who can rate these articles or suggest missing topics. In addition, readers can "follow" their favourite authors and be individually informed about their latest contributions.

The following table gives an overview of the application scenarios of BASECAMP in concrete everyday work:

Face-to-face event	Blended Learning	eLearning
enrichment	integrative, hybrid learning opportunities	completely online
• Participants will find presentations and training materials in the face-to-face events. • Participants can actively research and deepen topics from the event in BASECAMP	• Digital content and tutorials (videos, interactions, quizzes) are completed before the face-to-face event. • Face-to-face events serve for discussion, reflection and common application (transfer) of the learning content	• If necessary, participants search for terms or the following automated article recommendations. You can deepen topics yourself using video tutorials, texts and learning tasks with video solutions. • You go through self-tests in the form of a quiz and can then acquire proof (certificate) for this. • You follow authors or topics and are automatically notified as soon as a new article by the author is available

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Table 4: Application scenarios of BASECAMP, own presentation.

The creation of "experts-generated content" is one of the most important success factors of the project, as the knowledge content is strongly adapted to the company's internal processes and needs and the articles created have a considerable practical focus.

The design in the form of microcontent was also perceived as suitable for everyday use. Learning begins when needed (“moment of need”) and not in the classroom.

The topics vary from social media, campaign management, programmatic advertising, eCommerce to the latest trends such as artificial intelligence or TikTok inApp advertising.

Internal experts are directly involved in the creation of, for example, video content. They appear in the video clips of the tutorials and explain the content of the ScreenCasting videos in their own voice in the audio. The involvement of the experts enables a very short production process. This not only helps to increase acceptance, but also promotes identification with the topics and gives the content authenticity and credibility. An important sign was the appreciation and recognition of the expert work and role within the company.

The creation of short explanatory videos and interactive digital units was decisively made possible by the use of Web 2.0 authoring tools such as POWTOON and H5P.

9.4 Criteria for tool selection and added value achieved

The corporate learning team previously created a list of possible applications and platforms and then evaluated them according to certain criteria. Here is an overview of the criteria and their strengths and weaknesses:

	POWTOON	VYOND	ANIMAKER	H5P	learnin-gapps.org
Flexibility / media didactic adaptation options	Offers a wide range of characters and ready-made situations (office, home, leisure) and the ability to customize characters Pre-installed actions are extensive	Offers a wide range of characters and ready-made situations (office, home, leisure) and the ability to adapt characters Pre-installed actions are very extensive	Offers a wide range of characters and ready-made situations (office, home, leisure) and the ability to adapt characters. Pre-installed actions are very extensive	Offers a very wide range of exercise types	Offers a very good range of exercise types, but more suitable for school education
user friendliness	Modern, very clear user interface and a fast learning curve	Modern, clear user interface and a fast learning curve	Good, clear interface and moderate learning curve	Very clear interface and quick learning curve	Clear interface and fast learning curve

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Table 5: Selection criteria for Web 2.0 tools at BASECAMP – Part I

	POWTOON	VYOND	ANIMAKER	H5P	learningapps.org
Export options / connection to other systems	mp4, PDF, PPT, embedding	mp4, GIF	Complicated licensing model with export limitations	Can be accessed via a web link or integrated into a learning portal via iframe or interfaces, or can be integrated directly from some learning portals (Moodle, Wordpress, etc.)	Can be accessed via a web link or integrated into a learning portal via interfaces such as SCORM
Opportunities for cooperation	Team account Videos can be accessed for joint editing via a web link	Team account Videos can be accessed for joint editing via a web link	Rather limited	H5P.COM offers complete team management with write and view rights	Offers complete team management with write and view rights for schools

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Table 6: Selection criteria for Web 2.0 tools at BASECAMP – Part II

	POW-TOON	VYOND	ANIMAKER	H5P	learnin-gapps.org
Reuse / adaptation of created content	You can quickly customize videos you create and import scene templates from videos into other videos	You can quickly customize videos you create and import scene templates from videos into other videos		Very light and comfortable	Very light and comfortable
Support / community develop-ment	Offers excellent support and continuous platform develop-ment	Offers excellent support and con-tinuous platform develop-ment	Offers excel-lent support and continu-ous platform development	H5P.COM offers excellent support and continuous platform development (by H5P. ORG)	Rather limited

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Table 7: Selection criteria for Web 2.0 tools at BASECAMP - – Part III

The decision in favour of POWTOON was not only determined by technical criteria, but also by the user-friendliness and the collaboration options that the tool offers.

The table shows that VYOND and ANIMAKER certainly offer more options for video animation, but the more complex user interface also represents a greater barrier to use. An intuitive and simple user interface, on the other hand, is an important factor in

ensuring acceptance and cooperation between the authors.

The decision for H5P was enormously influenced by the media didactic advantages as well as the possibilities of flexible integration and adaptation. H5P.COM provides the community that oversees the H5P.ORG (Open Source) project with a commercial version. This also shows that "free of charge" is not to be equated directly with "Web 2.0": The project focused on important "Web 2.0 aspects" such as acceptance by the authors, minimizing the entry barrier, exchange and simple communication between the author community.

9.5 Application scenarios

POWTOON is ideal for creating company explanatory videos. Explanatory videos are short films in which texts, moving images, sound and language are used to explain abstract concepts and relationships. With the help of MediaCom's corporate learning team, the expert creates a short storyboard as a basis and then a video that examines the specific topic. Often times, the author's voice for the audio is recorded in sync with the video. The author can then upload the finished video to BASECAMP himself and share it with his colleagues there. Explanatory videos can convey an emotional message to the viewer more successfully and convey a feeling of identification through voice and design. Social-cognitive learning theory emphasizes the role of identification with a model or role figure in knowledge construction. The positive effect of explanatory videos with POWTOON on motivation, the learning of new content and the development of digital skills is empirically proven by the literature (c.f. Makarius 2017 / Rioseco et al. 2017).

Viewers retain full control when watching videos and can always view the content exactly when the information is needed. The pause, fast-forward and rewind functions also allow you to easily repeat or skip content. This leads to increased self-control and self-motivation.

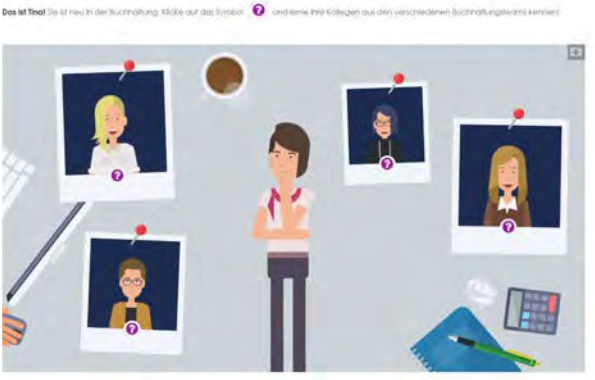

Figure 32: Explanatory video.

In particular, procedural knowledge (such as work steps, processes) can be clearly shown in a video and applied directly in practice.

H5P elements were used in knowledge articles to increase the interactivity of the knowledge content, for example as flash cards ("truth or myth"), where the learner is asked to guess whether the statement is true or not.

Figure 33: Learning card.

Or to use exploratory methods, as with exploratory hotspots:

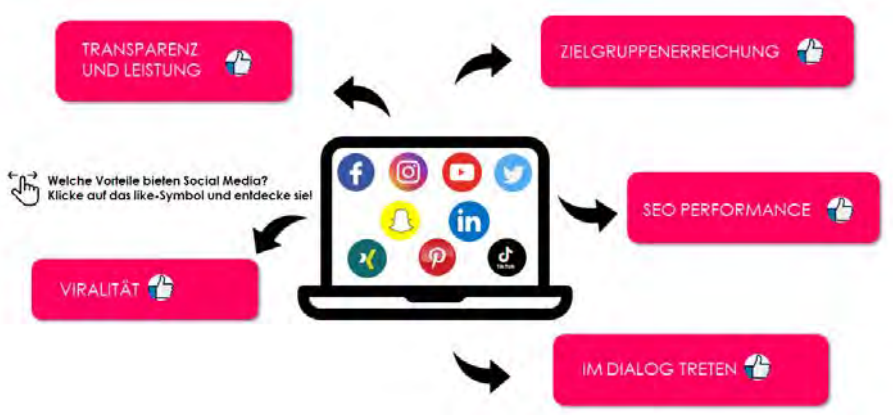

Figure 34: Hotspots.

Other usage scenarios used are:
• Brief revision quizzes after watching a video
• Interactive video with multiple choice questions and different video sequences depending on the learner's answer
• Exploratory images with sliders to discover content for yourself
• Assignment tasks (drag & drop)

9.6 Conclusion: potentials and challenges of Web 2.0 tools

In summary, we would like to sketch two brief remarks at this point, which have arisen from our experience with Web 2.0 tools, and give some cautionary notes on their use.

Media didactic design: Are tools sufficient to create digital learning content? The design of microcontent and the creation of digital content do not mean that the media didactic design fades into the background. The integration of Web 2.0 tools, however, requires the authors to be actively supported by ´media didactics´, both in the design of multimedia objects based on media didactic principles (c.f. Mayer 2009) and in the organization and sequencing of the micro-content for the learning environment, the formulation of tasks that structure the learning process and the provision of exams and certifications (c.f. Kerres 2007).

Organizational culture as a core driver for Web 2.0. It is often overlooked that a specific success factor in the implementation of Web 2.0 tools and technologies is the existing corporate or organizational culture. Some studies show a positive correlation between an organization's degree of openness and willingness to learn (c.f. Fard et al. 2009). Indeed, Web 2.0 tools and technologies require a high level of trust on the part of the organization in its own employees, the willingness of employees to experiment with new ways and forms of internal knowledge transfer and the ability to work independently.

This in turn requires the organization's willingness to delegate responsibility to employees. The existence of the pure technical infrastructure does not lead directly to a sustainable implementation. Rather, factors such as a participatory management system, promoting the creativity of employees, systematic thinking, teamwork and a high degree of participation in decisions have a positive effect on learning and are at the same time prerequisites for the successful use of Web 2.0 tools.

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10. Digitisation and eLearning in the EFL classroom

Aurora Beutner

The world changes. Due to globalization, technologisation and digitization our modern world moves together internationally (cf. Kanu 2018, p. 61) International cooperation, projects and exchange receive an increasing importance with regards to global collaborations in different scientific disciplines (cf. Mamedov et al. 2019, p. 441ff.). Therefore, the use of digital media gradually increases in every field of economy but also academia. Because of this change in the academic and economic world it is necessary to integrate these changes also at school, in the educational system and in the school curriculum (cf. Stacey et al. 2018, p. 1ff.). The all-embracing impact of digitization in the modern living environment needs to be reflected in the social learning environment – at schools.

In the fields of technology and the natural sciences the involvement of digitization is obvious in researches, projects as well as vocational education and training (cf. Stacey et al. 2018, p.9ff.). This digital inclusion is generally considered to be a positive strength of these scientific domains (cf. Stoykova 2017, p. 18f.). On the other hand, in contrast the integration of digital media in the social sciences seems to lag behind (cf. Revermann et al. 2007, p. 99f.). Therefore, digitization at school is also falling short and is not realized in its full potential. This deficiency is also connected to the teachers' lack of knowledge in this field and their insufficient abilities to integrate digital means in the modern EFL classroom (cf. Revermann et al. 2007, p. 10ff.).

Figure 35: What is eLearning? Own presentation.

In general, eLearning currently already effect schools and modern language teaching. Teaching itself has changes a lot over the years and especially the use of modern communication systems, the internet, learning platforms or MOOCs shows the great impact of eLearning also in the foreign language classroom (cf. Omidshafiei et al. 2019, p. 6128ff. / Revermann et al. 2007, p. 21ff.). In Germany it has become more and more popular to change old, traditional board and use so-called smart boards during the lesson. ELearning already starts here, when a teacher uses the internet on the smartboard to facilitate the learning process, the understanding of new input and to make the learning livelier and more available for the students (cf. Veeramanickam / Mohanapriya 2016, p. 81ff.).

Nevertheless, these rather fundamental parts of eLearning can be further exceeded in class. Different forms of eLearning offer various possibilities and options not only for the teacher but also for the students (cf. Revermann et al. 2007, p. 7ff.). Different studies show that eLearning is a great opportunity to support traditional learning strategies and methods especially in the EFL classroom. The use of the internet, of learning platforms and of communication systems mainly influences the extracurricular learning of the students (cf. Akinrinmade / Ayeni 2017, p. 19ff.). Especially in foreign language learning it is often necessary to expand the language learning also beyond the English lessons and to motivate the students to learn at home. This home-learning is also part of the language learning process of the students and therefore of the EFL, virtual classroom (cf. Amin 2018, p. 39ff.). With the help of learning platforms or MOOCs home learning and performance reviews become much easier (c.f. Shalatska 2018, p. 186ff.). Students can learn at home and focus on their individual needs and gaps while the teacher can control their learning progress and achievements also outside of the classroom.

It is not possible to learn a language adequately with only three lessons a week. Speaking and listening competences are mostly not focused on in the EFL classroom at school (c.f. Tavil 2010, p. 765ff.). These necessary competences, which are of great importance especially for language contact and real language use outside of the classroom, have to be learned at home. This continuous process and lifelong learning can be supported at school by the teacher. Learning platforms help not only to integrate eLearning in the EFL classroom and to introduce it to the students (Putri et al. 2020, p. 19ff.). Their personal language learning process at home can be additionally supervised and encouraged by the teacher. The teacher-student communication is not only reduced on their lessons and teaching time at school but breaches the educational sphere and reaches into the students' home learning and individual confrontations with foreign languages (cf. Baruah 2018, p. 93ff.).

But step by step, eLearning blazes the trail also inside EFL classrooms. It is much more common nowadays to work with modern media and modern networks to improve the learning process of the students (cf. Chotipaktanasook 2016, p. 56ff.). Modern methods

are combined with traditional ones to achieve the best learning ability of the students. A very common use of eLearning tools is the integration of video clips, graphics, comics, or graphic novels in the foreign language learning (cf. Revermann et al. 2007, p. 6). This focus on visual learning is connected with the better understanding of new topics by the students and the use of realia at school (cf. Bala 2015, p. 43ff.). Subject matters are tried to be linked to the students' surroundings and social, familial and everyday environment at possible. School as part of the educational sphere of the student's everyday life should not be separated from other parts of life but more and more connected with them. By this, the students develop a stronger relation to educational subject matters taught at school due to their connection to the student's living surroundings (cf. Benson 2012, p. 29ff.). Subject matters do not longer come as abstract and unapproachable as before but need to be integrated in youthful interests, problems and dreams.

There are different ways in which eLearning can be integrated in the EFL classroom. The use of emails and newsgroups, as well as weblogs and podcasts help to exchange information and facilitate the acquisition of new knowledge (cf. Revermann et al. 2007, p. 6ff.). This is in so far useful for the learners as eLearning seems to be way more flexible, motivating and supporting for them (cf. Keller / Suzuki 2004, p. 229ff.). Due to learner centeredness the communication between learner and teacher becomes more interactive. The use of realia and the integration of the learning process into real situation out of the everyday life of the learners, collaborative group work and other new interactive methods can be implemented best with the integration of eLearning in the EFL classroom (cf. Berge 2002, p. 181ff.). This can for example be done with online test-components, which offer a continuous and direct testing of the new knowledge, subject matters and understanding of the learners.

Figure 36: eLearning, own presentation.

Due to the highly digitalized world, the living surrounding of the students drastically changed over the past years. Modern and social media, smartphones, the internet, social networking and communication means are all fixed components of their everyday life and students cannot imagine their life without these technological means and devices (c.f. Kortti 2017, p. 115ff. / Koroleva 2016, p. 205ff.). The attempt to connect school in general and language learning in particular closer with the student's living surroundings, therefore also means that a change of the everyday life also requires and educational change in the EFL classroom and generally at schools. An interconnectedness between daily and school life of the students can only be achieved if both spheres are equalized in the influence of digitization and technology. This means that eLearning is the chance to retrieve the balance and connection between school and living surrounding of the students and to help them to improve their skills and abilities at school by included the high standard of technology and digitization of their daily lives also at school and in class.

Nevertheless, it is of high importance to be aware of the discrepancies in digitization in European households and schools. While learners are highly digitalized at home, schools still suffer from lacking technology and modern, digital endowment (cf. Revermann et al. 2007, p. 8). Especially German schools are behind the current standards in digitization and have no access to multimedia online tools, learning platforms or online learning material (cf. Revermann et al. 2007, p. 8). Also, the use of computers and a solid internet connection is not always given at German schools. Therefore, learners, but also teachers have deficits in digital competences and the handling of modern media or computers. They only gain their digital and medial knowledge at home and in their out-of-school life (cf. Revermann et al. 2007, p. 8).

The school deficits in the use of multi-media tools, which only enable the implementation of eLearning in the EFL classroom, also go along with a scepticism of the teachers against these digital methods (cf. Revermann et al. 2007, p. 8). Especially German teachers have a critical attitude towards eLearning and digitization at school. Moreover, there are additional gender differences. While male teachers mostly learn their multi-media skills themselves, female teachers are taught these competences by members of their families or colleges at school (cf. Revermann et al. 2007, p. 8).

In addition, eLearning also plays an important role concerning international comparisons of educational systems, the abilities of students and the shortcoming of education in specific countries. Due to the PISA study, Germany is also part of an international comparative study, which rates the educational system and the abilities of students. After the PISA shock, when Germany received below-average results especially in literary reading, listening and writing competences, eLearning first became discussed and relevant for the educational system (cf. Revermann et al. 2007, p. 8). It became clear that countries with greater focus on eLearning, as the Scandinavian countries

Denmark, Norway, Sweden or Finland, also achieve better results in the PISA test. The importance of eLearning became obvious after these findings in Germany for the first time (cf. Doecke 2018, p. 97ff.).

The development of student's and also teacher's competences become increasingly important. eLearning is a good way to improve and generate these competences. Nevertheless, the willingness to self-learning, which requires individual time management, self-motivation and to independently deal with new subject matters and problems, can be challenging for many students (cf. Revermann et al. 2007, p. 7). These challenges can hinder the positive use of eLearning. Moreover, the lacking competences of teachers and their in-deficit handling of new, virtual forms of learning can exacerbate these negative effects.

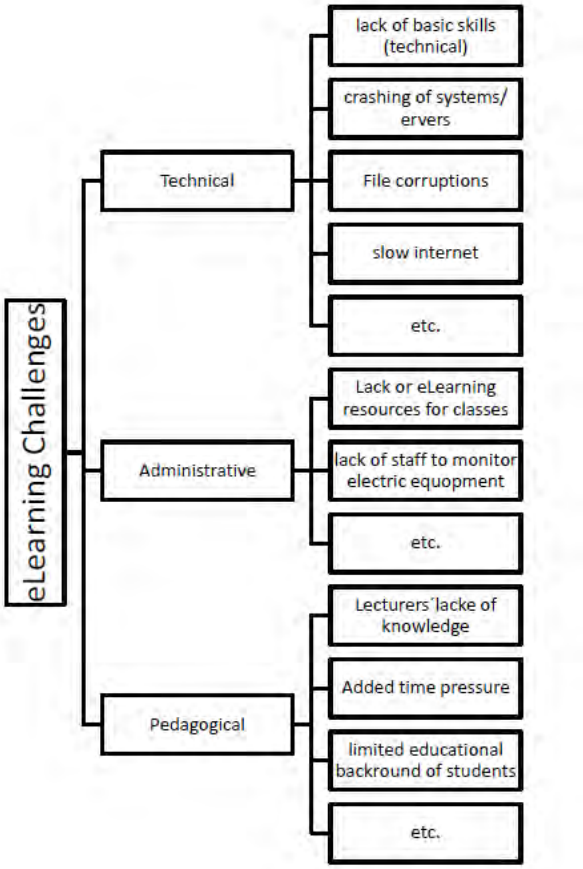

Figure 37: eLearning Challenges. Based on Revermann et al. 2007.

In general, the implementation of eLearning in the EFL classroom is not only the teacher's duty but also a school intern organizational decision of the head teachers at schools. Online learning platforms and eLearning in general is a great innovation at schools and need to be integrated in the school routines and processes. Therefore, educational management by the head teachers, to analyse and advance eLearning becomes more and more necessary (cf. Isnaini et al. 2020, p. 536ff.). However, due to the fact that educational programs and curricula, in which eLearning also has to be integrated, it cannot only be done by the head masters themselves. Also on a political level, politicians have to become aware of the technological shortcomings of educational systems, the discrepancy between digitalized everyday life and technological retarded schools (Bonk 2016, p. 6ff.). This is the only way to completely transfer digitization and eLearning in the EFL classroom.

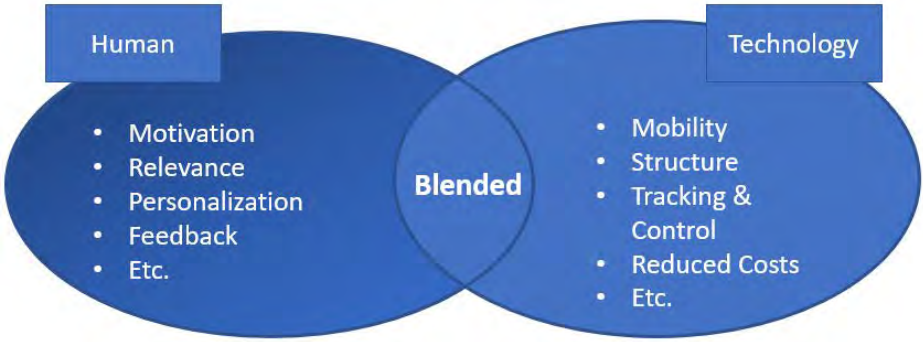

Figure 38: Digitalisation and eLearning in Classroom. Based on Bonk 2016.

In language learning the advantages of eLearning, which are self-learning, communication, learner-centeredness and direct assessment tests, are more important than in every other subject. The competence of communication is the basic competence of language learning. To be able to communicate in a foreign language is the only way to completely acquire it and to get in contact with native speakers (c.f. Luk / Lin 2017, p. 11ff.). This competence can additionally only be achieved with self-learning at home, which again can be most easily implemented with the help of eLearning (cf. Revermann et al. 2007, p. 8). The leaner herby focuses on him-/ herself and can get direct feedback by the teacher via eLearning methods and communicative networks. Therefore, eLearning and media competences must be coordinated and balanced so that both, learners and teachers, can acquire both simultaneously.

To conclude, it becomes clear that there is still a way to go until eLearning can be completely integrated in the EFL classroom and to reach its full potential. Although

there are, also on an international level, first steps in the right direction it becomes increasingly necessary to deal with eLearning in more detail at every school and in every school type. eLearning is not about changing the EFL classroom and the educational system completely into online teaching and learning. The adequate balance between traditional but also modern teaching methods and approaches is rather the best way to reach to overall educational goal of demanding and promoting the student's abilities and to prompt not only their language learning but also their personal development.

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Part E – The DigI-VET Curriculum and Profiles

11. The DigI-VET Learning Outcome Matrix and the DigI-VET Curriculum – Integration into course structures

Marc Beutner
The purpose of these chapter is to illustrate how outcomes align with teaching and learning methods and assessments in the DigI-VET approach.

The following general aims and objectives are focused with the LOM:

This Learning Outcome matrix is designed to inform about the development of the curriculum structure to integrate Digitisation and Industry 4.0 in VET-courses. Focusing on a learning outcomes approach facilitates the tailoring of the pedagogic induction resources. This provides the possibility to suit specific cultural and societal values and ensures that local issues and necessary topics are addressed within the DigI-VET approach (c.f. DigI- VET 2020).

The topics addressed in the DigI-VET-measures for **Persons who are teachers and trainers or learners in the field of VET** are:

General part of DigI-VET measures
1. A Short overview of project objectives and aims to achieve
2. Introduction to the DigI-VET curriculum
3. The target group - Characteristics of the DigI-VET target group, their needs and expectations
4. Introduction to the e-learning platform

Subject related part of DigI-VET measures:
5. Definitions- of terms
6. Description of the history towards digitisations and industry 4.0
7. The need of digitisation in today´s world of work
8. Current status and future developments
9. Examples of Industry 4.0 Approaches using the Online Observatory
10. Best practices of integrating digitisation in VET-scenarios and courses

Important Aspects and Challenges for Persons who are teachers and trainers or learners in the field of VET are:
Important for teachers and trainer in VET are pedagogical approaches and the idea of being "facilitators of learning" and the different style of learning, the quality of the curriculum and their support especially concerning the use of the e-learning platform and the resources.

A special challenge concerning the DigI-VET-Curriculum could may be the lack of time. Therefore, the main challenge will be the time commitment.

In addition to that, the main challenges are being authentic, the motivation of students, patience in the tutoring and mentoring processes and a stable technology.

It is important that the measures need to be concise, short, relevant and delivered face to face in a flexible way. The benefits of participating have to be emphasized and the opportunities for questions and networking should be raised. It is necessary to allocate appropriate time for the participants' needs.

Based on the results of the research at of the DigI-VET partners the following two LOMs could be derived:

One is addressing teachers and trainers in information measures and one is addressing the learners in the classroom situations of such teachers and trainers:

11.1 Learning Outcome Matrix (LOM) for persons who are teachers and trainers in the field of VET (DigI-VET LOM1)

Outcome	Teaching and Learning Activities	Assessment
Having taken this course, participants (teachers/ trainers) will be able to:	**The participants (teachers/trainers) will be taught to achieve this specific outcome through the following learning activities:**	**The participants (teachers/trainers) will be assessed on their achievement of this specific outcome through the following assessment tasks:**
understand the main aspects, fundamentals and modules of the DigI-VET measure and the aims of the project as well as the philosophy of DigI-VET.	The participants will get informed by a ppt presentation which provides an overview concerning the DigI-VET idea and the measure.	An oral feedback and a short evaluation questionnaire is main basis of assessing the right understanding of DigI-VET.
use and dynamize the DigI-VET e-learning platform and its functions and supporting elements.	The participants will go through a live demonstration. Therefore, the are forced to see and reflect the actions and also to do all actions themselves.	The assessment will be carried out in the DigI-VET online forum. There will be an easy and time-independent place to discuss, share impressions and get feedback of participants and trainers
organize and create engaging face-to-face sessions fitting to the curricular ideas of DigI-VET.	The participants will take part in a workshop to create their own lessons plan.	During the workshop there will be feedback sessions and oral support by the trainers.

understand key principals of the pedagogical approach of DigI-VET.	This understanding will be raised by discussion groups. These groups work in teams on their expectations and requirements of the UMW curriculum and the pedagogical approach. In presentations, main aspects can be combined and made available as a basis for intensive discussions.	The assessment will be carried out in a wall newspaper of each group on which main key principles are documented. This will be the basis for oral feedback.
adopt the learning content to the needs of graduates	The adoption process will be learned in short case studies which will be analysed and combined with practical experiences. These experiences will be integrated in creating own learning contents and necessary didactical material by the participants.	The assessment of the adopting process will be done in two way, creating an own short learning content and the necessary didactical material by the learners and a group discussion with feedback on these created contents.
know about learning theory and facilitating learning processes as well as implement it in their face-to-face sessions.	The participants can achieve these knowledge aspects via self-directed learning with the support of the trainers. They also get role awareness via a roleplay in which they have to act as a learning facilitator.	The assessment will take place in the direct communication situation and can be carried out in discussion forums as well to get direct feedback.
recognise different perspectives on digitization and the different ideas of defining digitization and digitalisation.	The participants are discussion different points of view and take part in a pro-contra discussion.	The assessment of getting to know their own problems with learning can be carried out best in an oral way in a discussion process

know about the history of digitization and industry 4.0 and take this knowledge into account in their face-to-face sessions.	The participants can achieve these knowledge aspects via self-directed learning with the support of the trainers and their systematic coaching.	The assessment will take place in the direct communication situation and can be carried out in discussion forums as well to get direct feedback.
understand the need of digitisation in today's world of work	The participants discuss a presentation about group processes and roles in learning groups. They create an own working team and set roles to design a flipchart presentation themselves to highlight the key aspect	The assessment will be via creating an own team to achieve an aim is the basis for feedback on group rules, communication, roles and effectiveness.
are aware of the current status and future developments in industry 4.0 and digitization approaches	The participants go through different approaches and create own poster overviews.	Direct communicative feedback and short overview descriptions allow to assess the awareness.
work on dealing with the examples of Industry 4.0 approaches provided by the DigI-VET Online Observatory.	The participants go through the online observatory and share insights and ideas on the showcases.	In a pro-contra discussion, the participants compare the insights provided by the DigI-VET Online Observatory with own experiences and rate the situations.
discuss the expectations and best practises of the integration of digitization and industry 4.0 in VET teaching and learning.	The participants discuss these points in a discussion group.	Direct communicative feedback processes allow to assess the awareness of expectations and benefits.

Table 8: Learning Outcome Matrix (LOM) for persons who are teachers and trainers in the field of VET (DigI-VET LOM1).

11.2 Learning Outcome Matrix (LOM) for persons who are learners in the field of VET (DigI-VET LOM2)

Outcome	Teaching and Learning Activities	Assessment
Having taken this induction/course, learners will be able to:	**The learners will be taught to achieve this specific outcome through the following learning activities:**	**The learner will be assessed on their achievement of this specific outcome through the following assessment tasks:**
recognise different perspectives on digitization	The learners are discussion different points of view and take part in a pro-contra discussion.	The assessment of getting to know their own problems with learning can be carried out best in an oral way in a discussion process.
explain and compare the terms digitization and digitalisation.	The learners write down and compare definitions of industry 4.0 and digitization.	The written text can be taken an assessment and oral feedback can provide insight in the way how the learners understood the definitions and if they are able to do the comparison.
know about the history of digitization	The learners can achieve these knowledge aspects via information material and a structured discussion.	The assessment will take place in direct communication and immediate feedback.
know about the history of industry 4.0	The learners can achieve these knowledge aspects via information material and a structured discussion.	The assessment will take place in direct communication and immediate feedback.

Describe todays need of digitisation	The learners provide examples of the world of work and use the online observatory to get deeper insights. They create a text or an audio file with the descriptions of such situations.	The assessment via feedback on the texts or audio files and lead to a deepening discussion.
compare the examples of Industry 4.0 approaches provided by the DigI-VET Online Observatory.	The learners go through the online observatory and share insights and ideas on the showcases. They fill in a comparison matrix.	The filled-in matrices of the learners can be used as a wall-newspaper to communicate about the comparisons and assess the used criteria for the work and an oral discussion provides feedback on the level of understanding.

Table 9: Learning Outcome Matrix (LOM) for persons who are learners in the field of VET (DigI-VET LOM2).

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12. Digital Competence Profiles for VET

Jana Stelzer

In times of globalization everything is changing. There are huge changes in the economy, but also in the educational sector. One reason for that is the digitalization and digital transformational processes. Particularly in the field of education, new challenges have arisen as a result of digitisation processes (cf. Beutner 2019; cf. KMK 2016). Keywords such as digitization and industry 4.0 are more present than ever before (cf. Sloane / Emmler / Gössling / Hagemeier / Hegemann / Janssen 2018).

"Digitization is the process of converting analogue signals or information of any form into a digital format that can be understood by computer systems or electronic devices. The term is used when converting information, like text, images or voices and sounds, into binary code. Digitized information is easier to store, access and transmit, and digitization is used by a number of consumer electronic devices" (Techopedia 2020).

These enormous changes require new tasks and demands on learners and teachers. This also requires new competences. A competence area refers to learning and teaching with new media and can be classified as digital competences (cf. DigCompEdu 2018).

Digitisation requires new fields of action for teachers and learners. Within these fields of action there are huge influences. The German Kultusministerkonferenz (KMK) defines following areas of changes for schools:

- "Educational plans and teaching development, curricular developments,
- education, training and further education of educators and teachers,
- infrastructure and equipment,
- educational media, content,
- E-government, school administration programmes, education and campus management systems,
- legal and functional framework conditions" (KMK 2016, p. 4).

Depending on the school type, digitalisation influences these areas in various measures (cf. KMK 2016). In the view of the huge changes, new strategies regarding the curriculum and contents of lessons have to be developed. Therefore, KMK describes two objectives:

1) All federal states in Germany include the required competences which are necessary for an active, self-determined participation into their curricula and education plans as well as framework plans. In addition to professional competencies, digital competencies are also developed. In the context of digitisation, all lessons are concerned. For this reason, all learning areas have to be adapted to digitisation processes. In this respect, the integration of the digital world is essential (cf. ibid.).

2) An adapted design of lessons leads to more freedom for learner´s individualisation. Besides, learners will get the possibility for taking personal responsibility (cf. Sloane et al. 2018). Furthermore, digital learning environments help students to become part of a team and to organise, to develop solutions together, to provide feedback. All in all, the students get more responsibility for designing their own learning process and transferring their knowledge to practical situations (cf. KMK 2016).

Based on these, the construct of digital competence develops as an important role within school education. At this point KMK defines six fields of competences for "competences in the digital world" (KMK 2016, p. 10):
1) Searching, Processing and Storage
2) Communication and Collaboration
3) Production and Presentation
4) Protection and Safety
5) Problem solving
6) Analysis and Reflection (cf. KMK 2016, pp. 10).

12.1 Digitisation and Competences in VET Classroom
DigComp 2.1 and DigCompEdu publish a research study and present a digital competence framework for vocational education (cf. DigComp 2.1 2017; cf. DigCompEdu 2018).

"The DigCompEdu framework aims to capture […] educator-specific digital competences. The framework is directed towards educators at all levels of education, from early childhood to higher and adult education, including general and vocational training, special needs education, and non-formal learning contexts. It aims to provide a general reference frame for developers of Digital Competence models, i.e. Member States, regional governments, national and regional agencies, educational organisations themselves, and public or private professional training providers" (DigCompEdu 2018, p. 1).

In general, there are six competence areas. These areas are also divided into 22 sub competences.
• Area 1) Professional engagement: "focuses on the professional environment" (DigCompEdu 2018, p. 1).
• Area 2) Digital Resources: focuses "on sourcing, creating and sharing digital resources" (ibid.).
• Area 3) Teaching and Learning: focuses "on managing and orchestrating the use of digital tools in teaching and learning" (ibid.).
• Area 4) Assessment: focuses "on digital tools and strategies to enhance assessment" (ibid.).
• Area 5) Empowering Learners: focuses "on the use of digital tools to empower learners"

(ibid.).
• Area 6) Facilitating Learners' Digital Competence: focuses “on facilitating learners' digital competence”[4] (ibid.).

Within digital processes in VET, the person or a trainer has to be focused. For trainers’ digitalisation means that they “develop digital competences", on the other hand they should not lose “their pedagogical impact” (Sloane et al. 2018, p. 13). In this context, pedagogic-didactical competences are more important than ever before (ibid.). Regarding digitisation processes, pedagogical competences have to be developed among trainers and learners. Sloane et al. point out that there is a need for further training in relation to the didactic-conceptual abilities of the trainers. They have to learn to use digital media in lesson or training in the company. Therefore, the openness of the curricula is a challenge for the trainers because they have to decide when new media can be used in a meaningful way. Furthermore, they have to deal with questions such as ‘In which way new media supports learning contents?‘, ‘What kind of media should I use?‘ (cf. ibid., pp. 13f.).

In addition to training personnel, companies are also responding to digital change and industry 4.0. Besides, there are differences between the branches. The FGW (Forschungsinstitut für gesellschaftliche Weiterentwicklung e.V) has researched on this topic in 2018 (cf. Matuschek / Kleemann / Haipeter 2018).

“The explorative empirical study focuses on the active role of employees in the implementation of digital, ‘Industry 4.0’ technologies in industrial production. […]. Moreover, the empirical access via single cases of the implementation of Industry 4.0 solutions allows for tentative diagnoses also on the general development of Industry 4.0 in the respective industries” (ibid., p. ii).

For instance, in the chemical industry digital processes are steadily increasing. Nevertheless, they support human work. In this industry, it is not possible to replace people by digitisation because a very high level of expertise is required (cf. Matuschek et al. 2018).

In contrast, the automotive and electric industries are in a state of upheaval. Due to a high degree of automation processes in production, more and more jobs will be cut. Human labour is being replaced by digitization. On the other hand, the technical demands on work tasks are increasing, because work processes, especially in the electrical industry, are becoming more and more complex (cf. ibid.).

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[4] For more details, please have a closer look into the research study: https://ec.europa.eu/jrc/sites/jrcsh/files/digcompedu_leaflet_en-2017-10-09.pdf.

In summary, these results show that digital competences are necessary and need to be continuously developed by all employees, trainers and learners. The next chapter will give some insights into best practices of different apprenticeships in different sectors.

12.2 Digital competences in apprenticeships in different sectors
Three selected apprenticeships present different requirements and changes in German apprenticeships (cf. BMBF / BIBB 2018):

Industrial clerk:
Requirements/ changes regarding work tasks, e. g.:
• IT know-how: using digital media, understanding digital processes and dependencies in the system
• Project work: from supporting project assistant tasks to independent planning and carry out projects
• Data handling: management of large amounts of data
• Increased importance of social skills and communication skills, increasing demands on self-competence, such as flexibility, discipline and self-confidence

Media designer:
Requirements/ changes regarding work tasks, e. g.:
• Complexity in digital and print media production
• The digital production, the workflows are nearly digitized. There are more and more interfaces with the IT professions.
• Many processes are automated, such as data verification processes
• Global networked production is already possible today. Working in clouds enables parallel and time-decoupled activities.
• Diversification of digital and print media products
• Shorter innovation cycles
• Increased importance of Visual Effects
• Aesthetic demands have changed: more target group orientation, more effects etc.

Machinery and plant operator:
Requirements/ changes regarding work tasks, e. g.:
• Trends regarding digitisation: Networking of production systems (M2M), digital printing, Mobile assistance systems, simulation software, 3D printing of spare parts etc.
• This job profile should be preserved. It won´t be replaced due to the digitization
• Fine motor activities cannot be replaced by robots etc.

12.3 Digital Competence Profile DigI- VET

The following competence profile, the VET-DigCom Model, is the result of a desktop research about needed competences in the field of digitisation in enterprises and education.

The figure below illustrates the research results graphically:

(Please check the next page!)

Figure 39: The Digital Competence Profile Model in VET (The VET-DigCom Model). Own representation according to DigComp 2.0 (2016, pp. 8ff.); DigComp 2.1 (2017, p. 11); DigCompEdu (2018, pp. 2); KMK (2016, pp. 10ff.); Schorb (2017, pp. 257ff.).

The figure shows the competence profile in the field of digitization. Under the roof of digital competence, the media knowledge, the media acting and the media reflection are located (cf. Schorb 2017). These three types are the fundamental elements of the construct of digital competence. These elements form the framework of digital competences (cf. ibid.). These include in total eleven dimensions, which consists of further sub dimensions. Moreover, you can see that some dimensions are only for teachers or learners. There is also an intersection. In detail, it means that some dimensions of digital competences apply for both target groups.

Here, following dimensions can be allocated:
I. Media knowledge (Functional and structural knowledge)
II. Media reflection (Self-, media- and social-related reflection)
III. Media acting (Communicative, creative and participative action) (cf. Schorb 2017, p. 257ff.).

The following tables give an overview about the three mentioned dimensions. Moreover, you can find the sub dimensions and the corresponding explanations.

I. Media knowledge

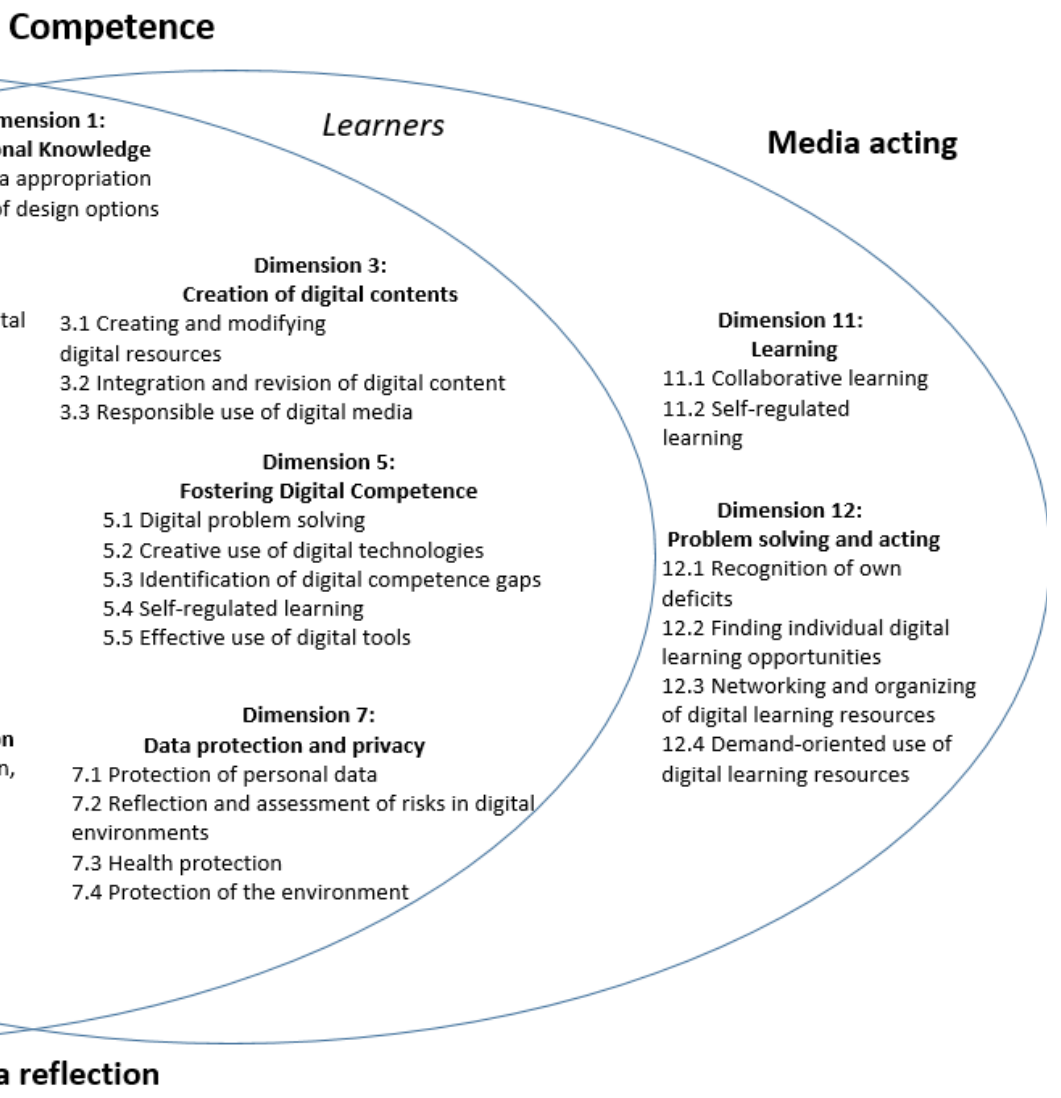
Competence
mension 1:
onal Knowledge
a appropriation
f design options
Learners
Media acting
Dimension 3:
Creation of digital contents
3.1 Creating and modifying digital resources
3.2 Integration and revision of digital content
3.3 Responsible use of digital media
Dimension 11:
Learning
11.1 Collaborative learning
11.2 Self-regulated learning
Dimension 5:
Fostering Digital Competence
5.1 Digital problem solving
5.2 Creative use of digital technologies
5.3 Identification of digital competence gaps
5.4 Self-regulated learning
5.5 Effective use of digital tools
Dimension 12:
Problem solving and acting
12.1 Recognition of own deficits
12.2 Finding individual digital learning opportunities
12.3 Networking and organizing of digital learning resources
12.4 Demand-oriented use of digital learning resources
Dimension 7:
Data protection and privacy
7.1 Protection of personal data
7.2 Reflection and assessment of risks in digital environments
7.3 Health protection
7.4 Protection of the environment
a reflection

Table 10: The VET-DigCom Model - Explanations for Dimension I: Media knowledge. Own representation according to DigComp 2.0 (2016, pp. 8ff.); DigComp 2.1 (2017, p. 11); DigCompEdu (2018, pp. 2); KMK (2016, pp. 10ff.); Schorb (2017, pp. 257ff.).

Dimension	Sub dimension	Explanations
Dimension 1: Functional Knowledge	1.1 Media appropriation	- Requirement for instrumental-qualificator skills with regard to hard- and software
	1.2 Use of design options	- Aesthetical design knowledge - Knowledge of text and image processing programs - Use and application of design options
Dimension 2: Data Collection and Evaluation	2.1 Management of data, information and digital content	- Analysis, comparison and critical evaluation of the credibility and reliability of data sources, information and digital content
	2.2 Survey and analysis of the learning status	- Review of learning success and competence acquisition - Learning control using by digital media - Critical analysis of learning behaviour
	2.3 Feedback through the use of digital media	- Giving feedback about learning success/ competence acquisition to the participants by using media

Dimension 7: Data protection and Privacy	7.1 Protection of personal data	- Knowledge of data protection regulations - Respecting of personal information and privacy - Consideration of data security - Use of privacy statements
	7.2 Reflection and assessment of risks in digital environments	- Knowledge and reflection about the risks of digital environments - Knowledge of safety precautions - Development of protection measures
	7.3 Health protection	- Knowledge of addictive potential - Protect yourself and others from potential hazards - Health-conscious use of digital media and with a view to social well-being
	7.4 Protection of the environment	- Awareness of the impact of digital technologies on the environment

II. Media reflection

Dimension	Sub dimensions	Explanations
Dimension 4: Reflection of digital contents/ resources	4.1 Analysis of digital media	- Critical analysis and evaluation of digital media - Knowledge and critical examination of the effects of digital media
	4.2 Evaluation of digital media	- Critical assessment and evaluation of the content of digital (educational)-resources - Knowledge and critical examination of the effects of digital media
	4.3 Organization and modification of digital resources	- Create, edit and modify digital (educational) resources (to the extent permitted by law) - Organize the content of digital resources and make it available to other interested parties, if necessary
	4.4 Understanding and Reflecting Digital Media	- Critically questioning regarding digital media - Assessment and consideration of social and ethical responsibility for oneself and others - Knowledge of the diversity of digital media/ (educational) resources - Knowledge of the importance of digital media in the social, societal and political context - Knowledge, Analyse and Reflection regarding the potential of digital media, especially in the education sector
	4.5 Data protection and privacy	- Knowledge of open educational resources and licenses - Creation of (open) licenses DigI-VET - Book -163- - Sensitisation within the framework of data protection regulations

Dimension 5: Fostering Digital Competence	5.1 Digital problem solving	- Identification of technical problems - Solving technical problems - Transferring digital knowledge to new situations
	5.2 Creative use of digital technologies	- Use of digital tools and technologies for knowledge creation and process innovation - To deal individually and collectively with cognitive processing in order to solve conceptual problem situations in digital environments.
	5.3 Identification of digital competence gaps	- Knowledge about (further) development of digital competences - Supporting others regarding (further) development of digital competences - Seizing opportunities to keep up with self-development and digital evolution
	5.4 Self-regulated learning	- Use of digital technologies to support self-regulated learning processes - Planning, implementation, control and reflection of the individual learning process
	5.5 Effective use of digital tools	- Knowledge about digital tools and decisions are most effective in supporting the individual learning process
Dimension 8: Professional Engagement	8.1 Reflective practice	- Self-critical evaluation of digital media - Reflection of the didactical preparation and use of digital media in coordination with practice
	8.2 Digital Continuous Professional Development	- Targeted use of digital media for own development
	8.3 Professional collaboration	- Collaboration and active sharing of experiences with other teachers through digital media

III. Media acting

Table 11: Age of the participants from Germany. Percentages.

Dimension	Sub dimensions	Explanations
Dimension 3: Creation of digital contents	3.1 Creating and modifying digital resources	- Creation and edition of digital content in multiple formats - Expressing yourself by digital resources
	3.2 Integration and revision of digital content	- Using digital media to integrate new tasks/formats/activities into the learning process in order to (further) develop digital content - Edition, presentation and sharing of digital content
	3.3 Responsible use of digital media	- Knowledge of copyright and licensing laws regarding data, information and digital content - Knowledge and compliance with legal requirements for the creation and further development of digital content - Respecting of personal rights
Dimension 6: Media-mediated Communication	6.1 Digital participation (interaction, collaboration)	- Ensuring that all stakeholders have access to the digital media - Consideration of previous knowledge of all involved parties - Knowledge and understanding of appropriate digital means of communication for a given context - Exchange data, information and digital content with others by using appropriate digital media - Participation of social, public and private services by using digital media
	6.2 Active involvement of all participants	- Using of digital media/technologies to increase and foster the active and creative engagement of stakeholders - Suggestions for complex problem-solving processes
	6.3 Netiquette	- Awareness of rules of conduct with regard to the use of digital technologies and interaction in digital environments. - Adaptation of communication strategies to the respective context - Raising awareness of cultural and generational diversity in digital environments
	6.4 Digital Identity	- Development and management of digital identity - Protection of own reputation - Protection of data generated by multiple digital media

Dimension 9: Empowering Learners	9.1 Actively engaging Learners	- Fostering the active and creative engagement of learners by using digital media. - Fostering of deep, transversal thinking - Dealing with complex practical issues - Extension of teaching to real learning situations
	9.2 Differentiation and personalisation	- Supporting learners in their learning process in order to achieve individual learning aims at their own learning pace
	10.1 Guidance	- Support learners individually and in groups by using digital media - Offering of innovative and new support strategies
	10.2 Collaborative learning	- Fostering of collaborative learning through digital media - Preparation learners specifically for using digital media and enable them to use digital media in group work phases, so that their cooperation and communication can be strengthened
	10.3 Didactical planning, preparation and implementation of teaching units by using digital media	Conscious use of digital media in the classroom - Planning, designing and implementation of digital teaching methods
Dimension 11: Learning	11.1 Collaborative learning	- Using of digital tools and technologies for collaborative processes and for the development of results within group work to strengthen communicative group processes
	11.2 Self-regulated learning	- Using of digital media to control and support the individual learning process - Learning progress can be documented and reviewed by using digital media - Organisation of the individual learning process

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12: Important competences for digital change – Cyprus respondents – Percentages

In summary, the VET-DigCom Model provides a fundamental orientation framework for teachers and learners with regard to digital competences, especially in the vocational training context. However, it should be mentioned that the characteristics of the individual dimensions and sub-categories vary in strength depending on the sector and the training occupation. Moreover, focal points are also set differently in the individual areas. It is also evident that the contents of the VET-DigCom Model relate primarily to vocational education and training. Nevertheless, the content components of this model can be modified and also adapted to other areas of education. This also shows that the model is already used within the Erasmus+ project DigI-VET.

Although the literature reveals that various competence frameworks for digital competences already exist, but they focus only on one target group of vocational training.

For example, the DigComEdu competence framework refers to teachers and leaves out the perspective of the learners as far as possible and does not depict any possible interfaces of digital competences (cf. DigCompEdu 2018). That is one reason why the VET-DigCom Model is reinforced in its necessity.

Dimension 12: Problem solving and acting	12.1 Recognition of own deficits	- Identification of own deficits regarding the use of digital media - Developing of measures/strategies to solve the deficits
	12.2 Finding individual digital learning opportunities	- Knowledge, assessment, use of effective digital learning environments
	12.3 Networking and organizing of digital learning resources	- Organization of a personal system of networking regarding digital learning resources
	12.4 Innovative and creative use of digital learning resources	- Knowledge of digital tools which support problem solving process - Knowledge of requirements for digital tools - Identification of digital tools which support problem solving process

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F Teaching and Learning Materials

Jennifer Schneider

One of the main aims of the European project DigI- VET is to create a curriculum structure to integrate Digitisation and Industry 4.0 in VET- courses. Therefore, the curriculum has a module structure and offers insights into current developments. The curriculum goes hand in hand with didactical materials and resource for teachers who wants to integrate it in their course structure. All the results are part of Intellectual Outcome 4 and available as download on the DigI- VET project website:

Tap to the link:
https//: http://digivet.eduproject.eu/wp-content/

The DigI- VET Training modules for VET- teachers and trainers are four modules with the following topics:
Every partner creates one of the modules which includes learning, discussion and reflection tasks to consolidate the learning content. Therefore, H5P online tasks and videos are embedded in the modules, too. For every module a classroom material for classroom lessons with tasks, instructions and guidelines for learners and trainers is created, too.

Besides the trainer modules there are 3 modules for learners. Every partner of the consortium creates every module, so at least there are 12 learner modules (4 modules for Module A/ B/ and C). For every learner module a classroom material were created, too. Moreover learning, discussion and reflection tasks complete the training modules; even with the integration of H5P tasks and YouTube videos.

13. Learning materials on Digitisation and Industry 4.0 from Germany

Jennifer Schneider
The following chapters present the German VET- training module 1: ´The DigI-VET project and the DigI-VET curriculum´ and the learner module A: ´Digitisation Terms and history´ as one of three examples of learner trainings.

13.1 VET- Trainer Module 1: The DigI-VET project and the DigI- VET curriculum

The training module is structured as a trainer presentation with integrated learning tasks for the trained trainers and VET- teachers. The following screenshot from the module shows the agenda and structure of the first module:

There are two main parts which will be focused at the training:
1. The DigI- VET Project as well as

2. The DigI- VET Curriculum.

Training Modules for VET- teacher and trainer

Module 1: The DigI-VET project and the DigI-VET curriculum

- created by University of Paderborn, Germany

Module 2: Digitisation and Industry 4.0 Terms and history

- created by Private Institute Emphasys Centre, Cyprus

Module 3: Good practices of digitization and Industry 4.0

- created by VAR Vocational Education and Training Ltd, United Kingdom

Module 4: The need of digitization in today´s world and insights into future developments

- created by Asociaţia Oamenilor de Afaceri Argeş Romania, Romania

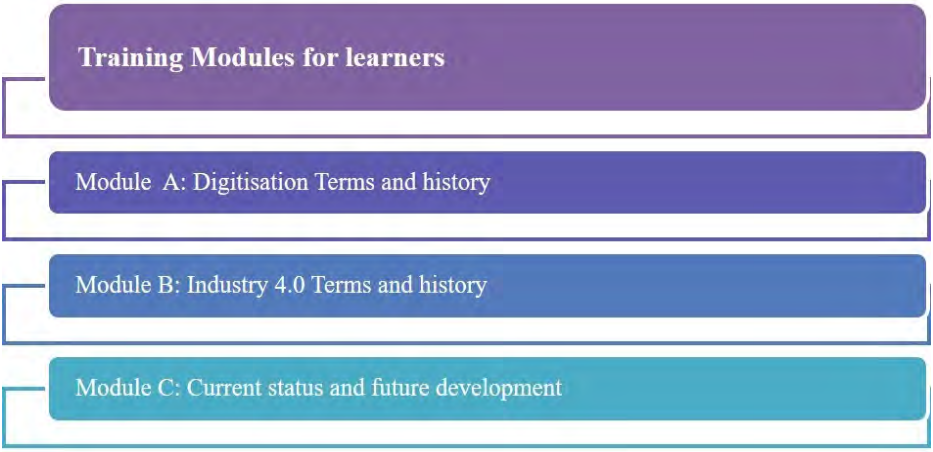


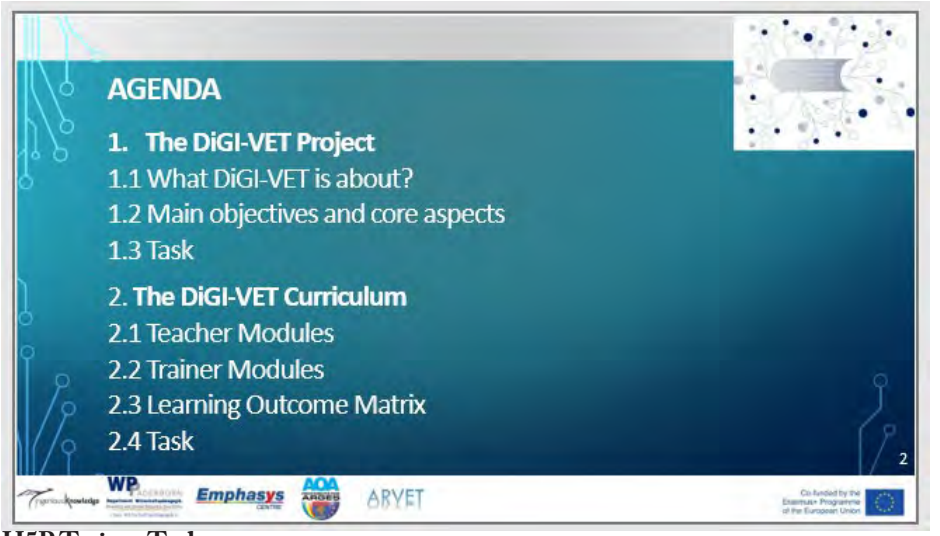
Figure 40: DigI- VET: Trainer Module 1 by UPB. Training Modules for Trainers.

First part of the trainer module:
The first part of the trainer presentation gives an insight of the partner consortium of the European DigI- VET project, the core aspects, aims and objectives. The trainer gives examples of the intellectual outcomes and shows the structure of the DigI- VET website, where all meeting documents, insights of the projects as well as final outcomes are available as downloads. The first part of the DigI- VET training module ends with interactive H5P online tasks which has to be solved by the trained trainers and teachers.

The next screenshots show the presentation slides of the first part of the trainer module. The final trainer module is downloadable under the DigI- VET website

Tap to the link:
http://digivet.eduproject.eu/?page_id=44&lang=de

Figure 41: DigI- VET: Trainer Module 1 by UPB. Training Modules for Trainers.



H5P Trainer Tasks:

Figure 42: DigI- VET Online Tasks /Trainer Module 1 by UPB. Training Modules for Trainers.

Second part of the trainer module:

The second part of the trainer module focus on the DigI- VET curriculum and explains the structure of the teacher modules 1 to module 4. The trained trainers and VET-teachers get an overview of what will be part of the module and what are the learning outcomes. Besides, the trainer explains the learner modules A to module C, the learning outcomes and how the online tasks, like H5P task and YouTube videos increase the understanding of taught input.

At least the learning outcome matrix explains the relationship between the 1. DigI- VET Training modules for VET- teacher and trainers as well as the DigI- VET modules for learners. For a better understanding the competence profile shows the main competences the modules will foster.

The second part of the trainer module ends with interactive H5P tasks to keep a check on the learning results and where is a need of further explanations for the trainers and VET- teachers.

The following screenshots shows the presentation slides of the second part of the trainer

module:

Figure 43: DigI- VET Online Tasks /Trainer Module 1 by UPB. Training Modules for Trainers.

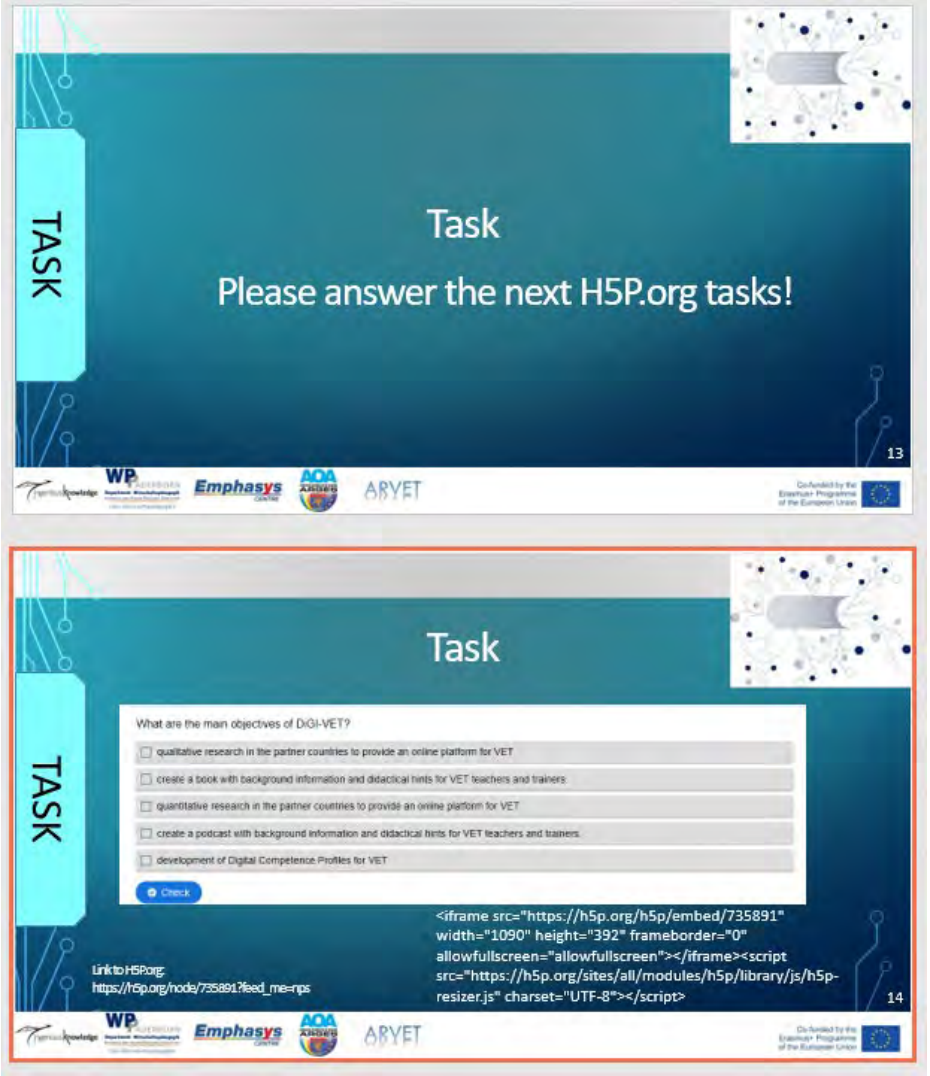


Figure 44: DigI- VET Online Tasks /Trainer Module 1 by UPB. Training Modules for Trainers

H5P Trainer Tasks:

Screenshots of the integrated H5P online tasks

Figure 45: DigI- VET Online Tasks /Trainer Module 1 by UPB. Training Modules for Trainers.

13.2 VET- Trainer Module 1: Classroom material

For every VET- trainer module the consortium creates an additional classroom material which support the learning outcomes and aims as well as to deepen the learning content which was taught by trainers. The classroom material can be used for self- learning sessions by learners as well as group and team work.

The following screenshot shows one cut out of the classroom material for module 1: The DigI-VET project and the DigI- VET curriculum. In this example the classroom material is designed in two parts: first a short introduction gives an overall overview of the following subject, topics and definitions about digitalisation.

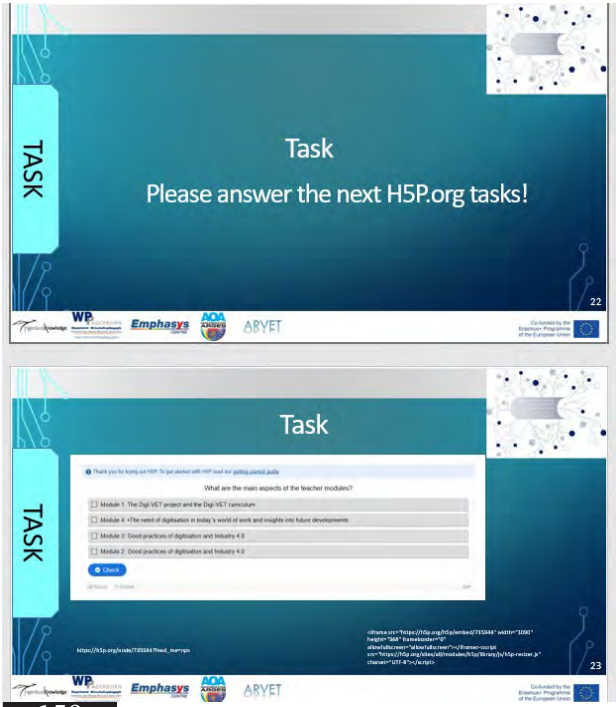


Figure 46: Classroom material of the VET Trainer module/ cut out.

After the introduction and definitions, the learner gets different tasks on the subject. The wide variety of tasks structures gives a holistic background and learning environment to the learner. The following cut out gives a quick view on some types of takes:

Figure 47: Screenshot of the Classroom material of the VET Trainer module/ cut out.

13.3 Learner Module A: Digitisation Terms and history

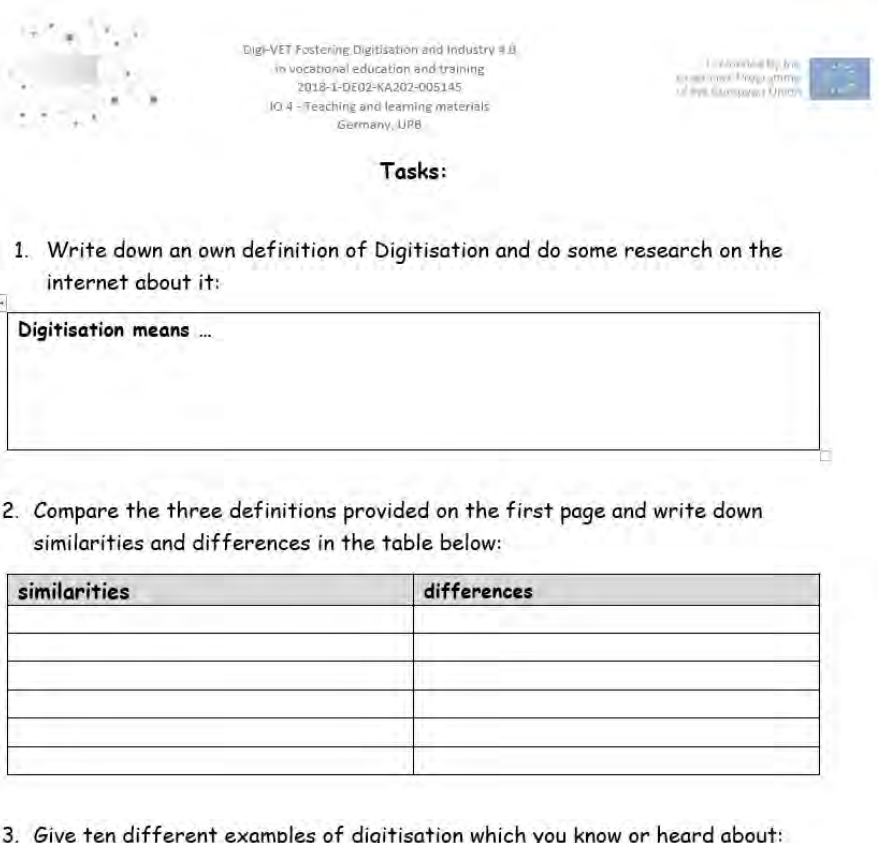
Similar to the trainer module the learner module is structured as a trainer presentation with integrated learning tasks for the trained learners. Every partner from the DigI-VET consortium creates three learner modules:

Module A: Digitisation Terms and history
Module B: Industry 4.0 Terms and history
Module C: Current status and future developments

The following screenshot from the module shows the agenda and structure of module A: Digitisation Terms and history.

Figure 48: DigI- VET: Learner Module A by UPB. Learner Module: Digitisation Terms and History.

The agenda shows two main parts of the module A:
• Explanations and definitions as well as an
• explaining video about the history of digitisation and Industry.



Digi-VET Fostering Digitisation and Industry 4.0
in vocational education and training
2018-1-DE02-KA202-005145
IO 4 - Teaching and learning materials
Germany, UPB

Tasks:

1. Write down an own definition of Digitisation and do some research on the internet about it:

Digitisation means …

2. Compare the three definitions provided on the first page and write down similarities and differences in the table below:

similarities	**differences**

3. Give ten different examples of digitisation which you know or heard about:

The second part is essentially to deepen the content in form of the video and interactive tasks.

The following part shows the different elements the learner module has included in module A. After every learning part the module comprise tasks to deepen the learning content, too.

First part of the learner module:
The next screenshots show the presentation slides of the first part of the learner module. The final learner module is downloadable under the DigI- VET website:

Tap to the link:
http://digivet.eduproject.eu/?page_id=44&lang=de

The learner of the DigI- VET project gives an idea what digitization means in the industrial context as well as explanations about the difference between digitalization, digitization and digital transformation. During the presentation the learner has the opportunity to start discussion and ask questions about the presented topics.

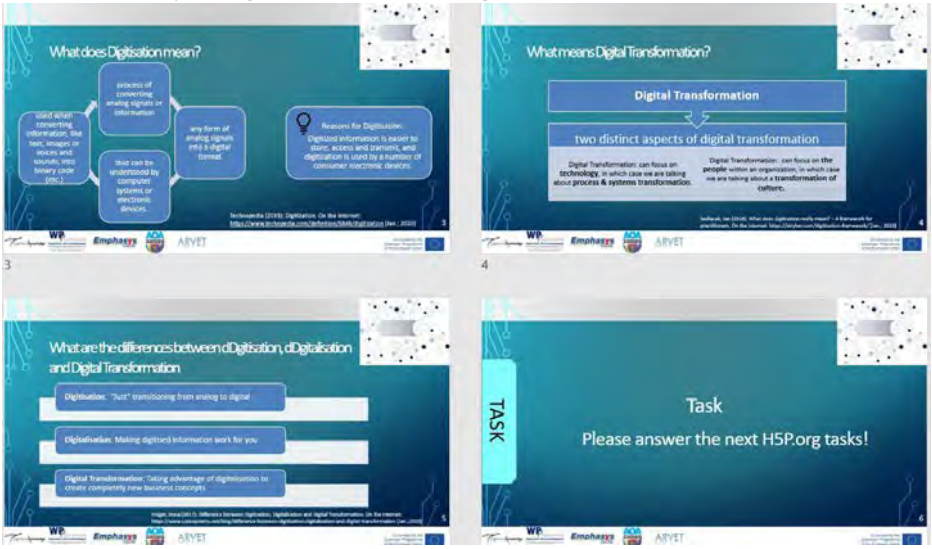
Figure 49: DigI- VET: Learner Module A by UPB. Learner Module: Digitisation Terms and History.

The first part of the learner module finishes with a H5P tasks to deepen the learned content.

H5P Learner Tasks:

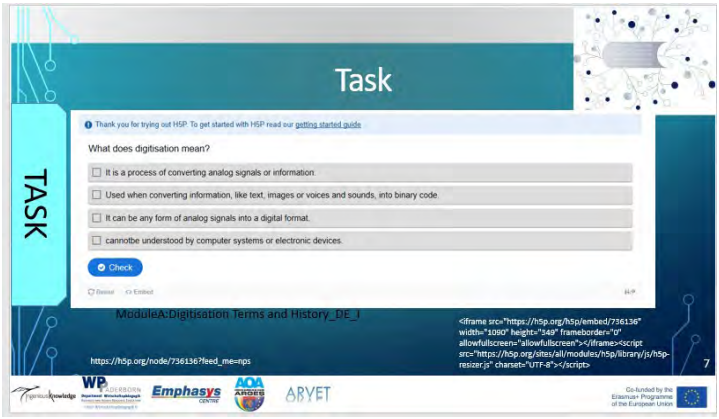
Figure 50: DigI- VET: Learner Module A by UPB. Learner Module: Digitisation Terms and History.

Second part of the learner module:
The second part starts with a short overview of the agenda and a YouTube video about the history of digitisation as well as digitalization. The learner should take some



notes, questions and impacts according the video. After the video the trainer starts an open discussion about the content of the video, too. All learners can participate in the discussion. The module ends with a H5P tasks to review the learning contents and show learning gaps.

13.4 Learner Modul A: Classroom material
Similar to the VET- trainer module the learner modules A to C get a classroom material for the real time training in classroom.



The material consists of two parts: First the learner gets an introduction to the taught content, definitions and/or examples.

In the second part the learner gets a variety of different tasks to deepen the learning content, review open questions and reveal learning gaps. The following screenshot of the classroom material of the learner module A shows the two parts of the worksheet.

Introduction part of the learner module A:

Figure 51: Classroom material of the Learner Modul A/ cut out.

Task part of the learner module A:

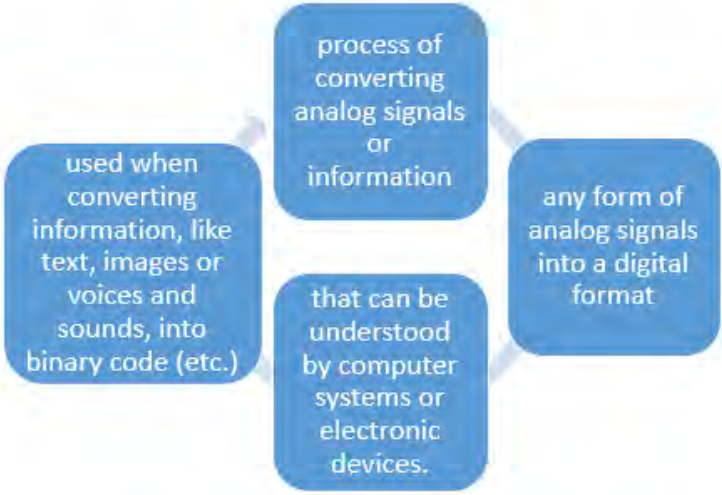
Figure 52: Classroom material of the Learner Modul A/ cut out

References

DigI- VET (2020): Retrieved from the Internet: http://digivet.eduproject.eu/?page_id=44&lang=de. Access date: 17.08.2020.

Digitisation?! What does it mean?

Our life is changing fast even the digitisation has become a fundamental part of our daily work and private business. But, what does digitisation means for VET? The following, general definition parts for digitisation shows a great overview of main parts of digitisation.



Reasons for Digitisation:

Digitised information is easier to store, access and transmit, and digitization is used by a number of consumer electronic devices.

Technopedia (2019): Digitization. On the internet: https://www.techopedia.com/definition/6846/digitization [Jan.; 2020]

Tasks:

1. Write down an own definition of Digitisation with focus on the field of vocational education and training:

Digitisation in VET means …

2. Please think on the main aspects Digitisation should focus on:

Digitisation should focus on…	**… because…**

3. Five different examples of digitisation which you know or heard about:

1. _____
2. _____
3. _____
4. _____
5. _____

14. Learning materials on Digitisation and Industry 4.0 from UK

Gelija Tamulyte

The following chapters provide the VET- training module 3 by UK "Importance of Digitisation for Education and Industry: From Smart Data and Smart Devices", Module 19 "A general view on the Future of Digitisation" and the classroom material from modules A, B and C.

14.1 VET-Trainer Module 3: Importance of Digitisation for Education and Industry – from Smart Data and Smart Devices

This training module is composed of information that could be used to present the

material by the trainee. The following screenshot portrays the contents of the presented module.

There are four parts:
1. The Importance of Digitisation in Education
2. The Importance of Digitisation in Industry
3. EU and UK perspective on Digitisation
4. Learner test/ trainer tasks

Figure 53: VET-Trainer Module 3, screenshot I, UK.

First part of the trainer module:
The first part of module 3 presentation provides with the opportunities the digitisation brings to Education. The trainer gives examples of examples such as online learning platforms or MOOC (Massive Open Online Courses). The trainer discusses not only the opportunities such as increased productivity, resource efficiency, convenience and

learning management systems (e.g. Blackboard) but the risks as well. Those risks may include lack of focus, loss of social interactions or incompetence to use technologies for teaching purposes.

The second part presents the opportunities and risks in Industry that are being brought by the continuous process of digitisation. The trainer mentions the examples for each

of them. The opportunities of Industry portray the positive correlation between the industry itself and the education: JISC UK Digitisation Programme (2004-2010), UK and Google partnership to release online 250 000 books with free access (2011) and Erasmus+ EDUC European Digital UniverCity (2019). The negative aspect of it – the risks – include maintenance of human labour force, incompetence to use machinery and unfulfilled job positions. The third part presents how UK and EU are both involved in the ways of using digitisation to boost economy. One of the given examples is the program to integrate technologies in learning established by EU. Lastly, there are trainer tasks provided to check the knowledge of those who are the participants of the presentation.

The screenshots below portray the slides of module 3. The final trainer module is downloadable under the DigI- VET website:

Tap to the link:
http://digivet.eduproject.eu/

Figure 54: VET-Trainer Module 3, screenshot II, UK.

14.1 VET- Trainer Module 3: Classroom material

As mentioned above, each trainer module has an additional classroom material contributing to learning aims and outcomes. The given screenshots present the classroom material for module 3: Importance of Digitisation for Education and Industry – from Smart Data and Smart Devices.

This classroom material consists of both – information that is given to acquire certain

information and the tasks to check own knowledge received through presentation and the text provided in the information sheet. The provided text boosts the knowledge of learners on the aspects of correlation between Industry and Education, provides aims and outcomes of Digi-VET project itself. This all gathered information will help learners to progress their knowledge about Industry 4.0 concept as they will get to know different

aspects of Industry 4.0. The more varied the knowledge will be – the more views will appear. Industry 4.0 and Digitisation is a good topic for a discussion and after acquiring all knowledge, the learners will be able to participate in debates or simply express their views by providing many examples learnt through the given materials.

Figure 55: VET-Trainer Module 3, Classroom Material, screenshot I, UK.

Figure 56: VET-Trainer Module 3, Classroom Material, screenshot II, UK.

Module B

Industry 4.0 Terms and history

Importance of Digitisation. How does it affect the Education and Industry?

The increased rate of digitisation has a wide impact on Education and Industry. Meanwhile, both of these areas can be affected on its own, at some instances, digitisation influenced both areas in one shot. When each of these mentioned situations occur and how does it shape the Importance of Digitisation?

Figure 57: VET-Trainer Module 3, Classroom Material, screenshot III,
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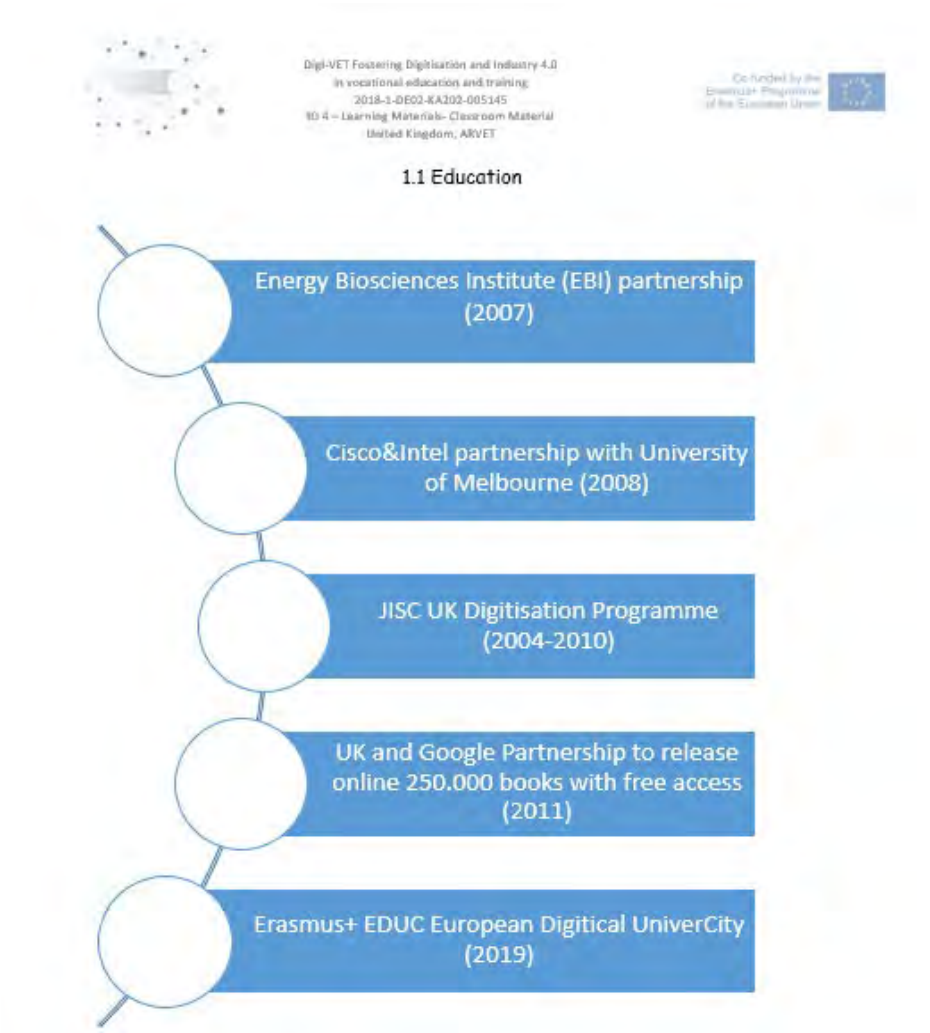


Figure 58: VET-Trainer Module 3, Classroom Material, screenshot IV, UK.

Figure 59: VET-Trainer Module 3, Classroom Material, screenshot V, UK.

Figure 60: VET-Trainer Module 3, Classroom Material, screenshot VI,UK.

Figure 61: VET-Trainer Module 3, Classroom Material, screenshot V, UK.

1.2 Industry and Education

Tasks:

1. Write down in your own opinion the definition of the importance of digitisation?

The importance of digitisation is …

14.2 VET-Trainer Module A: general view on Future of Digitisation

2. Given the seven listed opportunities in Education, list them according to the Importance and provide a reason for your opinion.

	The opportunity in Education	... because...
1		
2		
3		
4		
5		
6		
7		

The trainer module consists of 5 different parts contributing to the general view on the

3. Given three most recent examples of positive correlation between Education and Industry (Illustration 1.2), describe the impact of them on society and connect it to your own definition of the Importance of digistisation.

Example 1 is … it …., the importance is … .
Example 2
Example 3

Digl-VET – Aims, Structure and Core Ideas

DigI-VET and its main objectives

- It is a project financed by the European Union
- Based on Digitisation and Industry 4.0 in Vocational Education
- Taking place from 1 Dec 2018 to 30 Nov 2020
- 5 partnering organisations
- Main coordinator is Ingenious Knowledge GmbH (based in Germany)

future of Digitisation. Those parts include: the opportunities, innovations and risks, Three Horizons Framework, EU and UK approach and the learner tasks.

Digi-VET is about global chance caused by digitisation in the Education and Industry. It focuses on what actions had to be carried out to adapt to those changes.

AIM: to do qualitative and quantitative research in the partner countries to provide an online platform for VET on the DigI-VET website and create a book with background information and didactical hints for VET teachers and trainers.

Core Aspects: Research / Development of Curriculum and materials / Boosting awareness

Tasks

1. Describe in one sentence what is DigI-VET.

DigI-VET is .....

2. Time to be creative! Create your own diagram portraying the main core principles and elements of Digi-VET.

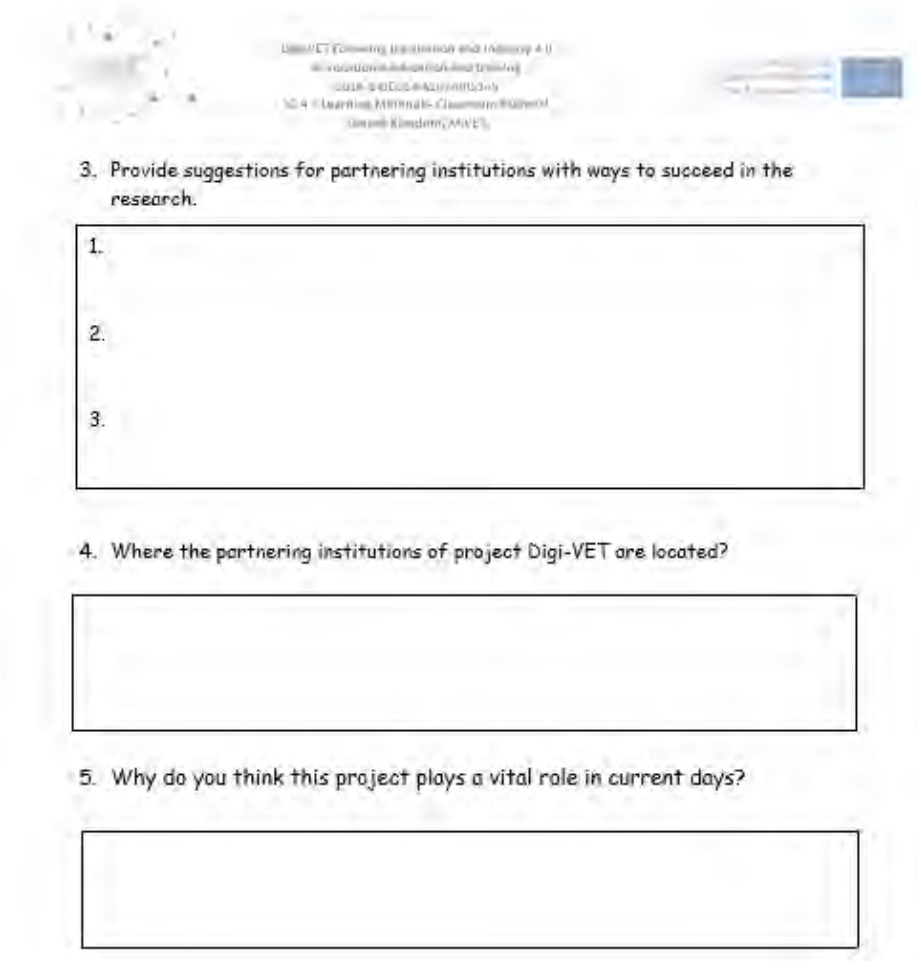
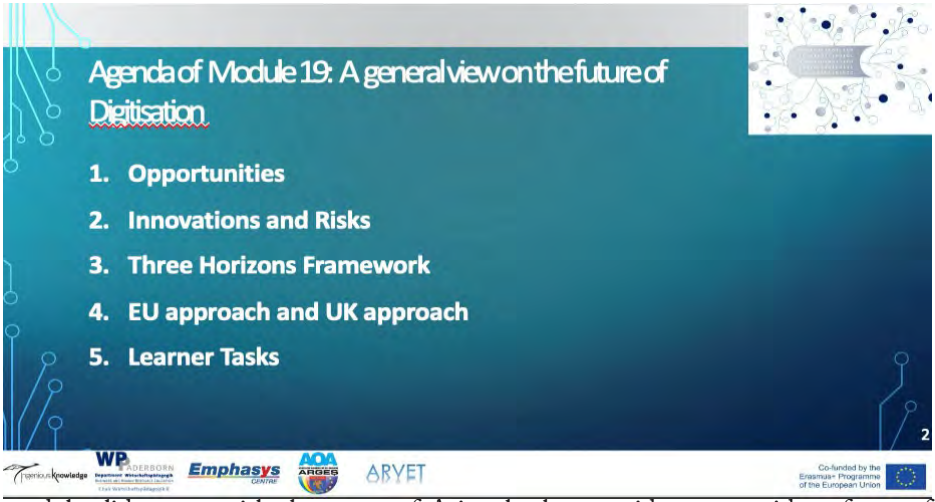


Figure 62: VET- Trainer Module A, Screenshot I, UK.

First part of the learner module:
The final learner module is downloadable under the DigI- VET website:

Tap to the link:
http://digivet.eduproject.eu/

This module provides the examples that shape the future of the Digitisation. The



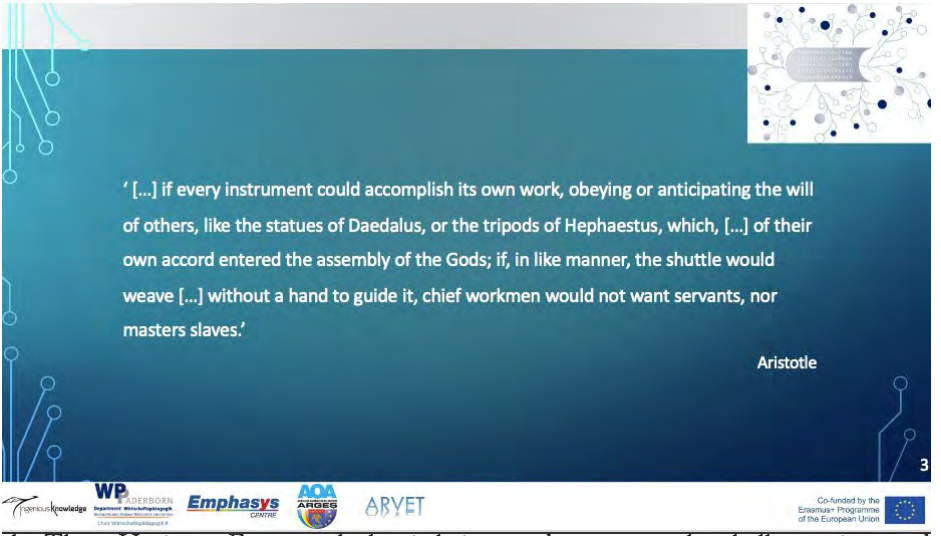
module slides start with the quote of Aristotle that provides a great idea of one of the risks the digitisation imposes on society – human labour force being changed by technological advancements.

Figure 63: VET- Trainer Module A, Screenshot II, UK.

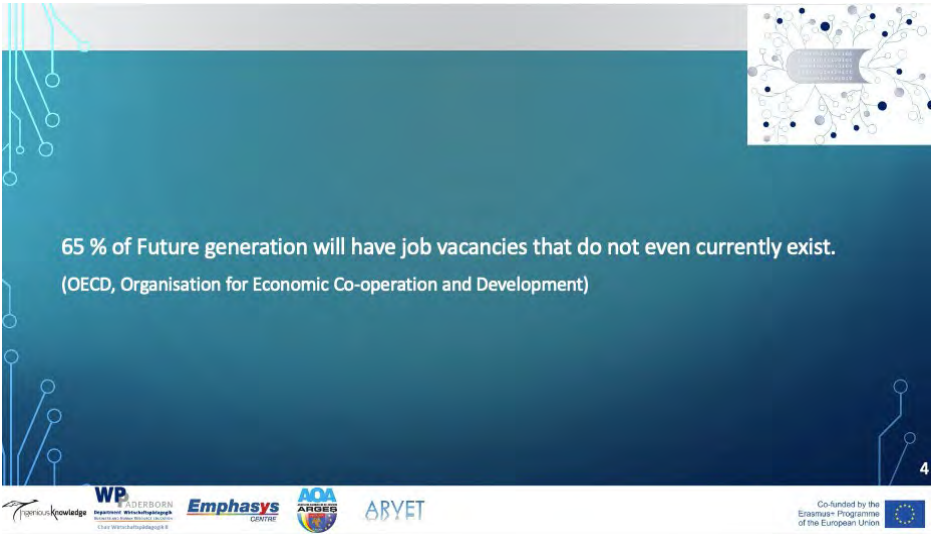
The following screenshot provides a statement from a module slide that causes a great concern regarding the future and gives enough space for the trainer to elaborate on it.

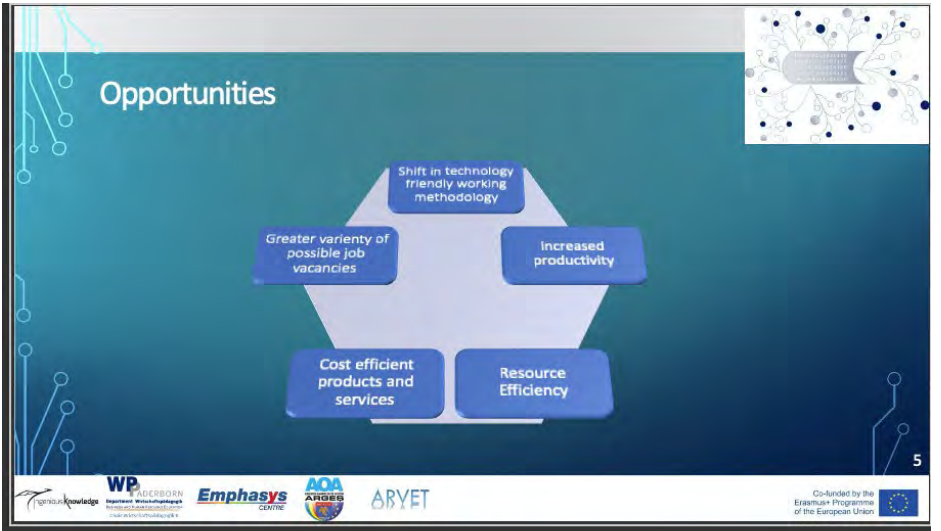
Figure 64: VET- Trainer Module A, Screenshot III, UK.

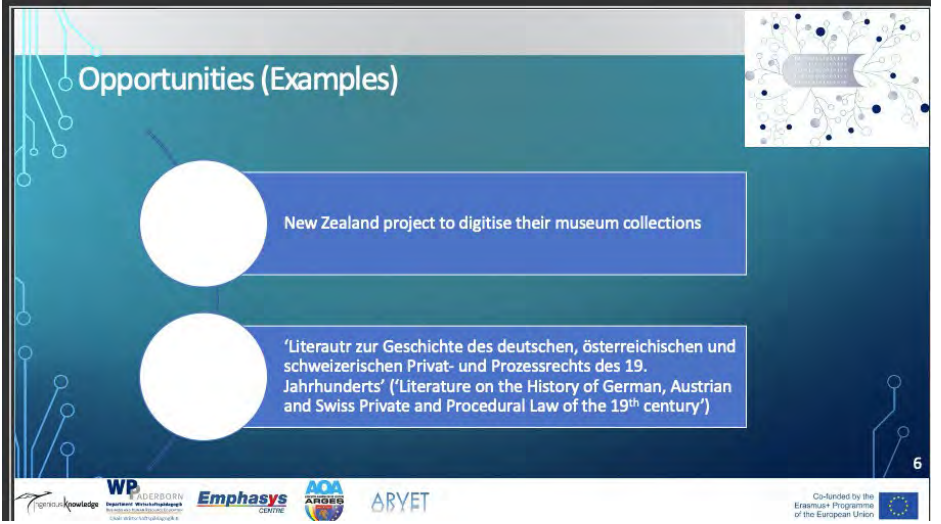
The module consists of several parts discussing the opportunities and risks indicated by the given examples that are related to current daily life. The highlight of the module is



the Three Horizons Framework that is being used to portray the challenges imposed by digitisation.




Opportunities
Shift in technology friendly working methodology
Greater varienty of possible job vacancies
Increased productivity
Cost efficient products and services
Resource Efficiency
5
Co-funded by the Erasmus+ Programme of the European Union


Opportunities (Examples)
New Zealand project to digitise their museum collections
'Literautr zur Geschichte des deutschen, österreichischen und schweizerischen Privat- und Prozessrechts des 19. Jahrhunderts' ('Literature on the History of German, Austrian and Swiss Private and Procedural Law of the 19th century')
6
Co-funded by the Erasmus+ Programme of the European Union

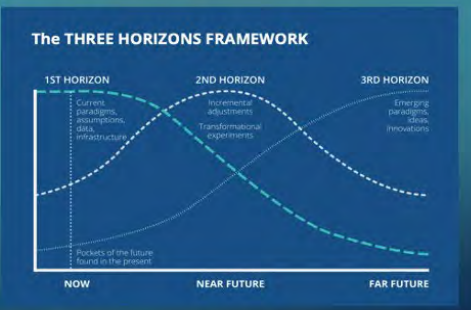
Three Horizons Framework

Lee Kuan Yew School of Public Policy supported by Konrad Adenauer Stiftung in their workshop report discussed their established Three Horizon Framework model describing the future of digitisation.

Co-funded by the Erasmus+ Programme of the European Union

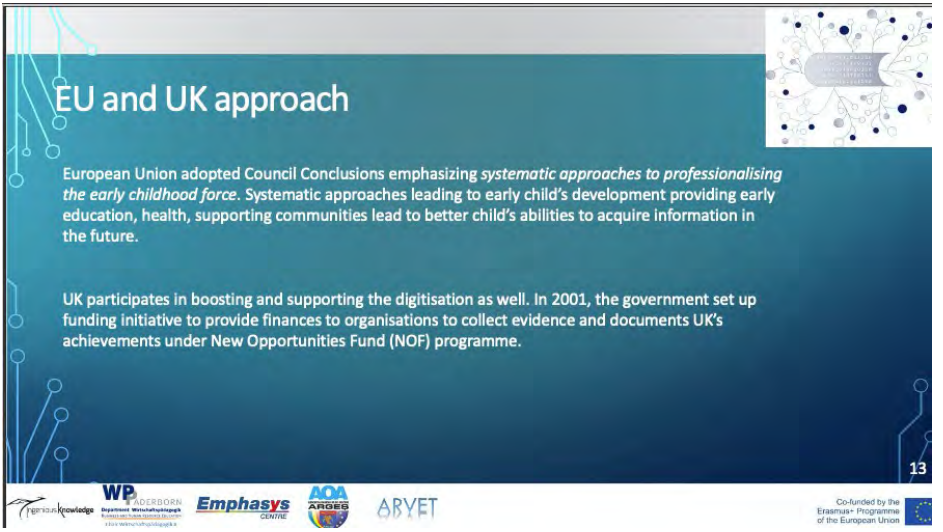
Three Horizons Framework

Horizon 1: the case for change
Horizon 2: dilemma between vision and reality, transition
Horizon 3: vision, ideal system



Co-funded by the Erasmus+ Programme of the European Union

Figure 65: VET- Trainer Module A, Screenshot IV, UK.

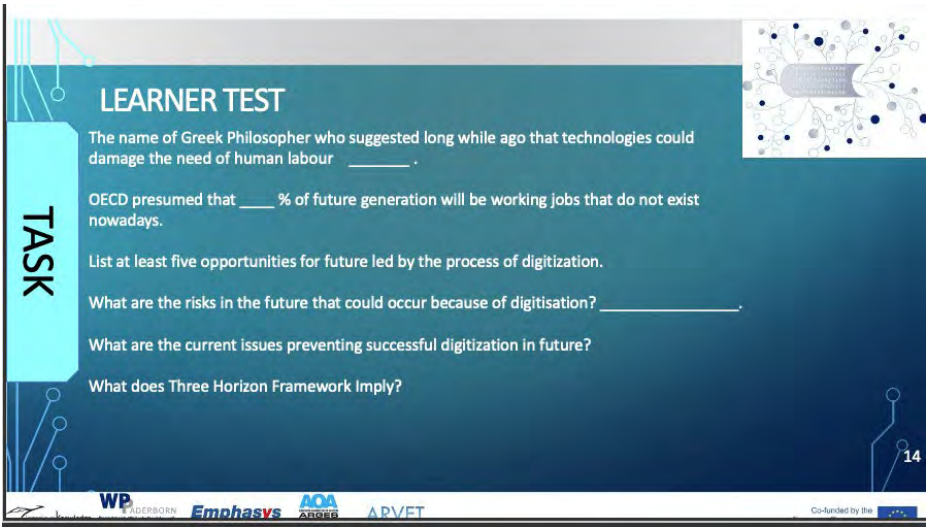


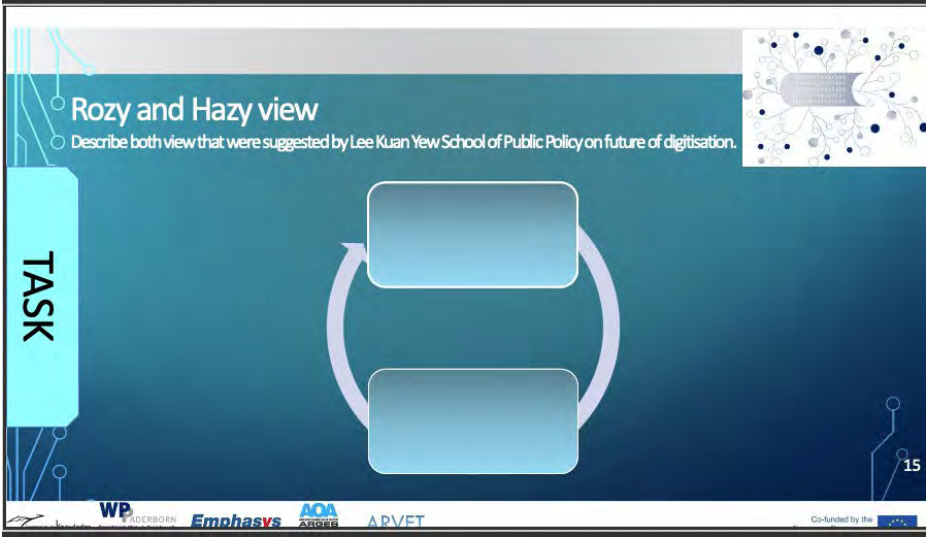
Learner Tasks:

Figure 66: VET- Trainer Module A, Screenshot V, UK.

14.3 Learner Modules A and C: Classroom material

The given screenshots present the classroom material created for Modules A and C. Similar to the tasks for module B, the classroom material consists of the information and the knowledge check.





Classroom material for module A:

Figure 67: Learner Modul A and C: Classroom Material, Screenshot I, UK.

Figure 68: Learner Modul A and C: Classroom Material, Screenshot II, UK.

Module A

Digitisation Terms and history

Mainly when students are being asked what the digitisation is, the common answer is increased level of technologies. However, is it the only possible definition or are there any other elements contributing to digitisation?

Tasks:

1. What are the 3 most essential factors defining the process of Digitisation? Contrast the effect of digital transformation on technology and on people.

1. **2.** **3.** Digital transformation on technology focuses on ……, meanwhile, digital transformation affects people by focusing on …….

2. Fill the chart.

Finish writing the definitions.
Digitisation is ….
Digitalisation is ….
Digital transformation is ….

3. Read the following passage from the report published by UK government (https://publications.parliament.uk/pa/cm201719/cmselect/cmsctech/1455/1455.pdf, accessed 9 June, 2020). Imagine you are being asked to draft the possible options to the government of how they could transform Government services. How would you come to this solution?

'In 2018, the Organisation for Economic Co-operation and Development (OECD) emphasised the importance of Governments across the world harnessing digital technologies in order to adjust to the "changing expectations and needs" of modern societies. In practice, meaning that their services were digital by design, data-driven, user-driven and proactive in policy making. They set out the power of digital to transform Government services and to put the citizen at the heart of what the Government does.

This transformation requires governments to take a user-driven approach, empowering citizens and business to interact and collaborate with the public sector to determine and address their own needs.

4. In Government Transformation Strategy (2017), UK government set 3 goals and one of them is to transform 'the relationship between citizens and the State - putting more power in the hands of citizens and being more responsive to their needs.'

   What is the importance of developing the relationship between the citizens and the State? How could citizens have more power?

The importance of relationship between the citizens and the State is …
Citizens could have more power in their hands if the government ….

Figure 69: Learner Modul A and C: Classroom Material, Screenshot III, UK.

Figure 70: Learner Modul A and C: Classroom Material, Screenshot IV, UK.

The given structure was being used to create a classroom material for module C as well as modules A and B. The following screenshots show certain part of the introduction and the tasks for the module C.

Figure 71: Learner Modul A and C: Classroom Material, Screenshot V, UK.

1. Using the first provided image, describe in your own words what is Industry 4.0. Which of the shown elements do you think contribute the most to Industry 4.0?

Industry 4.0 is …

2. Given the written passage from online platform, give two examples of real-life situations when you came across the Industry 4.0 yourself.

3. The Second Image shows the History of Industry 4.0. Describe the Importance on Society of each of them. Factors that could be considered: education, economics, environment, etc.

Figure 72: Learner Modul A and C: Classroom Material, Screenshot V, UK

Module C

General Aspects of Digitisation at Industry

While considering the aspects of how digitisation affects the Industry, the concept of *Internet of Things* is essential. It is connection between Internet and Device and the effect of this relationship towards other connected devices. E.g. self-driving cars, fitness devices measuring different aspects (e.g. heart rate, steps).

The Internet of Things (licence Free Pixabay image)

References

DigI- VET (2020): Retrieved from the Internet: http://digivet.eduproject.eu/?page_id=44&lang=de. Access

Task

Describe the Internet of Things, describe how it affects Industry and out of 12 chosen examples in the provided image, choose 5 and elaborate on their impact for Industry.

date: 16.09.2020.

15. Learning materials on Digitisation and Industry 4.0 from Cyprus

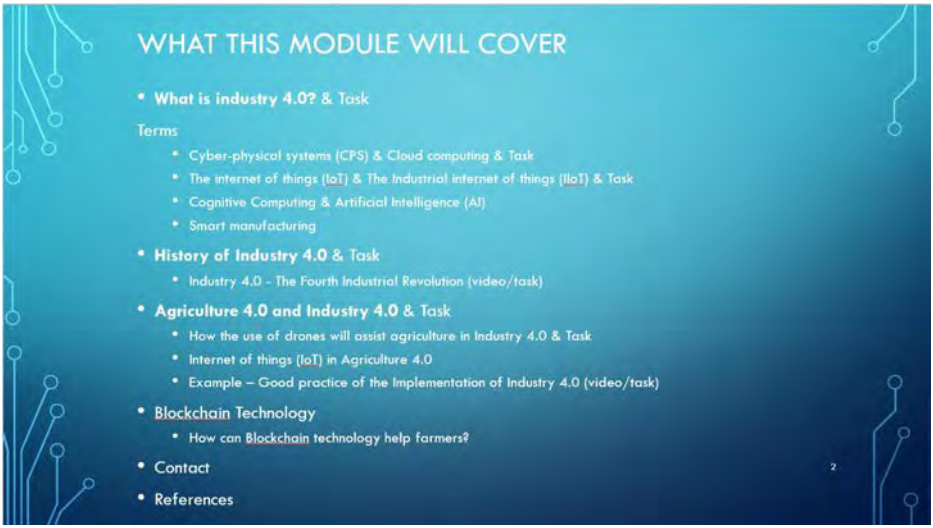
Nicholas Moudouros / Andrianna Georgiou

The following chapters present the Cypriot VET – Training ´Module 2: Terms, History and Agriculture of Industry 4.0´, Trainer and Learner modules A ´Terms and History´, B ´Terms, History and Agriculture in 4.0´ and C ´Current status in Cyprus´.

15.1 VET- Trainer Module 2: Terms, History and Agriculture of Industry 4.0

The training Module 2, will cover an overall idea of what Industry 4.0 is, along with some frequently discussed terms used and a brief explanation of the development of Industry 4.0 throughout the years. A small section then, covers Agriculture today and how Industry 4.0 has helped evolve this sector.

Figure 73: VET- Trainer Module 2, Screenshot I, Cyprus.



First Part of Module 2

The first part of the presentation gives an initial explanation of what Industry 4.0 is. The trainer here explains that this is the current situation the world is experiencing at the moment and everything around us is taking a digital form and automation is now part of our everyday life.

The terms which are explained in this presentation are:
• Cyber-physical systems (CPS) & Cloud computing &Task
• The internet of things (IoT) & The Industrial internet of things (IIoT) &Task
• Cognitive Computing & Artificial Intelligence (AI)
• Smart manufacturing

The following screenshots show some of the slides from the presentation of the trainer module. The final module will be uploaded here:

http://digivet.eduproject.eu/?page_id=44

Figure 74: VET- Trainer Module 2, Screenshot II, Cyprus.

Second Part of Module 2

The second part of module 2, gives a brief explanation of the history of Industry 4.0. How technology has involved thought out the years in this sector. It begins with the 1st Industrial revolution in the 1800s, continues with the 2nd introducing mass production, the 3rd by introducing microelectronics and automation and concluding the 4th = Industry 4.0 and today.

The following screenshots show some of the slides from the presentation of the trainer module. The final module will be uploaded here:

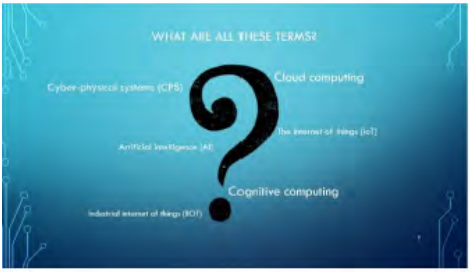


Figure 75: VET- Trainer Module 2, Screenshot III, Cyprus.

Third Part of Module 2

The third and final part of Module 2, focuses on Agriculture and Industry 4.0. How Industry 4.0 has aided the Agriculture sector. A short introduction of the topic is made and the following slides, focus on how drones have been developed to help the agriculture sector. Then it goes on to explain how the Internet of Things (IoT) can also help the agriculture sector. And last, but not least, the technology everyone is talking about – Blockchain and how it can help farmers.

The following screenshots show some of the slides from the presentation of the trainer

module. The final module will be uploaded here:

Figure 76: VET- Trainer Module 2, Screenshot IV, Cyprus.

HP5 – Trainer tasks

Screenshots of some of the integrated H5P online tasks

Figure 77: VET- Trainer Module 2, Screenshot V, Cyprus.

References

DigI-VET (2020): Retrieved from the Internet: http://digivet.eduproject.eu/?page_id=44&lang=de. Access date: 16.09.2020

15.2 VET- Trainer Module 2: Classroom Material

The material here, compliments the teacher's material / presentation. Below is a

screenshot from this material with some short text and explanation, along with some tasks.

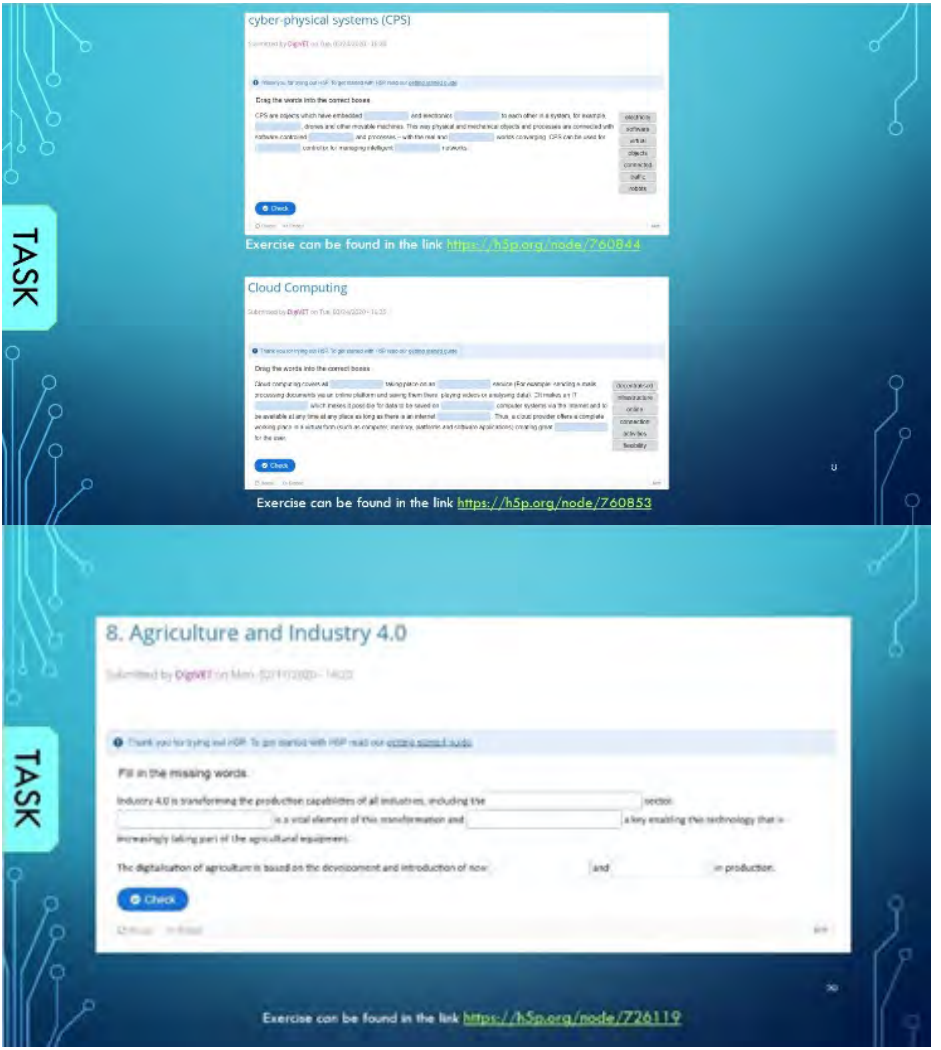


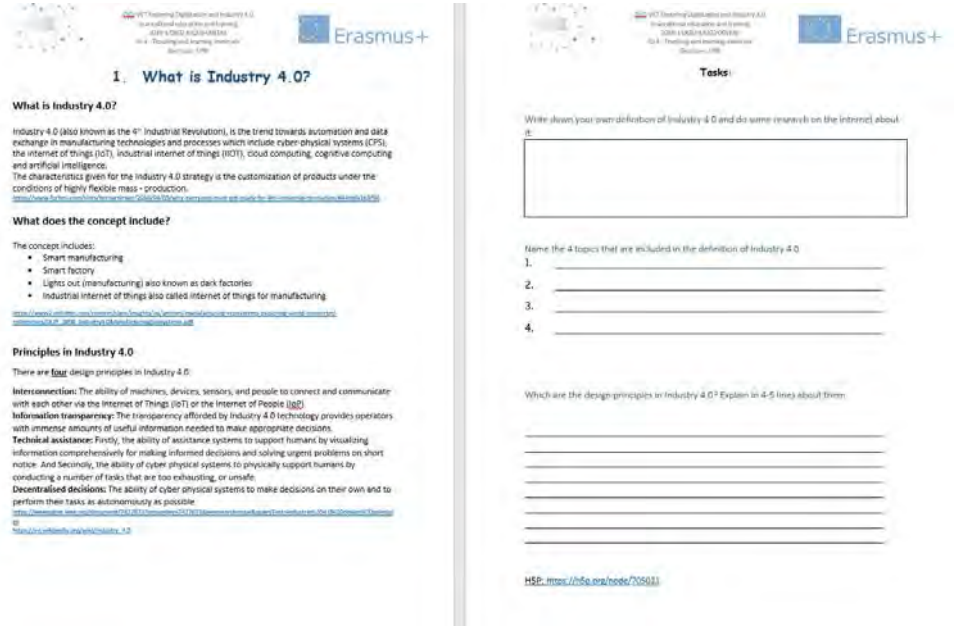
Figure 78:VET- Trainer Module 2, Classroom Material, Screenshot I, Cyprus.

15.3 Learner Module A: Digitization: Terms & History

For the presentation of module A, for the learners, as seen from the agenda below consists of a short introduction, some helpful terms in order for the reader to become

more familiar with the concept of digitization and the history of it.

The following screenshots are parts from the presentation of the learner module. The complete presentation will be uploaded here:



1. What is Industry 4.0?

What is Industry 4.0?

Industry 4.0 (also known as the 4th Industrial Revolution), is the trend towards automation and data exchange in manufacturing technologies and processes which include cyber-physical systems (CPS), the internet of things (IoT), industrial internet of things (IIOT), cloud computing, cognitive computing and artificial intelligence.
The characteristics given for the Industry 4.0 strategy is the customization of products under the conditions of highly flexible mass - production.

What does the concept include?

The concept includes:

- Smart manufacturing
- Smart factory
- Lights out (manufacturing) also known as dark factories
- Industrial internet of things also called internet of things for manufacturing

Principles in Industry 4.0

There are four design principles in Industry 4.0:

Interconnection: The ability of machines, devices, sensors, and people to connect and communicate with each other via the Internet of Things (IoT) or the Internet of People (IoP).
Information transparency: The transparency afforded by Industry 4.0 technology provides operators with immense amounts of useful information needed to make appropriate decisions.
Technical assistance: Firstly, the ability of assistance systems to support humans by visualizing information comprehensively for making informed decisions and solving urgent problems on short notice. And Secondly, the ability of cyber physical systems to physically support humans by conducting a number of tasks that are too exhausting, or unsafe.
Decentralised decisions: The ability of cyber physical systems to make decisions on their own and to perform their tasks as autonomously as possible.

Tasks:

Write down your own definition of Industry 4.0 and do some research on the internet about it:

Name the 4 topics that are included in the definition of Industry 4.0:

1. _____
2. _____
3. _____
4. _____

Which are the design principles in Industry 4.0? Explain in 4-5 lines about them:

_____
_____
_____
_____
_____
_____
_____
_____

H5P: https://h5p.org/node/705031

http://digivet.eduproject.eu/?page_id=44

Figure 79: Learner Module A, Screenshot I, Cyprus.

Figure 80: Learner Module A, Screenshot II, Cyprus.

HP5 tasks

Screenshots of some of the integrated H5P online tasks

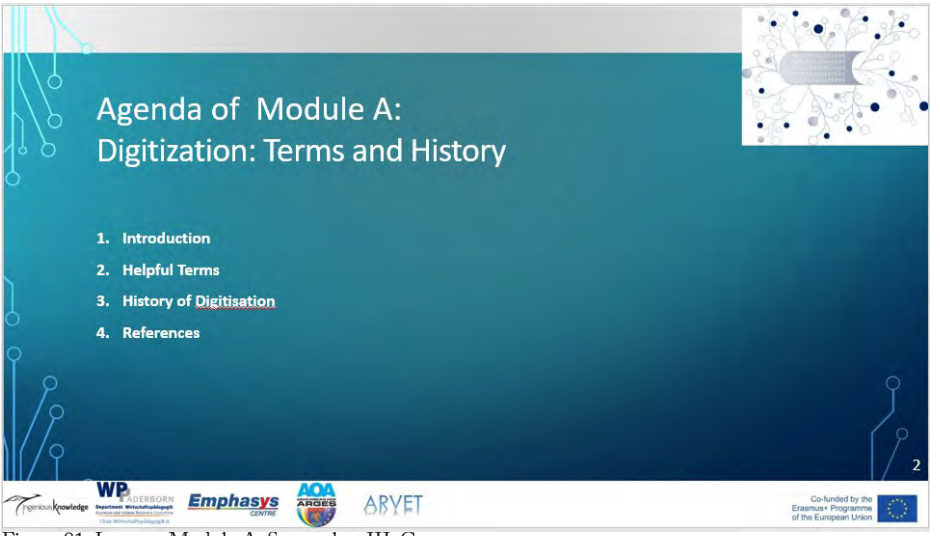
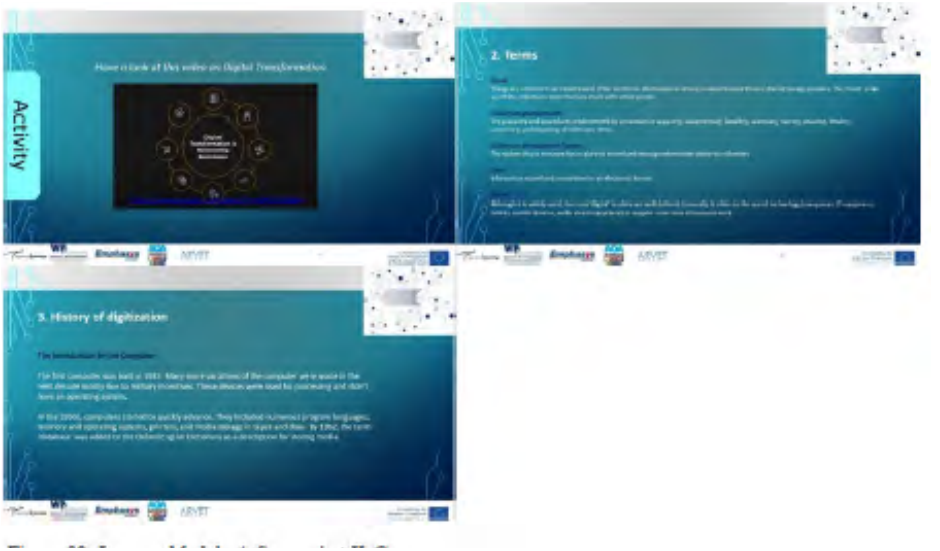


Figure 81: Learner Module A, Screenshot III, Cyprus.

All further information:

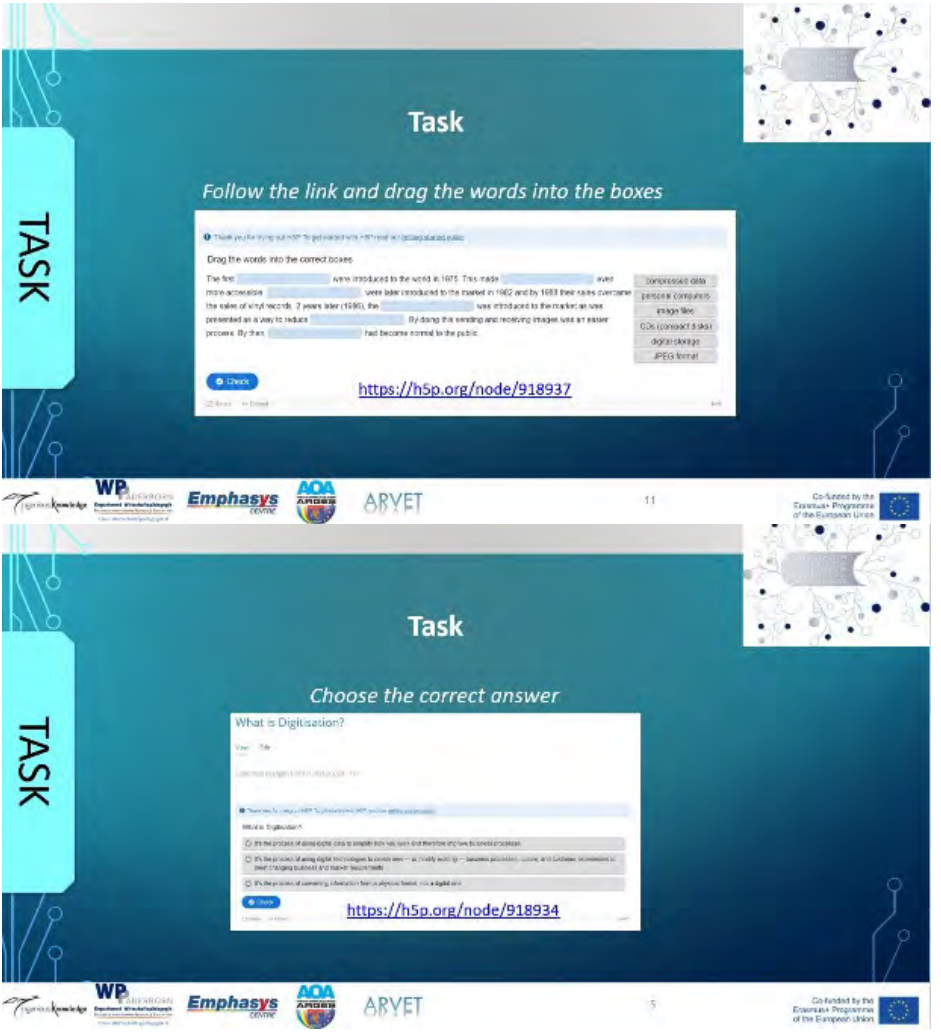


http://digivet.eduproject.eu/?page_id=44
Figure 81: Learner Module A, Screenshot III, Cyprus

15.4 Classroom Material Module A: Digitization: Terms & History

The classroom material complements the learner module A, and consists of an

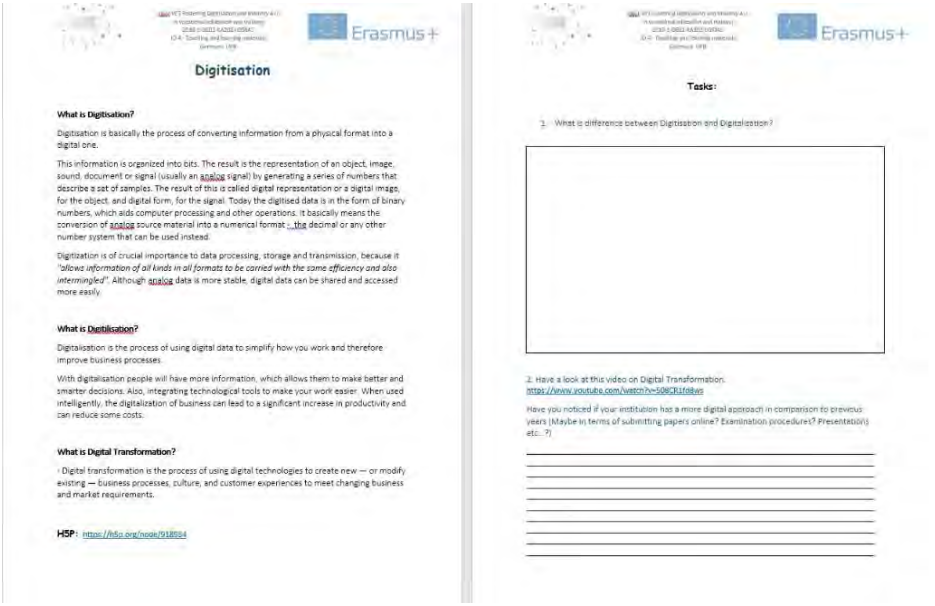
introduction to the topic, some helpful terms in order for the reader to become more familiar with the concept of digitization and the history of it.



The following screenshots are parts from the classroom material. The complete material will be uploaded here:

Figure 82: Learner Module A, Classroom Material, Screenshot I, Cyprus.

References



Digitisation

What is Digitisation?

Digitisation is basically the process of converting information from a physical format into a digital one.

This information is organized into bits. The result is the representation of an object, image, sound, document or signal (usually an analog signal) by generating a series of numbers that describe a set of samples. The result of this is called digital representation or a digital image, for the object, and digital form, for the signal. Today the digitised data is in the form of binary numbers, which aids computer processing and other operations. It basically means the conversion of analog source material into a numerical format ; the decimal or any other number system that can be used instead.

Digitization is of crucial importance to data processing, storage and transmission, because it *"allows information of all kinds in all formats to be carried with the same efficiency and also intermingled"*. Although analog data is more stable, digital data can be shared and accessed more easily.

What is Digitisation?

Digitalisation is the process of using digital data to simplify how you work and therefore improve business processes.

With digitalisation people will have more information, which allows them to make better and smarter decisions. Also, integrating technological tools to make your work easier. When used intelligently, the digitalization of business can lead to a significant increase in productivity and can reduce some costs.

What is Digital Transformation?

Digital transformation is the process of using digital technologies to create new — or modify existing — business processes, culture, and customer experiences to meet changing business and market requirements.

H5P: https://h5p.org/node/918894

Tasks:

1. What is difference between Digitisation and Digitalization?

2. Have a look at this video on Digital Transformation.
https://www.youtube.com/watch?v=50ECR1Fd6vs

Have you noticed if your institution has a more digital approach in comparison to previous years (Maybe in terms of submitting papers online? Examination procedures? Presentation) etc...?)

DigI-VET (2020): Retrieved from the Internet: http://digivet.eduproject.eu/?page_id=44&lang=de. Access date: 16.09.2020.

15.5 Learner Module B: Terms, History and Agriculture of Industry 4.0

This module consists of 3 main sections. Section A includes an introduction to the concept of Industry 4.0 and some terms. Section B explains briefly the History of Industry 4.0 and Section C is about Agriculture in Industry 4.0.

The following screenshots are parts from the presentation of the learner module. The complete presentation will be uploaded here:

All further information:
http://digivet.eduproject.eu/?page_id=44

Figure 83: Learner Module B, Screenshot I, Cyprus.

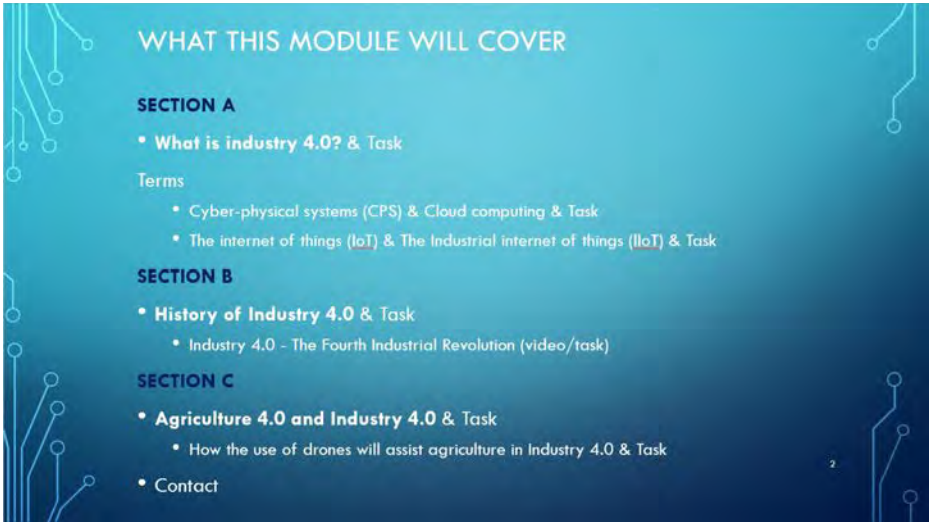


Figure 84: Learner Module A, Screenshot II, Cyprus.

HP5 tasks

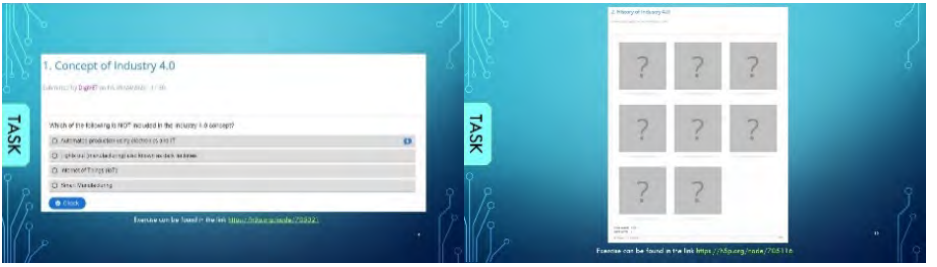
Screenshots of some of the integrated H5P online tasks

Figure 85: Learner Module A, Screenshot III, Cyprus.

15.6 Classroom Material Module B: Terms, History and Agriculture of Industry 4.0

The classroom material compliments the above presentation. The structure of this

document is:



http://digivet.eduproject.eu/?page_id=44

The following screenshots are parts from the classroom material. The complete presentation will be uploaded here:

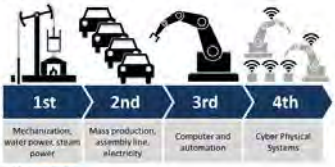
Figure 86: Learner Module A, Classroom Material, Screenshot I, Cyprus. Retrieved from the Internet: http://digivet.eduproject.eu/?page_id=44&lang=de. Access date: 16.10.2020.

All further information:
http://digivet.eduproject.eu/?page_id=44

2. History of Industry 4.0

The History of Industry 4.0

The following image shows the stages in which the development of the industrial manufacturing systems has developed from manual labour towards Industry 4.0. The has been described as the path through the four industrial revolutions.



The first industrial revolution began with the mechanization and mechanical power generation in 1800s. It brought the transition from manual work to the first manufacturing processes, mostly in the textile industry.

The second industrial revolution was triggered by electrification that enabled industrialization and mass production.

The third industrial revolution is characterized by the digitalization with introduction of microelectronics and automation. In manufacturing this facilitates flexible production, where a variety of products is manufactured on flexible production lines with programmable machines. Such production systems however still do not have flexibility concerning production quantity.

Today we are witnessing the fourth industrial revolution that was triggered by the development of Information and Communications Technologies (ICT). Its technological basis is smart automation of cyber-physical systems. The consequence of this new technology for industrial production systems is the reorganization of automation systems to self-organising cyber-physical production systems that allows flexible mass custom production and flexibility in production quantity.

5. Industry 4.0 Challenges

The challenges in implementing Industry 4.0 are Economic, Social, Political and Organisational/Internal.

Economic

- High economic costs
- Business model adaptation
- Unclear economic benefits/excessive investment

Social:

- Privacy concerns
- Surveillance and distrust
- General reluctance to change by stakeholders
- Threat of redundancy of the corporate IT department
- Loss of many jobs to automatic processes and IT-controlled processes, especially for blue collar workers

Political

- Lack of regulation, standards and forms of certifications
- Unclear legal issues and data security

Organisational/ Internal

- IT security issues, which are greatly aggravated by the inherent need to open up those previously closed production shops
- Reliability and stability needed for critical machine-to-machine communication (M2M), including very short and stable latency times
- Need to maintain the integrity of production processes
- Need to avoid any IT snags, as those would cause expensive production outages
- Need to protect industrial know-how (contained also in the control files for the industrial automation gear)
- Lack of adequate skill-sets to expedite the transition towards the fourth industrial revolution
- Low top management commitment
- Insufficient qualification of employees

Here you can see an interview by UATV English (Date: 5th of October 2017) - *Challenges of the Fourth Industrial Revolution.*
A brief explanation on how the Fourth Industrial Revolution is expected to be a huge challenge for educational institutions. How can they prepare students with the skills they need to be competitive in the global labour market in years to come?

Tasks:

Name the 4 stages of the industrial Revolution:

1. _____
2. _____
3. _____
4. _____

Which one of the Industrial Revolutions do you believe to be the most important and why?

_____
_____
_____
_____
_____
_____

H5P: https://h5p.org/node/795115

Tasks:

Name 2 Challenges from each sector (Economic, Social, Political and Organisational/Internal). From the sector that interests you more, please pick one and explain a bit further)
**This exercise requires need some further online research!*

_____
_____
_____
_____
_____
_____
_____
_____
_____

View this short video (by SAP https://www.sap.com/) about The Challenges Companies Face with Industry 4.0 and the importance of developing a road map to achieve business outcomes. Can you name 2 of the challenges the speaker is referring to?
Video: https://www.youtube.com/watch?v=cmhQAacd9xI

_____
_____
_____
_____
_____
_____
_____
_____
_____

H5P: https://h5p.org/node/713871

8.5 The Future of Agriculture in Industry 4.0

View all videos in this section to get an idea of the evolving future of Agriculture in Industry 4.0 (or Agriculture 4.0)

Video 1

Crux Agribotics' vision on Agriculture and how Robots with Vision and machine learning will automate the handling of crops end-to-end.

Video 2

This video was created by WolkAbout. It explains how their IoT Platform delivers all the features necessary to build a Smart Farming system, through the example of this video.

Tasks

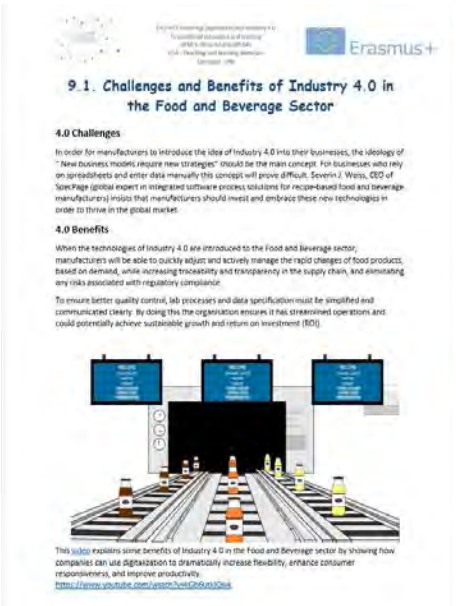
View both videos and have a brief discussion regarding the content. What ideas come to mind? Feel free to elaborate a bit on your idea (s)

Video 3

AUTONOMOUS PICKERS

The video here is a summary of everything that has been analysed in topics 8 – 8.5, with some good practises from around the world, of Industry 4.0 implementation.

H5P: https://h5p.org/node/729212



9.1. Challenges and Benefits of Industry 4.0 in the Food and Beverage Sector

4.0 Challenges

In order for manufacturers to introduce the idea of Industry 4.0 into their businesses, the ideology of " New business models require new strategies" should be the main concept. For businesses who rely on spreadsheets and enter data manually this concept will prove difficult. Severin J. Weiss, CEO of SpecPage (global expert in integrated software process solutions for recipe-based food and beverage manufacturers) insists that manufacturers should invest and embrace these new technologies in order to thrive in the global market.

4.0 Benefits

When the technologies of Industry 4.0 are introduced to the Food and Beverage sector, manufacturers will be able to quickly adjust and actively manage the rapid changes of food products, based on demand, while increasing traceability and transparency in the supply chain, and eliminating any risks associated with regulatory compliance.

To ensure better quality control, lab processes and data specification must be simplified and communicated clearly. By doing this the organisation ensures it has streamlined operations and could potentially achieve sustainable growth and return on investment (ROI).

This video explains some benefits of Industry 4.0 in the Food and Beverage sector by showing how companies can use digitalization to dramatically increase flexibility, enhance consumer responsiveness, and improve productivity.
https://www.youtube.com/watch?v=kQb6urkJQsk

Tasks

Explain the challenges manufacturers of Food and Beverage companies will face to apply Industry 4.0 to their businesses?

Explain the benefits manufacturers of Food and Beverage companies will receive when introducing Industry 4.0 to their businesses?

H5P: https://h5p.org/node/730878

DigI- VET (2020): Retrieved from the Internet: http://digivet.eduproject.eu/?page_id=44&lang=de. Access date: 16.09.2020.

15.7 Learner Module C: Current Status and future developments (for Cyprus)

The Learner Module C consists of 4 parts. The first is a brief introduction, followed by an explanation of the status of Digitization on the island. The third part consists of the Digital Transformation and Future developments and finally a conclusion (as seen in the screenshot below).

Figure 87: Learner Module C, Screenshot I, Cyprus.http://digivet.eduproject.eu/?page_id=44&lang=de. Access date: 16.10.2020.

The following screenshots are parts from the learner module C presentation. The complete presentation will be uploaded here:

Figure 88: Learner Module C, Screenshot II, Cyprus.

HP5 tasks

Screenshots of some of the integrated H5P online tasks

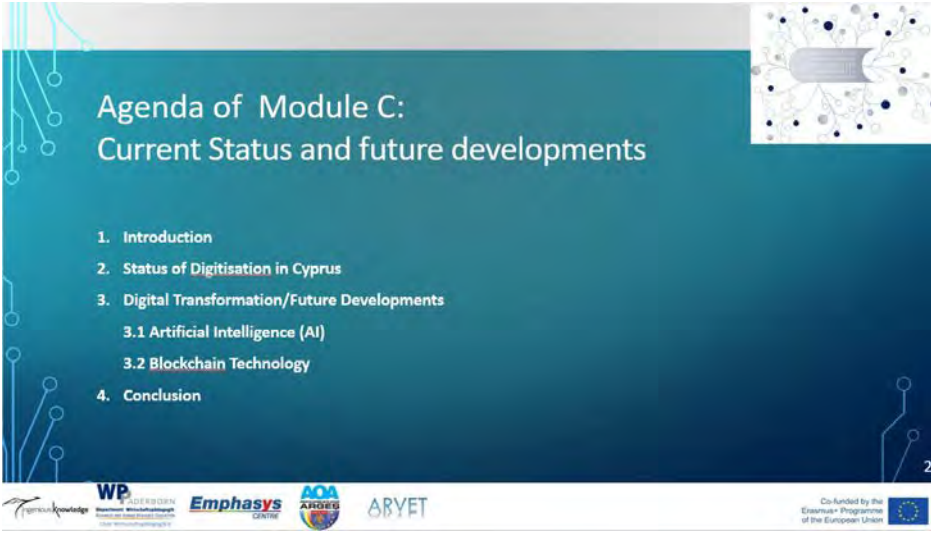


Figure 89: Learner Module C, Screenshot III, Cyprus.

15.8 Classroom Material C: Current Status and future developments (for Cyprus)
Similar to the Module for the Learner Material, Module C consists of the Status of Digitization in Cyprus, some information on Future Transformation/Developments in

Cyprus and Artificial Intelligence & Blockchain Technology in Cyprus.

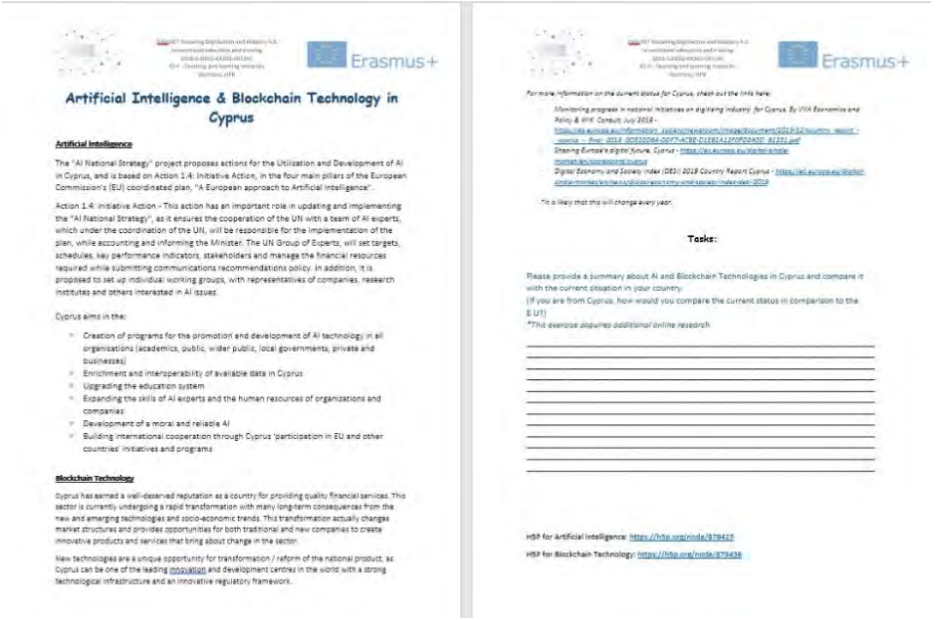
http://digivet.eduproject.eu/?page_id=44

The following screenshots are parts from the learner module C material. The complete presentation will be uploaded here:

Figure 90: Learner Module C, Classroom Material, Screenshot 1, Cyprus:

References

DigI- VET (2020): Retrieved from the Internet: http://digivet.eduproject.eu/?page_id=44&lang=de. Access date: 16.09.2020.



Erasmus+

Artificial Intelligence & Blockchain Technology in Cyprus

Artificial Intelligence

The "AI National Strategy" project proposes actions for the Utilization and Development of AI in Cyprus, and is based on Action 1.4: Initiative Action, in the four main pillars of the European Commission's (EU) coordinated plan, "A European approach to Artificial Intelligence".

Action 1.4: Initiative Action - This action has an important role in updating and implementing the "AI National Strategy", as it ensures the cooperation of the UN with a team of AI experts, which under the coordination of the UN, will be responsible for the implementation of the plan, while accounting and informing the Minister. The UN Group of Experts, will set targets, schedules, key performance indicators, stakeholders and manage the financial resources required while submitting communications recommendations policy. In addition, it is proposed to set up individual working groups, with representatives of companies, research institutes and others interested in AI issues.

Cyprus aims in the:

- Creation of programs for the promotion and development of AI technology in all organizations (academics, public, wider public, local governments, private and businesses)
- Enrichment and interoperability of available data in Cyprus
- Upgrading the education system
- Expanding the skills of AI experts and the human resources of organizations and companies
- Development of a moral and reliable AI
- Building international cooperation through Cyprus 'participation in EU and other countries' initiatives and programs

Blockchain Technology

Cyprus has earned a well-deserved reputation as a country for providing quality financial services. This sector is currently undergoing a rapid transformation with many long-term consequences from the new and emerging technologies and socio-economic trends. This transformation actually changes market structures and provides opportunities for both traditional and new companies to create innovative products and services that bring about change in the sector.

New technologies are a unique opportunity for transformation / reform of the national product, as Cyprus can be one of the leading innovation and development centres in the world with a strong technological infrastructure and an innovative regulatory framework.

Erasmus+

For more information on the current status for Cyprus, check out the links here:

Monitoring progress in national initiatives on digitising industry for Cyprus. By IHS Economics and Policy & IPPC Consult, July 2018 -

Shaping Europe's digital future, Cyprus -

Digital Economy and Society Index (DESI) 2019 Country Report Cyprus -

**It is likely that this will change every year.*

Tasks:

Please provide a summary about AI and Blockchain Technologies in Cyprus and compare it with the current situation in your country.
(If you are from Cyprus, how would you compare the current status in comparison to the E.U?)
**This exercise requires additional online research*

HSP for Artificial Intelligence: https://hsp.org/node/879435

HSP for Blockchain Technology: https://hsp.org/node/879436

16. Learning materials on Digitisation and Industry 4.0 from Romania

Daniel Crisan

The following chapter together with sub-chapters, present the Romanian VET- training module 4, ´The need of digitisation in today's world of work and insights into future developments´ and the learner module B, ´Industry 4.0. Terms and history´ as one of three examples of learner trainings material.

16.1 VET- Trainer Module 4: The need of digitisation in today's world of work and

insights into future developments

The training module is structured as a trainer presentation with integrated learning tasks for the trained trainers and VET- teachers. As you can see in the following screenshot, the module's agenda has two main parts:

1. The need of digitisation in today's world of work and
2. Insights into future development.

Figure 91: VET- Trainer Module 4, Screenshot I, Rumania.

First part of the training module.
In the first part of the module, the trainer presents the need for digitization from two perspectives: that of industry and that of education. The two screenshots below show the main challenges of digitization facing the industry of the future.

Figure 92: VET- Trainer Module 4, Screenshot II, Rumania.

And as industrial progress always entails the need for social, educational progress, the next part of training mode 4 deals with the need for education as a result of industrial digitization. Throughout four slides, the Trainer presents the social risks and challenges put in front of the educational system, by this industrial evolution due to digitalization.

Figure 93: VET- Trainer Module 4, Screenshot III, Rumania.

Figure 94: VET- Trainer Module 4, Screenshot IV, Rumania.

The conclusion is briefly presented in the last slide of this first part of the training

module:

Figure 95: VET- Trainer Module 4, Screenshot V, Rumania.

The first part of the training module for Trainers ends with a video presentation describing some of the transformations already encountered in society (Sweden), following the digitization.

Second part of the training module.
The second part of the training focuses on the perspectives of education, following the

challenges of digitisation and digitalisation:
• change of mentalities, both of the students and of the parents and teachers;
• the need to equalize the speed with which the digitization of educational resources takes place with the one with which the digitization of the educational process itself takes place;

Figure 96: VET- Trainer Module 4, Screenshot VI, Rumania.

Figure 97: VET- Trainer Module 4, Screenshot VII, Rumania.

• associating the artificial intelligence of computers with the cognitive, social and emotional abilities of humans, so as to educate ´first class people, not second-class robots´

• changing the future role of the classroom;
• Classrooms 2.0, artificial intelligence, chatbots, video learning

The conclusion of the second part of the Trainers training module 4 is that digitization must be found in the educational field from the first years of school (preschool) and be present in all forms of education, as shown in the screenshot below.

Figure 98:VET- Trainer Module 4, Screenshot VIII, Rumania.

The PowerPoint presentation ends with a few tasks - **H5P Trainer's Task,** designed to check if the materials taught have been mastered.

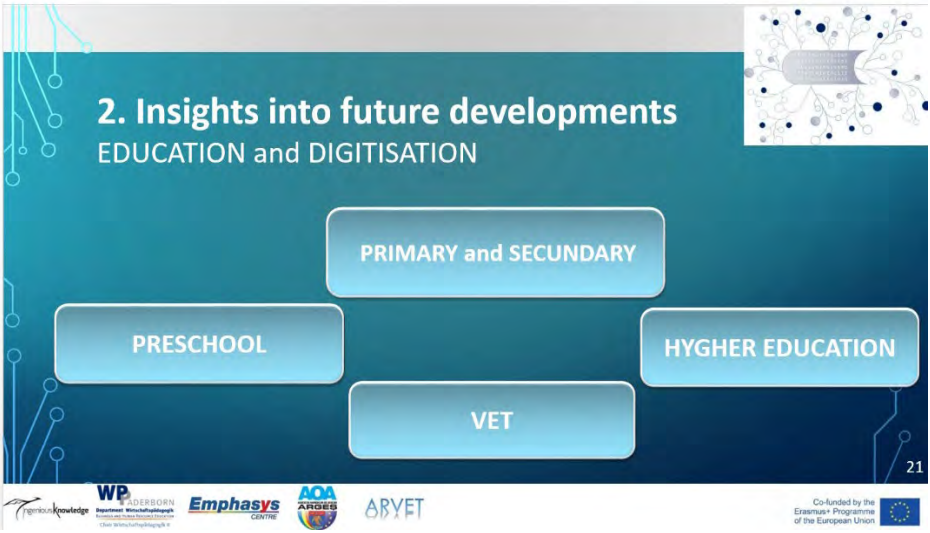
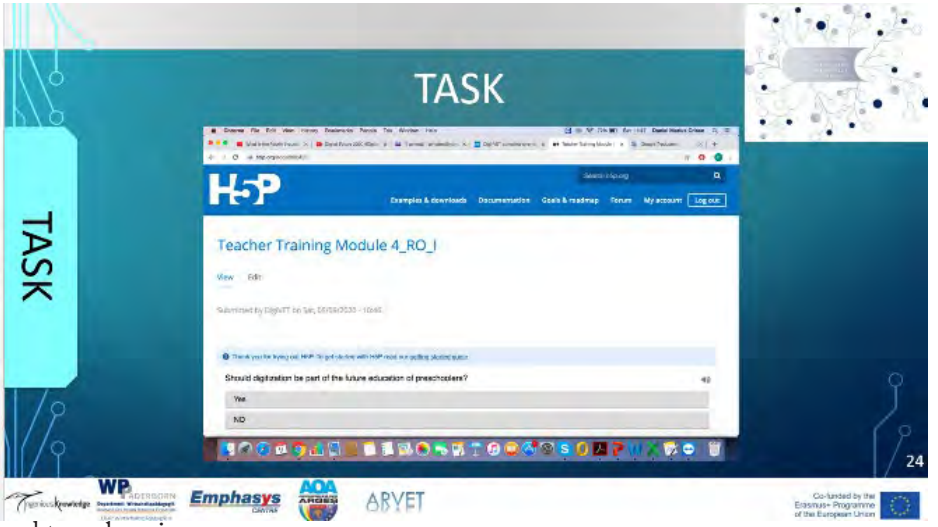


Figure 99: VET- Trainer Module 4, Screenshot IX, Rumania.

16.2 VET- Trainer Module 4: Classroom material

As you have seen in previous presentations, for each training module we have created an additional classroom learning material, designed to support the learning outcomes and objectives, as well as to deepen the content that was taught by the trainers. Classroom teaching materials can be used by learners for self-learning sessions, as well as for group



and team learning.

In the following screenshot you have presented the structure of the classroom material for trainer-module 4: **The need of digitisation in today´ s world of work and insights into future developments.** As you can see, the classroom material for module 4 is designed in two parts, each providing an overview of digitalization and digital transformations in industry and education, respectively.

Figure 100: VET- Trainer Module 4, Classroom Material, Screenshot I, Romania.

Chapter 1 presents in detail the influence of digitisation on industry: costs, influence on labour, the main characteristics of industry 4.0 which must be considered in the future educational process, the new ecosystems imposed by digitization, the benefits of industry 4.0 and the challenges for society and the risks it entails.

At the end of chapter 1 we have a task to help deepen the material taught and which is presented in the screenshot below:

Content:

Figure 101: VET- Trainer Module 4, Classroom Material, Screenshot II, Romania.

Chapter 2 addresses digitisation in education. Starting from the declared approach adopted by the European Union - ´DigEduPol´, the material presents the trends in current education as a result of digitisation, and then presents in detail education and digitization at each stage of the educational process: preschool, primary and secondary and higher education.

Tasks:

1. View this short video presenting some aspects of digital transformation in Sweden. What are the thoughts that go through your mind when you see him? Name 3 areas in which digital technology is already present.

Video: https://dl-mail.ymail.com/ws/download/mailboxes/@.id==VjN-yg8Wn-tmEHPwMwDVids6ETwRId_7tmO5f6d8tdJVLiuw8d1DfQwatJjYTaZNo-VHBmBxuc2UTjmHlmQVvjcwMQ/messages/@.id==AlkibN94PsahXq57YArdQFW2UjQ/content/parts/@.id==2/raw?appid=YMailNodin&ymreqid=9b29e981-164d-7380-1c55-020000019800&token=zitEzqOML3j84e6ealFTT5U7-km5qEQF52lp7AcCuBac0ZENuxotU1td8JhDzjr31-3oFZzDwpUNsBbpYEwEHVpN9cVZpwKi1m5WgdmxenEaXYsR4RvwvgV3QYEmzl84

The last sub-chapter presents the school of the future, showing that the battle between the traditional and the technical school will continue, the goal of the new type of education being the one presented in the next capture:

Figure 102: VET- Trainer Module 4, Classroom Material, Screenshot III, Romania.

For the assessment and fixation of knowledge, the chapter ends with a series of topics, presented in the screenshot below.

Figure 103: VET- Trainer Module 4, Classroom Material, Screenshot IV, Romania.

16.3 Learner Module B: Industry 4.0. Terms and history.

Viitorul se va referi la asocierea inteligenței artificiale a calculatoarelor cu capacitățile cognitive, sociale și emoționale ale oamenilor, astfel încât să educăm oameni de primă clasă, nu roboți de clasa a doua " - OECD, raportul Tendințe privind educația

.

The future will be about pairing the artificial intelligence of computers with the cognitive, social and emotional capabilities of humans, so that we educate first-class humans, not second-class robots"

—OECD, Trends Shaping Education report

The learner module is structured similar to the trainer module: a trainer PP presentation with integrated learning tasks for the trained learners. Each partner from the DigI-VET consortium creates three learner modules:

Module A: Digitisation Terms and history
Module B: Industry 4.0 Terms and history

Tasks

2. Answer to the following questions.
Single choice.

Nr	Question	Yes	No
1	Should digitization be part of the future education of preschoolers?	x	
2	Digitization must be part of primary and secondary education	x	
3	Digitization will not be part of VET education		x
4	Digitization must be part of university education	x	

3. Talking about education, which of the following statements are correct?

Multiple choices (the good one is marked in green).

Module C: Current status and future developments

I'll present you Module B: Industry 4.0. Terms and history.

The content of the material and the structure can be found in the attached screenshot:

Figure 104: Learner Module B, Screenshot I, Romania.

The first chapter is dedicated to the presentation of the evolution of technologies, starting with the first industrial revolution, with the use of water and steam power and the introduction of mechanization in the production process. The evolution of technologies brings with it the evolution of automation and a cyclical evolution of manufacturing.

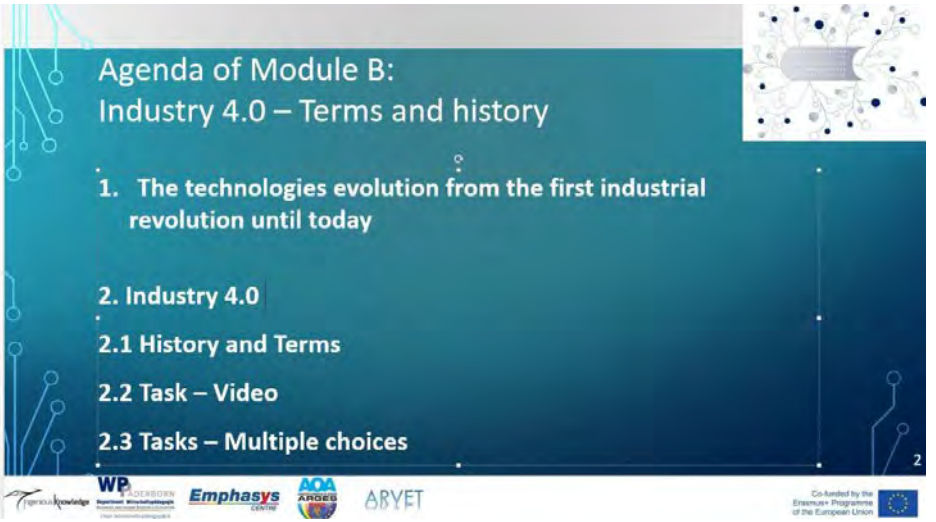
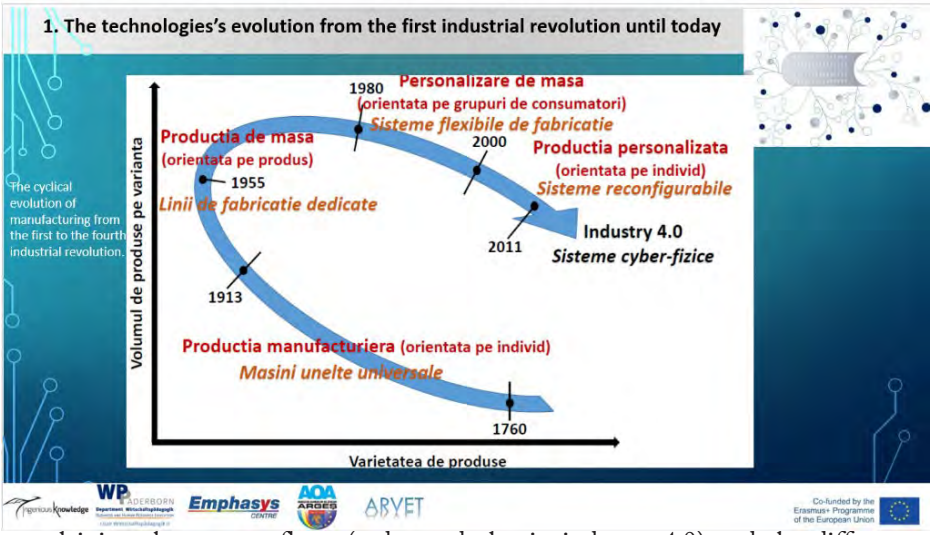


Figure 105: Learner Module B, Screenshot II, Romania.

The **second chapter** is entirely dedicated to Industry 4.0:

- a short history
- industry 4.0 specific technologies



• explaining the process flows (today and also in industry 4.0) and the differences between them

• specific characteristics of the new manufacturing concept Industry 4.0

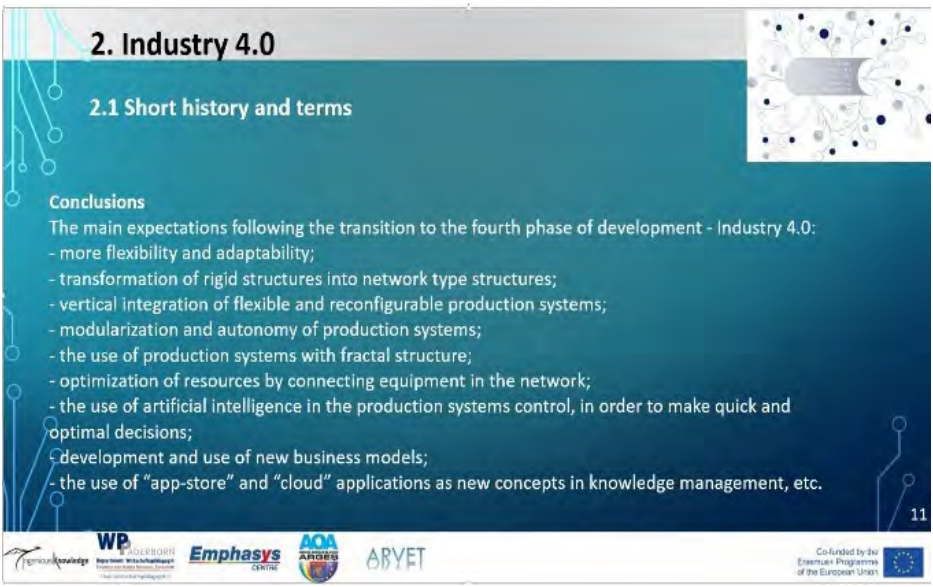
Figure 106: Learner Module B, Screenshot III, Romania.

The hopes and expectations we have from industry 4.0 end the chapter in the teaching material for learners - module B.

And a video regarding industry 4.0 and 3 questionnaires H5P Learner Tasks, come to help set the terms and the final verification of the student's knowledge.

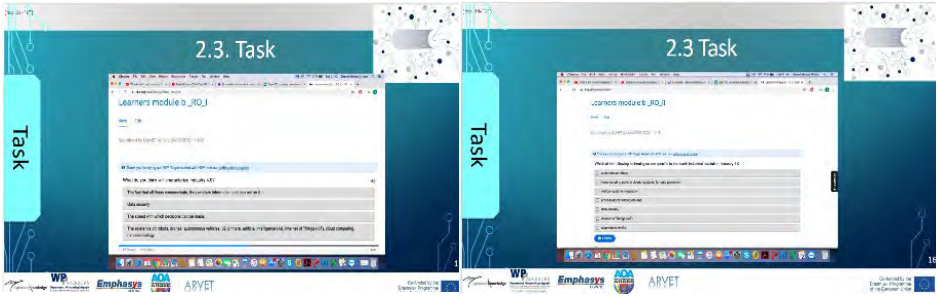
Figure 107: Learner Module B, Screenshot IV, Romania.

Figure 108: Learner Module B, Screenshot V, Romania.



16.4 Learner Module B: Classroom Material

Similar to the VET- trainer module the learner modules A to C get a classroom material for the real time training in classroom.



The learner Module B material consists in two chapter, each one with of two parts.

The following screenshot of the classroom material of the learner module B shows the

agenda of learner's didactical materials.

Figure 109: Learner Module B, Classroom Material, Screenshot I, Romania.

In the first chapter, the learner gets a presentation of the industrial evolution from the first industrial revolution – characterized by the introduction of mechanical production equipment driven by the force of water or steam, to the industry 4.0. – robots / cobots.

CONTENTS:

In the second part the learner gets different tasks to deepen the learning content, review open questions and reveal learning gaps.

Figure 110: Learner Module B, Classroom Material, Screenshot II, Romania.

The second chapter present o short history of the industry 4.0 concept and the principal differences from the present one, and finished with a variety of different tasks to deepen

1. Please watch the following video concerning the history of Industry 4.0. https://www.youtube.com/watch?v=v9rZOa3CUC8

Please note the essentials!

2. Answer to the followinf questions (single choice):

1. What do you think will characterize Industry 4.0?
2. a) The existence of: robots, drones, autonomous vehicles, 3D printers, artificial intelligence (AI), Internet of Things (IoT), cloud computing, nanotechnology.
3. The fact that all these communicate, they analyze information and can act alone based on it.
4. The speed the decisions can be made.
5. Data security

the learning content and reveal learning gaps.

Figure 111: Learner Module B, Classroom Material, Screenshot III, Romania.

References:

DigI- VET (2020): Retrieved from the Internet: http://digivet.eduproject.eu/?page_

2.3. Tasks:

Answer to the following questins (multiple choices):

3. Industry 4.0 is characterized by:
a) Automation of all components
b) Non-human intervention in the manufacturing process
c) Interconnection of all components of the production process
e) The existence of a highly performing IT sector
f) Increased need for data security
g) Digitization.

4. Which one of the following technologies are specific to the fourth industrial revolution, Industry 4.0
a) Internet of Things (IoT),
b) vertical systems integration
c) data security,
d) manufacturing parts in closed systems, for data protection
e) processing by adding material,
f) augmented reality,
g) autonomous robots.

id=44&lang=de. Access date: 16.09.2020.

Part G – The DigI-VET Study on digitisation and Industry 4.0

17. Evaluation Structure of the DigI-VET-Study

Marc Beutner

An evaluation approach is characterised by evaluation objects, evaluation subjects and valuing processes (cf. Beutner 2018, p. 37). The evaluation approach of DigI-VET mainly focusses on descriptive evaluations but also addresses explanative and prescriptive evaluation aspects (for the different approaches see Beutner 2018, p. 83). It is integrated a project evaluation approach but offers an own evaluation study which is as a combination of single evaluations (see as well Beutner 2018, p. 89).

The DigI-VET study offers insights into digitisation and industry 4.0 in Cyprus, Germany, Romania and United Kingdom.

The research activities combine desktop research with empirical research and therefore offer a combination of qualitative (cf. Flick 2000 and Flick / Kardorf / Steinke 2000) and quantitative approaches (cf. Mummendey 2014 sowie Raab-Steiner / Benesch 2015). The empirical research was conducted in two ways (a) a quantitative study based on multi-language questionnaires and (b) a qualitative interview study with Industry 4.0 and digitalisation users and providers. Therefore, questionnaires according to the target groups had to be created and also interview guidelines had to be designed. The research of DigI-VET was the basis of all work in DigI-VET and led into a research report and a best practice database with showcases on the website.

The qualitative interviews were based on a criteria-oriented approach to have a chance to get comparable information which could also be used to the showcase database of DigI-VET.

All interviews were conducted in mother tongue of the participants to allow a secure situation and a broader variety of answers. This also means that the answers had to be translated into English to offer a basis for the comparison and to make it assessable for all partners. For the analysis of the interviews we used the approach of content analysis according to Mayring (c.f. Mayring 2000). The average duration of each interview was about 15 minutes. All interviews were semi-structured. This helped to collect data based on an interview guideline. The core aim was to get direct information about the participant and his or her context. This was addressed to delineate personal meanings and experiences (c.f. Flick 1998; Strauss / Corbin 1998). An adequate documentation of the interviews was ensured by using and compiling data tables as well as a structured approach via argumentation tables. On the basis of the approach of Mayring content analysis was used to analyse and categorise the data derived from the interviews. In DigI-VET trustworthiness is an important issue. Therefore, all interviews were assigned and analysed by the same persons in the project team. All interviews were conducted by team members who agreed on a common ways and strategy to conduct the interviews.

This happened to make sure that always the same information were provided and the same design of the interview was applied. All categories that emerged from the data are consistent with the understandings of the participants. Consequently, validity it can be stated for the study. All interviews were conducted in 2019. The interviewed persons, had all an educational or economic background and were situated in the different partner countries. In total 20 interviews were conducted in the four partner countries.

The second part of the study is designed as an explorative quantitative research study and offers information concerning:

- The use of definitions of digitisation in the partner countries
- The challenges and opportunities which come along with digitisation activities
- The essential focus of digitisation
- The persons and groups which are responsible for digitisation aspects
- The awareness of industry 4.0 and the term itself in Europe
- The importance of digitisation and industry 4.0 with regard to today and the future
- Skill and competence sets which are important for digital change in society
- Estimation profiles of digitisation and their change in the future

This part of research was conducted during September 2020. The following chapter explains the research results and shows the particularities of the partner countries of the DigI-VET consortium.

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18. The DigI-VET Study - Insights in the research results

Marc Beutner

To provide an insight into the quantitative research results we will have a closer look at the different countries involved in DigI-VET. This will help compare the answers in the

different European countries and takes also the differences in life standard and IT in the countries into account. An aggregation over the countries could be misleading here.

18.1 Insights into the results from Cyprus

First, we will focus on the results from Cyprus.
Having a closer look at the participants of the Cypriot study it can be said that 96 participants took part in it. 38% of the respondents were female and 56% were male. Moreover, 6% would rather not tell their gender.

38% of the participants were under 30 years old and 6% were over 60. In Cyprus it was not possible to integrated all age groups in the study. There were no people who were between 41 and 50 years old:

Table 13: Age of the participants from Germany - Percentages.

Bellow 20	13
21-30	25
31-40	31
41-50	0
51-60	19
Over 60	6

Concerning the status 44% were teacher or trainers and 25% students or learners. This was the majority. The rest were staff members of the Human Resources Management (6%), business/company owners (6%), Educational and Career Counsellors (13%) or they haven´t provided an answer concerning this status aspect (6%).
Concerning the activity status most participants came from vocational schools (31%) or educational institutions (25%). Also 19% of the respondents did activities at a company. Moreover, 13 % were active at a university and 6% worked at VET providers as well as 6% at secondary schools.
Looking at the feedback of people who selected ´agree or ´strongly agree´ in the

questionnaire it can be stated that in Cyprus 100% of the participants pointed out that they think that digitisation is the process of converting information into a digital (i.e. computer-readable) format and that also 100% of the participants see digitisation as a process of converting economic processes from an analogue to a digital way of work. Also 100% of the participants think that digitisation is the digital modification of instruments and tools. Also 93.75% of the participants agreed or strongly agreed to the idea that digitisation means to compress data lossless or lossy. In addition to that, 81.25% stated that digitisation is the process of digital change in society and the digital transformation which is recognized as the digital revolution. Last but not least also three quarters of the participants from Cyprus (75%) think that digitisation means optimisation of Business processes using information technology.

With regard to the study answers from Cyprus it seems that the people accept different and broad views on mean digitisation at the same time. Many participants agreed to nearly all definitions. This can be a hint that the concept is still not clear enough. The term digitisation seems to be used with many connotations which make transparency often not that easy. It can also provide the hint that in Cyprus digitisation and digitalisation seems not to be differentiated exactly.

In Cyprus 69% of the participants state that they are familiar with the term industry 4.0. Taking the answers of the Cypriot participants into account digitisation focuses essentially on enhancing processes (96.88% rated for agree or strongly agree). Moreover, a huge number also agreed on the other aspects. Here, digitisation focusses essentially on digital network infrastructure (93.75%), on collecting data (93.75%) and offering information (93.75%). The lowest agreement percentage had the idea that digitisation focusses essentially on data security and privacy (81.25%). But, also with regard to this aspect the numbers are quite high.

In Cyprus, all respondents (rating for agree or strongly agree) were sure that digitisation should be handled by learner (100%) and business leaders (100%). The idea that digitisation should be handled by politicians got the lowest percentage (68.75%).

Rating the importance of digitisation in Cyprus today on a scale from 1 to 10 where 1 stands for unimportant and 10 for important, the mean is 8.69. This is a quite high number which underpins the importance. With regard to the situation in 5 years the mean increases to 9.31. This provides the insight that the importance of digitization will increase in the future.
The same rating was done with regard to industry 4.0. Here, a similar effect can be found. Concerning the situation today the mean of the importance of the change in Cyprus concerning industry 4.0 is 7.94 while for the situation in 5 years it becomes 8.43. In total, these ratings show, that the Cypriote participants estimate that the importance of the change by industry 4.0 will increase in the future.

Asking the Cypriot participants concerning the competences which are important for the digital change in society a competence estimation profile became obvious:

Table 14: Important competences for digital change - Cypriote respondents - Percentages.

It comes into view highest percentages for very important and import of the Cypriot

	Very important	Important	Less important	Unimportant
Social competences	50.00	37.50	6.25	6.25
Communicative competences	50.00	37.50	6.25	6.25
Methodological competences	60.00	26.67	6.67	6.67
Process-related competences	66.67	26.67	0	6.67
Research-related competences	66.67	26.67	0	6.67
Subject specific competences	56.25	37.50	0	6.25
Practice-related competences	62.50	25.00	0	12.50
Managerial competences	50.00	37.50	0	12.50
Other, please specify:	0	0	0	0

participants points on subject-related competences (93,75%). But also interesting are the high scores of process-related competences (93,34%) and research-related competences (93,34%). These are not that much in focus in the other countries as you will recognize later in this text.

With regard to the skills which are important for the digital change in society the respondents of Cyprus the following overview can be provided:

Table 15: Important competences for digital change - Cypriote respondents – percentage.

	Very important	Important	Less important	Unimportant
Basic IT skills	81.25	8.33	4.17	6.25
Deep IT skills	87.50	7.29	0.00	5.21
Technical skills	68.75	18.75	5.21	7.29
Organisational skills	75.00	12.50	9.38	3.13
Applying theoretical knowledge	68.75	18.75	5.21	7.29
Self-awareness and self-management	75.00	12.50	9.38	3.13
Leadership skills	66.67	20.00	6.67	6.67
Team working skills	81.25	6.25	0.00	12.50
Planning skills	62.50	18.75	12.50	6.25
Implementation skills	62.50	25.00	6.25	6.25
Evaluation skills	62.50	25.00	0.00	12.50
Ethical skills	56.25	31.25	2.08	10.42
Problem-Solving skills	75.00	18.75	4.17	2.08
Decision Making skills	62.50	25.00	5.21	7.29
Data analysis skills	62.50	18.75	6.25	12.50
Flexibility	68.75	18.75	6.25	12.50
Patience	75.00	10.42	2.08	12.50
Other, please specify	0.00	0.00	0.00	0.00

With regard to the table above the highest percentage for a very important skill can be found at deep IT skills and here we also find the highest combination of important and very important (94.97%). Problem-solving skills are the second highest skill with regard to the importance estimation (93.75%). The lowest scores for importance can be found

at data analysis skills (81.25%) and Planning skills (81.25%) which is also be surprising compared to the results in the other countries provided later in this text.

The rating of ´Digitisation is …´ provides us with a profile concerning digitisation and who it can be characterised. The following figure provides a red line for the rating of the situation today and a black line which represents the rating in the future (in five years). All numbers and crosses added in the profile show the mean of the rating in the specific row of the profile.

Table 16: Profile of Digitisation for Cyprus – Means.

Important		x x 2.0 2.1					Unimportant
Interesting		x x 1.6 2.2					Uninteresting
Motivating		x x 1.6 2.2					Demotivating
Fun		x 2.1	x 2.6				Boring
Inovative		x x 1.7 2.0					old-fashioned
Helpful		x 1.8	x 2.9				Not helpful
Useful		x x 1.9 2.0					Useless
Necessary		x x 1.7 2.0					Unncessary
Easy to use in teaching		x 2.3	x 3.0				Hard to use in teaching
Easy to use in learning		x 2.5	x 2.8				Hard to use in learning

In addition to this positive trend of estimations for the situation in the future in Germany also 100% (79.1% yes and 20.9% rather yes) of the participants think that VET teachers and VET trainers should support their students with digitisation to foster their learning processes.

In Cyprus the participants also provided qualitative feedback on opportunities of digitisation and industry 4.0 will be displayed here in its categories (combined due to only a few answers):
1. potential is unlimited.
2. mass production could grow even faster and easier
3. the entire industrial sector will run only on quick digital data processes

With regard to the qualitative question of other challenges of digitisation and industry 4.0, the Cypriot participants mentioned the following categories:
1. financial issues
2. educating people who do not have a technological background to handle the new sophisticated machinery
3. unemployment might rise as machines could replace the human factor

18.2 Insights into the results from Germany

Regarding the German study results it can be said that 115 participants took part in it. 43.5 of the respondents were female and 56.5% of the participants were male. 57.4% of the participants were under 40 years old (19.1% under 30 years) and 2.6% were over 60 years old. In Germany the study integrated all age groups.

Table 17: Age of the participants from Germany - Percentages. Concerning the status, it can be stated that 58.3% of the people who answered to the questionnaire in Germany were teachers and 15.7% were learners. The third largest group were business or company owners with 7% of all German respondents.

Bellow 20	1.7
21-30	17.4
31-40	38.3
41-50	27.8
51-60	12.2
Over 60	2.6

Also, with regard to their status, 66.1% of the German participants were active at a

vocational school. 13% were active in a company and 7.8% at a university. Some people worked at chambers (5.2%), were active at a VET provider (2.6%), worked at an employer's association (1.7%) or at a trade union/ employees association (1.7%). Also 0.9% were active at a teacher association or at the government (0.9%).

In Germany 100% of the participants stated that they think that digitisation is the process of converting information into a digital (i.e. computer-readable) format. We are looking here concerning these aspects on people who selected ´agree or ´strongly agree´ in their feedback. And also, a huge number, namely 99.1% of the respondents think that digitisation is a process of converting economic processes from an analogue to a digital way of work. Moreover, 98.3% pointed out that digitisation is the digital modification of instruments and tools. Also 98.3% of the participants claimed that digitisation means optimisation of Business processes using information technology. 97.4% of the participants responded that digitisation is the process of digital change in society and the digital transformation which is recognized as the digital revolution. But only 39.1% of the German respondents think that digitisation means to compress data lossless or lossy.

For Germany these results mean that the people are not really able to see the differences in different views on digitisation. But, most of them are very sure that compressing data without loss is not a core focus on digitisation. The numbers of participants who agreed to nearly alldefinitions were enormous and this may hint to the need of more awareness concerning the tasks and elements of digitisation or it may hint on the fact that the term digitisation is used with many different connotations in Germany. This also indicates that a difference between digitisation and digitalisation seems not really to be focused in Germany today.

The term industry 4.0 is known by 67% of the German participants which is nearly 2 thirds of the respondents.

Concerning the challenges which come along with digitisation most of the respondents agreed or strongly agreed to challenges for society (68.7% + 30.4% = 99.1%). Also 99.1% agreed or strongly agreed on challenges for politics, on challenges for enterprises / companies and on challenges for teachers/trainers. But the strength of agreement between these four is different in order of their mentioning in the sentences before. The next table will provide a more detailed overview and also shows that also other possible challenges are rated quite high:

Table 18: Challenges of Digitisation with regard to German respondents - Percentages

This shows that the participants seem to be very aware of possible risks and challenges. The agreement is very high in all presented cases. This could also hint on uncertainty

	Storngly agree	Agree	Disagree	Strongly disagree
Digitisation is a process which challenges society.	68.7	30.4	0.9	0
Digitisation is a process which challenges enterprises / companies.	47	52.2	0.9	0
Digitisation is a process which challenges everyone.	41.7	56.5	1.7	0
Digitisation is a process which challenges teachers / trainers.	41	50	0.9	0
Digitisation is a process which challenges learners.	39.1	57.4	3.5	0
Digitisation is a process which challenges politics.	44.3	54.8	0.9	0
Digitisation is a process which challenges economy.	38.3	60.0	0.9	0

which goes sometimes along with overestimation of challenges. But it has to be noted that the participants feel this way even if their estimation may not be realistic. This may hint to the need of more information and transparency.

According to the German participants digitisation focuses essentially on data security and privacy (98.3%) as well as on enhancing processes (98.3%). Here, we look at the answers of the participants who agreed or strongly agreed. 93.0 % of the respondents think that digitisation focusses essentially on offering information. Moreover, 92.2% pointed out that digitisation focusses essentially on digital network infrastructure. Just, the idea that digitisation focusses essentially on data collection was not agreed on that much (65.2%) but also here nearly two third of the respondents agreed.

In Germany, all respondents (agree or strongly agree) think that digitisation should be handled by VET providers (100%), technical experts (100%), staff members if companies (100%) and teachers and trainers (100%). The lowest percentage of 87.8% stated that digitisation should be handled by politicians.

Rating the importance of digitisation today on a scale from 1 to 10 where 1 stands for unimportant and 10 for important, the mean is 7.46, which is pretty high. With regard to the situation in 5 years the mean goes up to 8.00 which shows that the importance will increase.

Doing the same rating with regard to industry 4.0 a similar effect can be seen on a

level which is just a bit higher. For today the mean of the importance of the change concerning industry 4.0 is 7.60 while for the situation in 5 years it is 8.82. These ratings show, that the German participants think that the importance of the change by industry 4.0 will increase as well.

Regarding the competences which are important for the digital change in society the following results occurred:

Table 19: Important competences for digital change - German respondents - Percentages.

Interesting is the fact that the majority of the German participants points out that research-related competences are less or unimportant. All other provided competences

	Very important	Important	Less important	Unimportant
Social competences	7.00	85.2	7.8	0
Communicative competences	45.2	54.8	0	0
Methodological competences	34.8	65.2	0	0
Process-related competences	73.9	26.1	0	0
Research-related competences	0.9	43.5	53.00	2.6
Subject specific competences	57.4	40.0	2.6	0
Practice-related competences	12.2	83.5	4.3	0
Managerial competences	8.7	81.7	9.6	0
Other, please specify:	0	0	0	0

were seen as relevant (rating at important or very important). Also remarkable is the fact that always 100% of the respondents agree or strongly agree on the importance of communicative competences, methodological competences and process-related competences.

With regard to the skills which are important for the digital change in society the German participants of the study put the number of persons who voted for very important on ethical skills .

	Very important	Important	Less important	Unimportant
Basic IT skills	76.5	23.5	0	0
Deep IT skills	86.1	13.9	0	0
Technical skills	18.3	81.7	0	0
Organisational skills	52.2	47.8	0	0
Applying theoretical knowledge	7.0	57.4	35.7	0
Self-awareness and self-management	0	19.1	80.9	0
Leadership skills	0	21.7	76.5	1.7
Team working skills	0	56.5	43.5	0
Planning skills	77.4	22.6	0	0
Implementation skills	31.3	67.8	0.9	0
Evaluation skills	2.6	90.4	7.0	0
Ethical skills	2.6	67.8	29.6	0
Problem-Solving skills	79.1	20.9	0	0
Decision Making skills	47.0	52.2	0.98	0
Data analysis skills	10.4	85.2	4.3	0
Flexibility	14.8	82.6	2.6	0

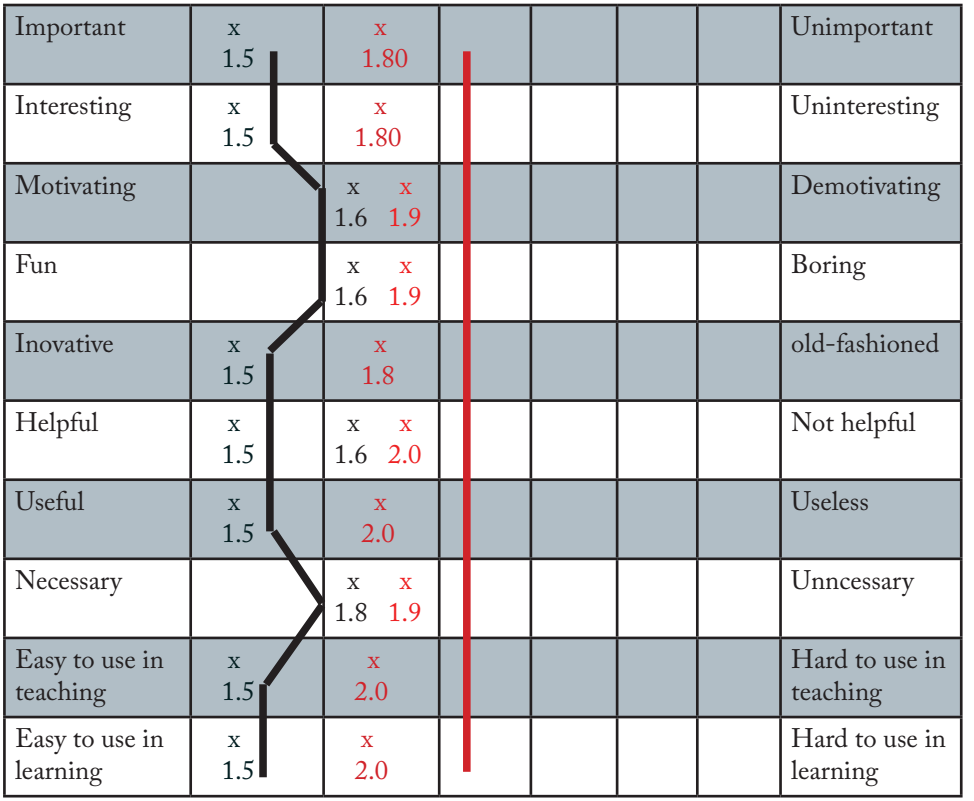
Patience	10.4	85.2	2.6	1.7
Other, please specify	0	0	0	100.00

The highest percentage for a very important skill can be found at Deep IT skills. 100 % of the respondents think that Basic IT skills, Deep IT skills, technical skills organisational skills and problem-solving skills are important or very important. The skills Self-awareness and self-management (80.9%) as well as Leadership skills (78.2%) are seen by the majority of the German participants as unimportant or less important.

Having a closer look at digitisation (Digitisation is …) a profile can be created. In the following figure the red line describes the rating for the situation today and the black line represents the rating for the situation in the future with regard to a five years perspective. The crosses with the numbers next to it provide always the mean of the rating in this profile row.

Table 21: Profile of Digitisation for Germany – Means.

In addition to this positive trend of estimations for the situation in the future in



Germany also 100% (79.1% yes and 20.9% rather yes) of the participants think that VET teachers and VET trainers should support their students with digitisation to foster their learning processes.

In Germany the participants also provided qualitative feedback on opportunities of digitisation which will be displayed here in its categories:

1. Speeding up knowledge (mentioned with the highest frequency of 7 times
2. Knowledge is increasing
3. Processes are quicker
4. Cost reduction
5. More automation
6. Everybody can get information easily
7. Better life standard
8. More content
9. Less problems

The qualitative feedback on opportunities of industry 4.0 of the German participants focused on the following categories:

1. Processes are much smoother (mentioned with the highest frequency of 4 times)
2. Easier work
3. Speeding up production
4. More interaction
5. Better overview
Clear information on work structures
7. Smart products
8. Services can be increased
9. new markets
10. better in competition
11. workforce is better involved
12. new possibilities

Concerning the qualitative question of other challenges of digitisation, the German participants mentioned the next categories:

1. too much work (mentioned with the highest frequency of 11 times)
2. data security
3. information losses
4. no concept
5. different approaches
6. cost intensive
7. content not only created by experts
8. financing is complicated
Regarding the qualitative categories on challenges of industry 4.0 the respondents answered:

1. data security (mentioned with the highest frequency of 12 times)
2. workload
3. no process overview
4. high costs
5. only experts are aware of industry 4.0
6. different in every enterprise
7. need to teach industry 4.0 and digitisation
Interesting is here that there a cost effects mentioned as opportunities (low costs) and challenges (high costs) and also a similar situation regarding getting overview (opportunity: better overview; challenge: no process overview). The participant seems to have different ideas or estimations concerning these topics.

18.3 Insights into the results from Romania

In Romania N= 111 participants responded to the study. With regard to Romania 60% of the respondents were female and 38% were male. 2 % would rather not say anything about gender. The majority of the respondents was up to 30 years old (52%) but the study integrated here participants of all age groups. But just 3% were over 60 years old.

Table 22: Age of the participants from Romania - Percentages.

20 % of the people who answered to the questionnaire in Romania were teachers and 38% were learners. The third largest group were business or company owners with 10% of all

Bellow 20	29
21-30	23
31-40	19
41-50	15
51-60	11
Over 60	3

Romanian respondents. With regard to their status 19% were active at a primary school and 11% were active in a secondary school. The other teachers 3% of the respondents came from vocational schools. 10 % of the participants in Romania were active at a university and also 10% at another educational institution. 18% of the people were active at a company. Some people worked at chambers (3%), at an employer's association (8%) or at a trade union/ employees association (1%) while the rest provided no answer.

In Romania 92% of the people who took part in the study think that digitisation means optimisation of Business processes using information technology (they selected agree or strongly agree). 90% of the respondents agreed or strongly agreed to the definition that digitisation is the process of converting information into a digital (i.e. computer-readable) format. Bit less percentages of the respondents, namely 86%, agreed or strongly agreed to the definition that digitisation is a process of converting economic processes from an analogue to a digital way of work. 80% stated that digitisation is the process of digital change in society and the digital transformation which is recognized as the digital revolution. Moreover, 76% pointed out that digitisation is the digital modification of

instruments and tools. Also 70% of the Romanian respondents think that digitisation means to compress data lossless or lossy. This is in total quite surprising because all definitions provide a different focus. Always more than 3 quarters of the participants agreed or strongly agreed and seems to hint on the fact that they are not really sure, what is exactly focussed with digitisation or have a good overview what different aspects could be addressed with the same term. A difference between digitisation and digitalisation seems not really be focused. The term industry 4.0 is known by 53% of the Romanian participants which is just a bit more than half of the respondents. Regarding challenges which go along with digitisation most of the respondents agreed or strongly agreed to challenges for society (49% + 43% = 92%). But also, other challenges could be seen:

Table 23: Challenges of Digitisation with regard to Romanian respondents - Percentages.

Digitisation focuses essentially on digital network infrastructure is a statement that 86%

	Storngly agree	Agree	Disagree	Strongly disagree
Digitisation is a process which challenges society.	43	38	15	4
Digitisation is a process which challenges enterprises / companies.	43	49	7	1
Digitisation is a process which challenges everyone.	41	35	22	2
Digitisation is a process which challenges teachers / trainers.	41	50	9	0
Digitisation is a process which challenges learners.	40	49	11	0
Digitisation is a process which challenges politics.	22	51	26	1
Digitisation is a process which challenges economy.	39	51	9	1

of the participants agreed or strongly agreed on. Also 84% of the respondents think that digitisation focusses essentially on offering information. 82% see in digitisation a process of data collection. 78 % pointed out that digitisation focusses essentially on enhancing processes while 71% state that digitisation focusses essentially on data security and privacy.

Most respondents think that digitisation should be handled by VET providers, 98 participants, followed by 93 respondents who think it should be handled by technical experts and 92% who think it should be handled by teachers and trainers. The lowest percentage of only 55% stated that digitisation should be handled by politicians.
Rating the importance of digitisation today on a scale from 1 to 10 where 1 stands for unimportant and 10 for important, the mean is 8.15, which is pretty high. With regard to the situation in 5 years the mean goes up to 8.92 which shows that the importance will increase.

Doing the same rating with regard to industry 4.0 a similar effect can be seen on a level which is just a bit lower. For today the mean of the importance of the change concerning industry 4.0 is 8.11 while for the situation in 5 years it is 8.73. This also shows that the Romanian participants think that the importance of the change by industry 4.0 will increase as well.

With regard to the competences which are important for the digital change in society the following results occurred:
Here the important competences are practice-related and research related competences and communicative competences. But, also the other competence aspects are rated quite high. The highest number of ´very important´ ratings can be found at subject specific competences. Here is also the highest percentage of the combined rating of important

	Very important	Important	Less important	Unimportant
Social competences	33	46	16	5
Communicative competences	40	49	8	3
Methodological competences	35	50	12	3
Process-related competences	39	44	14	3
Research-related competences	49	42	7	2
Subject specific competences	53	41	4	2
Practice-related competences	41	48	8	3
Managerial competences	37	45	15	3
Other, please specify:	0	0	0	0

Table 24: Important competenc
change - Romanian respondents -

or very important, which is 90%.

With regard to the skills which are important for the digital change in society the participants put the number of persons who voted for very important on ethical skills.

	Very important	Important	Less important	Unimportant
Basic IT skills	55	29	8	7
Deep IT skills	55	36	10	
Technical skills	43	48	4	1
Organisational skills	35	50	12	2
Applying theoretical knowledge	40	47	9	
Self-awareness and self-management	30	49	13	5
Leadership skills	29	39	23	7
Team working skills	42	45	7	2
Planning skills	35	48	9	4
Implementation skills	36	50	8	1
Evaluation skills	29	58	9	2
Ethical skills	29	57	17	5
Problem-Solving skills	36	55	8	1
Decision Making skills	42	47	8	1
Data analysis skills	46	44	7	
Flexibility	36	42	16	4

Patience	32	41	10	7
voted Other, please specify				

The highest numbers of participants who voted with very important or important can be found at deep IT skills (91 participants), technical skills (91 participants), problem-solving skills (91 participants) and data analysis skills (90 participants).

The profile concerning digitisation (Digitisation is …) looks like this in red, when you fill in the means of each row and concerning digitisation with regard to the (Digitisation will be …) like this in black:

Table 26: Profile of Digitisation for Romania – Means.

In total in Romania 93% of the participants think that VET teachers and VET trainers should support their students with digitisation to foster their learning processes.

Important		x x 1.6 2.0					Unimportant
Interesting		x x 1.6 1.8					Uninteresting
Motivating		x x 1.8 2.2					Demotivating
Fun		x 1.9	x 2.5				Boring
Inovative		x x 1.6 1.7					old-fashioned
Helpful		x x 1.6 1.6					Not helpful
Useful	x 1.5	x 1.6					Useless
Necessary	x 1.5	x 1.7					Unncessary
Easy to use in teaching		x x 1.6 1.9					Hard to use in teaching
Easy to use in learning		x x 1.6 1.8					Hard to use in learning

18.4 Insights into the results from United Kingdom

In UK N= 103 participants responded to the study. With regard to UK 61.9% of the respondents were female and 38.1% were male. The majority of the respondents was up to 40 years old (61.2%) but the study integrated here participants of all age groups. But just 1% were over 60 years old.

Table 27: Age of the participants from Romania - Percentages.

25.5% of the people who answered to the questionnaire in UK were teachers and 37.8%

Bellow 20	15.3
21-30	25.5
31-40	20.4
41-50	25.5
51-60	12.2
Over 60	1.0

were learners/students. The third largest group of all UK respondents were other types of educational experts with 12.2%. With regard to their status no one was active at a primary school and 17.3% were active in a secondary school. The other teachers 19.4% of the respondents came from VET providers schools. 25.5% were active at universities, 28.6% came from other educational institutions. Some people 7.1% worked at companies and 2.0% at other institutions.

I

n UK 100% of the respondents were sure that digitisation is the process of converting information into a digital (i.e. computer-readable) format. At bit less - 99% of the people who took part in the study think that digitisation means optimisation is a process of converting economic processes from an analogue to a digital way of work. They selected agree or strongly agree. 95.1 % of the respondents stated that digitisation is the process of digital change in society and the digital transformation. According to 90.3% of the participants digitisation means optimisation of business processes using information technology. This is in total quite surprising because all definitions provide a different focus. Always more than 3 quarters of the participants agreed or strongly agreed and seems to hint on the fact that they are not really sure, what is exactly focused with digitisation or have a good overview what different aspects could be addressed with

the same term. A difference between digitisation and digitalisation seems not really be focused. The term industry 4.0 is known by 80.6% of the UK participants and therefore has a broad basis in UK.

Regarding challenges which go along with digitisation most of the respondents agreed or strongly agreed to the statement ´Digitisation is a process which challenges teachers/ trainers.´ (73.8% + 19.4% = 92%). But also, other challenges could be seen:

Table 28: Challenges of Digitisation with regard to UK respondents - Percentages.

According to 98.1% of the UK respondents who agreed or strongly agreed digitisation

	Storngly agree	Agree	Disagree	Strongly disagree
Digitisation is a process which challenges society.	67.0	25.2	5.8	1.9
Digitisation is a process which challenges enterprises / companies.	73.8	19.4	3.9	2.9
Digitisation is a process which challenges everyone.	77.5	13.7	5.9	2.9
Digitisation is a process which challenges teachers / trainers.	73.8	19.4	5.8	1.0
Digitisation is a process which challenges learners.	56.3	32.0	9.7	1.9
Digitisation is a process which challenges politics.	65.0	25.2	7.8	1.9
Digitisation is a process which challenges economy.	78.6	11.7	7.8	1.9

focuses essentially on enhancing processes. In addition to that, 97.1% of the British participants pointed out that digitisation is essentially on offering information. Moreover, 95.1% stated that digitisation is essentially about collecting data. 92.2% had in mind that digitisation focuses essentially on digital network infrastructure. But, only 73.8 % stated that digitisation focuses essentially on data security and privacy.
Most respondents think that digitisation should be handled by technical experts (99.0%). This is followed by 97.1 % who think it should be handled by teacher, 92.2% of the respondents who think it should be handled by VET providers and 88.3% who think that digitisation should be handled by learners. The lowest percentage of only 52.4% stated that digitisation should be handled by politicians.

Rating the importance of digitisation today on a scale from 1 to 10 where 1 stands for unimportant and 10 for important, the mean is 8.5, which is really high. With regard to the situation in 5 years the mean goes up to 9.63 which shows that the importance will increase tremendously.

Doing the same rating with regard to industry 4.0 a similar effect can be seen on a level which is a bit lower. For today the mean of the importance of the change concerning industry 4.0 is 7.8 while for the situation in 5 years it is 9.32. This means that the UK participants point out that the importance of the change by industry 4.0 will increase, too.

Concerning the competences which are important for the digital change in society / industry 4.0 the following table offers the core results:

Table 29: Important competences for digital change - UK respondents - Percentages.

	Very important	Important	Less important	Unimportant
Social competences	91.2	0.0	7.8	1.0
Communicative competences	98.0	0.0	1.0	1.0
Methodological competences	87.1	0.0	11.9	1.0
Process-related competences	84.3	0.0	14.7	1.0
Research-related competences	93.1	0.0	5.9	1.0
Subject specific competences	95.1	0.0	3.9	1.0
Practice-related competences	94.1	0.0	4.9	1.0
Managerial competences	94.1	0.0	4.9	1.0
Other, please specify:	69.6	0.0	8.7	21.7

Within this overview the most important competences are communicative competences, subject specific competences, practice-related and managerial competences. But, also most of the other competence aspects are rated quite high (above 85%). The highest number of ´very important´ ratings can be found at communicative competences.

With regard to the skills which are important for the digital change in society the participants put the number of persons who voted for very important on ethical skills.

	Very important	Important	Less important	Unimportant
Basic IT skills	97.1	0.0	2.0	1.0
Deep IT skills	53.9	0.0	46.1	0.0
Technical skills	80.4	0.0	19.6	0.0
Organisational skills	97.1	0.0	2.9	0.0
Applying theoretical knowledge	86.3	0.0	13.7	0.0
Self-awareness and self-management	95.1	0.0	4.9	0.0
Leadership skills	93.1	0.0	5.9	1.0
Team working skills	98.0	0.0	1.0	1.0
Planning skills	100.0	0.0	0.0	0.0
Implementation skills	97.0	0.0	3.0	0.0
Evaluation skills	94.1	0.0	5.9	0.0
Ethical skills	98.0	0.0	2.0	0.0
Problem-Solving skills	99.0	0.0	1.0	0.0
Decision Making skills	97.1	0.0	2.9	0.0
Data analysis skills	95.1	0.0	4.9	0.0
Flexibility	80.0	0.0	0.0	20.0

Patience	0.0	0.0	0.0	0.0
Other, please specify	0.0	0.0	0.0	0.0

Table 30: Important competences for digital change – UK respondents – Number of participants who voted.

The highest numbers of participants who voted with very important or important can be found at planning skills (100%), problem-solving skills (99 %), team working skills (98%) and ethical skills (98%).

Filling in the means of each row the profile concerning digitisation today (Digitisation is …) looks like the red line and concerning digitisation with regard to the future (Digitisation will be …) looks like black line:

Table 31: Profile of Digitisation for UK – Means.

In UK no participants answered on the question if VET teachers and VET trainers should support their students with digitisation to foster their learning processes.

Important			x 3.5	x 3.9			Unimportant
Interesting				x 3.6	x 4.0		Uninteresting
Motivating			x 3.5	x 3.9			Demotivating
Fun				x 1.6	x 3.8		Boring
Inovative				x 1.6	x 3.9		old-fashioned
Helpful				x 3.8	x 3.9		Not helpful
Useful			x 3.3	x 3.8			Useless
Necessary			x 3.3	x 3.8			Unncessary
Easy to use in teaching	x 1.3			x 3.9			Hard to use in teaching
Easy to use in learning				x 4.0			Hard to use in learning

Nevertheless, UK the participants also provided qualitative feedback on opportunities of

digitisation which will be displayed here in its core categories:
1. Benefits to humanity globally due to easing of work processes and better work-life balances. / Better work-life balance (6 times)
2. Better compiled/longer lasting data (2 times)
3. Cheaper production (2 times)
4. Decreased inequality effecting all industries (2 times)
5. Digitisation is easing work processes benefitting humanity across the world.
6. New Innovations
7. The rise of digitisation will create new job opportunities
8. People can lean faster
9. Easier access to education

The qualitative feedback on opportunities of industry 4.0 of the UK participants focused mainly on the following categories:
1. All sectors benefit from new technology from telecommunications, information, media, entertainment to medical, food and even leisure industries (12 times)
2. New products and services (5 times)
3. Increase efficiency, profit margins, increased productivity and economic growth (5 times)
4. Easing working practices and allowing more free time for personal hobbies and leisure. (4 times)
5. Processes are much smoother (mentioned with the highest frequency of 4 times)
6. Speeding up production (2 times)

Concerning the qualitative question of other challenges of digitisation, the UK participants mentioned the next categories:
1. Privacy and security (19 times)
2. Lack of labour force who is fully adapted to work in an environment influenced by digitisation
3. Lack of social skills
Regarding the qualitative categories on other topics which should be addressed:
1. A new code and security precautions may be needed for the safety of all users across the internet (3 times)
2. Promote privacy (2 times)
3. Issues about misinformation, fake news is a major challenge facing educators in the 21st Century (2 times)
4. Ethical and moral issues
Interesting is here that privacy issues are mentioned several times with different decisions and that this emphasises the importance of these aspects.

References

All information are own study results of the DigI-VET project.

Part H – The future of Digitisation

19. Learning Analytics and Smart Services – Digital opportunities and risks
Nina Fröhlig / Rasmus Pechuel

19.1 Introduction to Learning Analytics and Smart Services

Learning analytics are still in their infancy, but the expectations for this technology and its potential are high. Teachers can use learning analytics to accompany the learning process, evaluate the learner's data, identify problems, identify patterns, identify success indicators, poor grades or dropouts at an early stage, evaluate the usefulness of the learning materials, promote conscious learning, reflection and self-reflection to increase understanding of learning environments in order to intervene, support and advise, as well as to improve teaching, resources and the learning environment.

Learners can use Learning Analytics to keep an eye on their own actions, interactions and learning processes, compare their own activities with others, increase conscious learning, reflection and self-reflection, their participation in discussions as well as their learning behaviour and performance improve and thus become more effective learners. There are high hopes for significant improvements in the understanding of learning processes and correspondingly better learning results. Fears range from data protection to a development towards an understanding of learning that is increasingly aimed only at measurable results.

In countries like the USA, China, Japan and Estonia, learning analytics are already part of everyday school life. Teachers are relieved of routine tasks, students receive individual software support, and educational reforms are checked for their effectiveness using reliable data. Learning analytics, as it is used abroad, often does not meet European data protection standards.

Big Data in Education, what can be collected?
Data can either be collected by tracking the use of software like a learning platform or an app, that the student uses from a laptop, a desktop computer or a mobile phone. Another, more detailed way is via wearables like smart watches, data glasses or smart shirts. In contrast to other mobile computer systems, the main tasks of wearables include tracking using sensors, hardware and software applications as well as mobile information processing. The data resulting from tracking arise from the surroundings, the behaviour (e.g., activity) and the physiological state (e.g., heart rate) of the user. Learning Analytics could use wearables to detect eye movement or to detect behaviour e.g., in team work.
In case the student uses a learning software e.g., via mobile phone, the following data could be gathered:

- When does the student enrol to a course?
- When is he/she logged in to the course or the forum?
- When does he/she work on the course?
- How does he/she work on the course?
- How long are his/her sessions?
- Where does he/she take longer or shorter time?

• When does he/she stop and ask or look up in the forum?
• If he/she finds an answer, is the task answered right afterwards?

When using wearables, even more data is generated and can be collected.

19.2 Definition of Learning Analytics and Educational Data Mining

The demarcation of learning analytics to educational data mining seems very essential. Educational Data Mining is very much about the extensive automation of the process. The teacher himself plays only a minor role (c.f. Romero / Ventura 2013). Learning Analytics, on the other hand, places the person who is teaching in the centre and is seen more as a supporting science. Interventions should become possible through analyses in order to intensify the high degree of individuality in the learning process and to help learners in a targeted manner (c.f. Ebner 2019).

Learning Analytics are structured collecting, analysing and utilising data created in the learning process. Purpose is primarily a better understanding of to get learning processes and learners. Learning analytics can be used in particular for individualisation, for understanding and for contributing to improving learning processes (definition by George Siemens).

Learning analytics focus on applying tools and techniques at larger scales in instructional systems.
• When is a student ready to move on to the next topic?
• When is a student at risk for not completing a course?
• What grade is a student likely to receive without intervention?
• Should a student be referred to a counsellor for help?

Educational Data Mining

The use of data and models to predict student progress and performance, and the ability to act on that information.
• Data mining focuses on developing new tools and algorithms for discovering data patterns
• What sequence of topics is most effective for a specific student?
• Which student actions are associated with better learning and higher grades?
• What features of an online learning environment lead to better learning? (c.f. Ebner 2019)

Types of Data in education

• Identity data: user information (e.g., name, age, location), rights of the user, admin rights of the user, etc.

• User Interaction data: engagement metrics, click rate, page views, bounce rate, etc.
• System-wide data: rosters, grades, disciplinary records and attendance information.

These three data sets are the easiest to collect, but their significance for student outcomes is not very high.

Inferred Content Data: How well does a piece of content "perform" across a group, or for any one subgroup, of students? What measurable student proficiency gains result when a certain type of student interacts with a certain piece of content? How well does a question actually assess what it intends to?

In general, inferred data is when a system assigns a value to users based on their observable activity. The collection of inferred content data is complex. Algorithmically normed assessment items are required to generate efficacy data on instructional materials. If you have these assessment items, you are able to split up instructional content and measure the resulting proficiency gains of students.

Inferred Student Data: Exactly what concepts does a student know, at exactly what percentile of proficiency? Was an incorrect answer due to a lack of proficiency, or forgetfulness, or distraction, or a poorly worded question, or something else altogether? What is the probability that a student will pass next week's quiz, and what can she do right this moment to increase it?

Inferred student data is the most difficult type of data to generate. Doing so requires low-cost algorithmic assessment norming at scale. You also need sophisticated database architecture and tagging infrastructure, complex taxonomic systems, and groundbreaking machine learning algorithms. To build it, you need teams of teachers, course designers, technologists, and data scientists. Then you need a lot of content and an even bigger number of engaged students and instructors interacting with that content (c.f. Knewton 2013).

19.3 Aspects to consider when applying learning analytics

In order to be able to apply learning analytics, seven essential aspects have to be considered (Ebner et al, 2015):

1. Learning Awareness: Learning analytics is about learning and the improvement of the learning process. Weaknesses and strengths can be analysed in a targeted manner to derive how the learning goal will be achieved faster in the future. It is not about deriving assessments from the data.

2. Privacy Awareness: Data protection has to have top priority in all learning analytics measures, so that misuse of data is excluded. In many cases it is sufficient to anonymise

and aggregate the data. As little personal data may be stored as possible and never without consent of the learner.

3. Time Awareness: It is important to keep an eye on the time aspect. Data collection only makes sense over a corresponding period of time, and assistance and forecasts can only be given if the data analysis is not subject to major fluctuations.

4. Visual feedback: Learning Analytics lives from the corresponding data visualisation. This must be chosen carefully so that the statements of the desired target group can be captured as quickly as possible without misinterpretation.

5. Pedagogical intervention: To influence learning behaviour through pedagogical interventions should be one result of the learning analytics process. Appropriate pedagogical knowledge and attention to the individual characteristics and situations is necessary to achieve this.

6. Big Data: Ultimately, it's about data. It is always questionable how this data has arisen and that even the factual is not always easy interpreting is when you don't know the actual situation.

7. Insights and structure of knowledge: Finally, learning analytics help to gain new insights. Insights into how learning arises in a specific case, which processes and structures appear.

19.4 Opportunities and risks

Opportunities

• Improving the quality of teaching

Learning Analytics can provide the teaching staff with detailed feedback on their educational content and activities, on their teaching and on their assessment process. This information gives them the opportunity to continuously improve. Universities are reporting that better data about the student experience enables the institution to identify and address concerns of learners better. These interventions can help e.g. to improve feedback which can help to build better relationships between students and staff (c.f. Sclater et al 2016).

• Boosting retention

The review on learning analytics in the US, UK and Australia found evidence that information about individuals, such as prior qualifications and educational progress

can help to predict students' progress in their studies and help them by personalised interventions such as advice or support from a tutor can then be taken to help to try to retain those students. Learners likely to withdraw can be identified earlier than in the past.

"At New York Institute of Technology (NYIT), approximately three out of every four students who do not return to their studies the following year had been predicted as at risk by the model. Similarly, analysis of data from Nottingham Trent University showed that less than a quarter of students with a low average engagement score progressed from the first to the second year, whereas over 90% of students with good or high average engagement scores did so."
(Sclater et al 2016)

"The Signals project at Purdue University is one of the earliest and most frequently cited learning analytics implementations. Later projects have refined the modeling techniques, developed intervention strategies or transferred predictive models to other contexts. Use of the Signals system led to at 14% reduction in the number of D and F grades. In addition, learners seem to like having data provided to them on their progress. 89% of students in one survey at Purdue University considered Signals a positive experience, while 74% said their motivation was increased by using it." (Sclater et al 2016)

• Enabling students to take control of their own learning

Learners themselves, particularly when beginning higher education, often have little idea of how they are performing in comparison with others, have gaps in prerequisite knowledge, and lack key study skills. Giving students better information on how they are progressing and what they need to do to meet their educational goals is another important application for learning analytics. This has the potential to transform their learning and their understanding of how they learn by giving continual formative feedback as they progress through their studies. Meanwhile some universities are providing analytics-based systems to help students to select future modules, building on data about their career choices, aptitudes and grades for previous modules to provide optimum pathways through their studies (Sclater et al 2016).

Risks
From today's perspective, there is little restriction regarding the technical possibilities of learning analytics. In the future, more and more patterns of data will probably be created, activities aligned and learning progress visible. This is generally very welcome as long as you take privacy and data protection very seriously.

Finally, there should also be a warning against using Learning Analytics without thinking. Ultimately, it's data, statistical analysis, and patterns that often do show

surprisingly good approximation to reality, but just as good enough provide scope for mistakes. Learning Analytics is designed to support the teacher and ultimately the students. Learning itself remains a social process and sometimes does not work as linearly as you would theoretically imagine. Therefore, the technical possibilities should always be seen only as aids, nothing more but nothing less (c.f. Ebner 2019).

19.5 Insights and future forecasts

Regarding technologies there are endless ideas for future developments. It is expected that the use of learning analytics will be intensified in the future, by tracking and evaluating the use of software like learning platforms or apps, that the students use from a laptop or a mobile phone. This is already being done and it is expected to be expanded and improved by the use of algorithms and AI in the coming years. If and how this would be used by public institutions is also a question of public regulations, personal data and more.

Another development is, that more and other devices could be used. Learning analytics could be performed in class by using different devices like wearables, cameras, facial recognition and robots. One vision is a smart classroom that makes use of the following devices:

- wearable badges that track the student's location and emotion,
- high-definition cameras in the classroom with facial recognition technologies
- Educational collaboration robots (cobots) with Artificial Intelligence Education (AIED) applications assist teachers in the classroom. They could monitor learners as they engage with Intelligent Learning Environments; flag and attend to learners who need extra help that the ILE cannot provide; keep learners engaged and interested; and answer questions that a learner might have. (Timms 2016)

As you can imagine, technological possibilities won't be the limit. As technology advances and gets more reasonable priced even costs won't be the limit anymore.

The question that should be asked is, how much technology is needed and useful to improve student's learning results. How much surveillance do we want for children and adults in education and how much do they want? How does their behaviour change once they are observed all the time in their learning behaviour? How are they able to develop their personality adequately once being observed all the time? Are there more advantages or more disadvantages in using learning analytics and smart services? How can personal data be protected from data abuse?

All these questions need to be asked and discussed in public and with regard to the high responsibility that these decisions carry to find the best way for the society.

"Learning itself remains a social process and sometimes does not work as linearly as you

would theoretically imagine. Therefore, the technical possibilities should always be seen only as aids, nothing more but nothing less." (Ebner 2019)

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20. A general view on the future of Digitisation

Gelija Tamulyte / Rajesh S. Pathak / Daniel Crisan

An ancient Greek philosopher Aristotle came across the risks that new technologies impose on our lives a while ago. He described that as "[…] if every instrument could accomplish its own work, obeying or anticipating the will of others, like the statues of Daedalus, or the tripods of Hephaestus, which, […] of their own accord entered the assembly of the Gods; if, in like manner, the shuttle would weave […] without a hand to guide it, chief workmen would not want servants, nor masters slaves" (Medema / Warren 2003).

An ancient philosopher emphasized the risk of automation or digitisation destroying the labour market resulting in social revolution. However, each phenomenon has its own benefits and challenges. Digitisation is not an exception.

20.1 Platform of possibilities and unlimited opportunities

While imposing a possible risk on labour, it provides a great variety of possibilities. OECD[5] states that 65 % of future generation will have job vacancies that do not even currently exist. With continuing digitisation process, products will be created in a more efficient way, thus making both products and services more affordable to society. This will increase demand for supplies thus protect the jobs.

Shift in the working methods result in moving towards a major focus on results. The human-based work ethics will shift towards methodology involving the use of technologies (e.g. computers, storing big quantities of information 'On Cloud'). Even the use of computers carries a risk of errors with connectivity, they are still more reliable and can process more data than any human being could. In close future, there should be noticeable difference in human thinking towards more creative solutions. Currently, it can be seen that both - industry and education employers or teachers - tend to include technologies as much as possible to take old fashioned model of problem solving to another level. Taking education into consideration, there is certain digital content that was always in a digital format and cannot be accessed in any other way (Lee 2002). The creation of only digital versions keeps widely increasing.

"I believe in the face of new technologies, humanity will be able to use them to benefit us. Most people aspire to a good life, not a miserable life," Huawei CEO Ren Zhengfei said during a Davos tech session focused on the Fourth Industrial Revolution.
Generally speaking, some of the anticipated social trends associated with the revolution will be a rising middle class, reverse brain drain, Halal economy and women's empowerment.

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[5] OECD stands for Organisation for Economic Co-operation and Development. It is an organisation of 37 member states. Its major goal is to work on boosting world trade.

There will also be an increased intent on "innovating to zero". This is where the focus of product development and technology is done with a "zero" negative impact on the world. This can involve everything from cars with zero emissions and zero accidents to carbon-neutral cities.

Smart products will be everywhere, from smart clothing, watches, and phones, to smart buildings and smart cities. One smart product that is expected to vastly improve people's lives will be smart cities: the industry is slated to be worth $2.57 trillion by 2025. These smart cities rely on the Internet of Things to collect data, which can then be used to provide insights for better managing assets, resources, and services. These include everything from garbage collection systems to urban planning.

With two-thirds of the world's population expected to be living in urban areas by 2050, smart cities will become essential to allocating the necessary resources for populations. There will also be the rise of "mega districts," which will be key centers for investment, leading to the idea of "city as a customer" strategies for businesses — as opposed to focusing on targeting nations.

20.2 Innovations and risks

Industry 4.0 is revolutionizing the way we live, work, interact with our environment and with each other to create a better world for all. Much of what would be considered science fiction two decades ago is driving the world toward the Fourth Industrial Revolution. Industry 4.0 will completely change the landscape of business, as well as how humans interact with their environment and each other.

Founder and Executive Chairman of the World Economic Forum Klaus Schwab, who coined the phrase "Fourth Industrial Revolution", argued in 2016 that the revolution "is blurring the lines between the physical, digital and biological spheres".[6]

Many predict that it will usher in a new age of bounty: increasing lifespans, improving healthcare, reducing global poverty, and more. Others see darker possibilities in the vast data sets used to drive change during the revolution. But we must not forget that this technology is only a tool. It is neither good nor bad.

In industry, there are certain innovation trends that are considered to be caused because of digitisation. This set of trends include business activities, cheaper experimentation, easy access to widely sharing the ideas, opportunities to replicate innovation with greater spread (c.f. Brynjolfsson / McAfee 2014). The digitisation is currently breaking the boundaries and launching a new way of thinking affecting the whole future. It makes

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[6]Schwab Kl. (2020): The Fourth Industrial Revolution: what it means, how to respond. Retrived in the internet: https://www.weforum.org/agenda/2016/01/the-fourth-industrial-revolution-what-it-means-and-how-to-respond/. Access date: 18.05.2021.

the world more global, providing easier access to global debates. However, nothing comes without the risks.

The first risk of digitisation in industry – the risk of jobs and current low levels of productivity. While it was mentioned before that digitisation boosts demand for products thus securing the jobs, it also imposes a risk since technologies enable companies to seek increased production employing fewer number of employees. However, currently there is still not enough investments in technologies and the rate of productivity is low. The economists refer to this situation as *productivity crisis*.

The second risk connected to the first one is the factor that technological transformation takes longer time than expected (c.f. Schaible / Fischer / Seufert / Fuest 2017). The lack of investments into technologies lead to its slow incorporation into economy and minor change on economy. The research of radio-frequency identification and another area which tracks moving objects in certain area such as airport halls (so called *Internet of Things*) is held to be worth investments and further investigation (c.f. Frith 2014). Certain technologies included in new innovations require developed set of skills to work it. For those skills to be established, trainings that cost money and time have to be provided and most firms seem yet unwilling to provide that for majority of their employees. Therefore, in a close future, no major changes should happen in labour force, however, in long term, digitisation will cause a major change once productivity *crisis* collapse.

Digitisation is known as one of the processes affecting economy, however, it has a major impact on the legal system as well. New technologies led to different types of communication creating international legal pressure in legal arena (c.f. Macmillan 2020). One of the areas of law that becomes more and more relative nowadays is the intellectual property law, further indicated as IP law. The history of it stems from the end of 19th century when grounds were established on the matters protecting the tangible property (c.f. Polcak 2015). However, the concept of it applies to IP as well. UK government defines intellectual property law as the person holding a right over the work created using own mind, e.g. inventions, product design (c.f. GOV 2020). IP law is based on restrictions to protect someone's right over the intellectual property. That individual not only has the power over their work but is able to be in charge of its economic value (Lessig 2004; Ghosh 2007). Lots of legal disputes arise in law because of copy rights and that is one of the challenges ignited by increasing digitisation. However, there is a positive outcome coming out of this. Cultural artefacts (e.g. paintings, books, newspapers) that are known for the long-established existence have no law protecting the copyrights of that content. The opportunity to access it online is driven by digitisation. Investments into technology can lead to increase of powerful machines being able to capture certain fragments of cultural artefacts without causing any damage (c.f. Polcak 2015). Germany is a great example of how digitisation can

benefit the legal global arena. German libraries put effort to digitise valuable historic legal documents to make it accessible for others. One project 'Literatur zur Geschichte des deutschen, österreichischen und schweizerischen Privat- und Prozessrechts des 19. Jahrhunderts' ('Literature on the History of German, Austrian and Swiss Private and Procedural Law of the 19th century') indicates how different Member States can successfully benefit from digitisation. With an essential help from German Research Foundation, the collection of historic legal documents (4,316 books) was digitised and made accessible for scientists overseas (c.f. Vogel / Schrecklinger 2014). New Zealand took similar approach when the museums sought to digitise their collections (Corbett 2013). However, difficulties of copyrights were raised due Copyright Act 1994, which is relative to the challenges of digitisation.

In 5 years with continuing digitisation there will be structural changes in economy. The nature of jobs will be different and will require different set of skills as mentioned above. People having less skills will have reduced working hours and just a small bunch of employees maintaining the knowledge of technologies will receive enough hours to work. Lee Kuan Yew School of Public Policy supported by Konrad Adenauer Stiftung in their workshop report discussed their established Three Horizon Framework model describing the future of digitisation (c.f. Kuan 2019).

Three Horizons Framework (Kuan 2019):
Horizon 1: the case for change
Horizon 2: dilemma between vision and reality, transition
Horizon 3: vision, ideal system

This given framework shows how possible future patterns work and how emerge of certain horizons can lead to great potential of digitisation. Digitisation leads to increase of Monopolistic structures and some platforms have great dominance over others e.g. Google, Amazon, Facebook. They change the perception of thinking creating incentives to innovate and invest. That is the point where start-ups are established (c.f. Bobkov / Herrmann 2019). Due digitisation, infrastructure changes and governments need to know how to adapt as well. Because of technologies, data analytics can help governments and businesses to make informed decision and provide opportunities for positive socio-economic change. The created concept 'seamful spaces'describes the new overlapping infrastructure which marks the collusion of different spaces working together and contributing to flexible infrastructure (c.f. Vertesi 2014). It is essential to look at infrastructure from long term timeframe taking into account social and technical components (Bowker et al. 2010).

Technological evolution is an ongoing process that profoundly changes today's way of life. Ensuring people's employability (the ability to find, retain or change a job using the skills and abilities required by the labour market) in a society where robots, drones

and 3D printers take over a large part of the repetitive tasks traditionally performed by people, create new challenges and opportunities. Artificial intelligence and cyber security are key areas because these technologies are necessary for the proper functioning of robotic systems. They must be part of the knowledge bag of all future employees.
The main stakes of technological changes are given by the emergence of new winners and new losers both at individually level and at the level of companies and countries. In the world of Industry 4.0 experts in cyber security and artificial intelligence will be increasingly in demand. The continuity of the functioning of the physical-cybernetic systems is an essential requirement in a world where most of the goods and services come from robots, 3D printers and drones.

The concept of public order extends to the cyber space at this moment. As the number of robots and drones in the industry will increase, so will the number of cyber security and artificial intelligence experts on the labour market.

The research by Lee Kuan Yew School of Public Policy published in their report two future perspectives of how digitisation can shape our world in the foreseeable future – the rosy and the hazy outlook.

The rosy view portrays all the advantages that technologies can bring into future if used appropriately. This modernisation could lead to solving problems using technology that were impossible to be solved. The general quality of lives could be improved by prolonging the life of individuals. Inequality could decrease. Technologies would be 100% accurate, allowing easy efficient communication across languages by not causing any errors. In a rosy scenario, people would have certain period of time given my employers to receive skills to work with technologies in a longer period of time causing less stress to acquire the knowledge (c.f. Salanova / Del Libano / Llorens/ Schaufeli 2014). Major cyber-attacks would be averted by the state.

The hazy perception provides a view of a world lacking resources, constant conflicts between technologies and humanity, extreme inequality, polarization of income and power.

Personal identity theft due to the lack of security causing chaos in society. Hacking became so popular nowadays leading to loss in privacy, while 15 years ago 'hacking' was related to an underground political activity (c.f. Koch 2017). Personal connections being replaced with online interactions, people having stronger addictions to social media. Which perspective will be more developed in the future depends on how much we, ourselves, put effort into learning to adapt to digitisation and how governments deal with it.

20.3 EU approach on Children development

Deloitte Research suggest three cores of integrating technologies and creating integrated education ecosystem (c.f. Banerjee / Belson 2015). This includes providing foundation for learning, making the content based on students' passions and innovations creating evaluation tools to assess the learning process of students.

However, not everything lays in digitisation. World Bank acknowledges that first contributing factor to how student acquires the knowledge stems from early childhood development (c.f. Cardini 2018). European Union adopted Council Conclusions emphasizing systematic approaches to professionalising the early childhood force. Systematic approaches leading to early child's development providing early education, health, supporting communities lead to better child's abilities to acquire information in the future. Therefore, current projects to boost early childhood development could lead to children receiving knowledge how to work with technologies and take the most from digitisation while boosting the economy in the long-term future (German Development Institute 2018).

UK participates in boosting and supporting the digitisation as well. In 2001, the government set up funding initiative to provide finances to organisations to collect evidence and documents UK's achievements under New Opportunities Fund (NOF) programme (c.f. Rikowski 2010).

It must be said that future **educational makerspaces** are of particular importance, because children have to learn as a child to think trans disciplinarily. To be engaged in the society of the future, today's children must learn to be technologically creative, to think trans disciplinarily, to program computers, to have critical skills, to master the ways of expressing complex ideas through digital storytelling.

A Deloitte study released in March 2020, shows that preparing employees for Industry 4.0 remains a challenge, and climate change is on top of business leaders' concerns. "Adapting employee skills to the Fourth Industrial Revolution remains a challenge for organizations around the world, as leaders still do not fully understand what skills are needed to succeed in the ever-changing world we live in, the latest Deloitte study shows regarding the degree of readiness for Industry 4.0, based on the responses of over 2,000 business leaders from 19 countries."

The study also highlights that, for the first time, climate change has become one of the main concerns of leaders around the world. Nine out of ten respondents fear that the effects of climate change may have negative effects on their organizations, and many are implementing programs that seek to provide solutions for increasingly limited resources and environmental protection.

In terms of the impact of various types of technologies, the study found that business leaders expect IoT, AI, cloud and big data / analytics solutions to have the greatest effects on organizations, followed by nanotechnology, robotics and sensors.

The fourth industrial revolution is characterized by the fusion of physical elements and digital technologies - such as robots, drones, autonomous vehicles, 3D printers, artificial intelligence (AI), Internet of Things (IoT), cloud computing, nanotechnology - which communicate, they analyse information and can act on it, giving more flexibility to organizations, customers and society and allowing them to reduce their response time and make smart decisions based on data analysis.

Speed will be the key word for ordinary administrations with complex decision-making processes, subject to rigorous and extended procedures for long periods of time. They will have to adapt and legislate for the first-time situations, new social relations, unheard of interactions between people, values and automatic systems. Already, the ethical questions generated by the responsibility of a car accident in the near future in which the driverless vehicles will be in traffic are already known.

We can talk about the fear of the unknown, about the uncertainties or the inability to predict how things will change after this new revolution. But history has shown us that, always, the place of one civilization is taken by another. And civilization has been and will remain a human creation.

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