A Model Describing the Required Digital Competencies of VET Educators for Practical Use

Boriss Misnevs
Computer Science Department
Transport and Telecommunication Institute
Riga, Latvia
Misnevs.B@tsi.lv

Krisine Uzule
Economics and Management Department
Transport and Telecommunication Institute
Riga, Latvia
Uzule.K@tsi.lv

***Abstract*— The study is devoted to the development of a digital competence model for vocational education educators with the aim of subsequent integration into a digital platform. The model meets the requirements of a green economy and is built based on the DigCompEdu standard, considering specific digital competencies determined by the requirements of the industry. It is proposed to carry out this extension of the model based on the e-CF standard.**

Keywords*—*competence; knowledge; skills; Use Case; digitalization.

I. INTRODUCTION

Professional education and training have been going through difficult times in recent years. On the one hand, the need for specific, well-trained specialists is growing, on the other hand, the number and quality of vocational education graduates is increasingly lagging the needs of industries.

The causes of this problem are widely studied in the European community and academia [1]. In addition to this, there is now a new reason to provide additional assistance to vocational education because like the entire European economy, vocational education training (henceforth – VET) have to go through the process of digitalization.

Vocational educators, as it was shown in a VET educators' survey [2], indicate a list of problems. In the survey, about half of local vocational instructors, who participated in the survey, had indicated a low level of students' motivation (49%), difficulties with sustaining student enrollment levels in VET (47%), student absenteeism (41%), low availability of computers (34%), poor interconnection between the vocational curriculum and the local labor market (26%), challenges in sustaining high instructional standards (24%) etc. [2].

Many of these issues can be solved through the digitalization of vocational education. For this purpose, it is necessary to create a special digital platform that will, on the one hand, solve the problems of modern vocational education, on the other hand, be part of the European green ecosystem.

For these purposes, it is necessary to design and develop an innovative learning model to identify and assess the digital skills of VET educators, and to offer a well-structured platform and training programs enhancing their digital competence.

II. THE IMPORTANCE OF DIGITALIZING VET EDUCATION

The 4th industrial revolution, which was launched around 2000, requires technological complexity at a much higher level than the previous 3rd industrial revolution [3]. Modern technologies are formed on the basis of computer technologies that integrate with manufacturing, agriculture, medical and other sectors. Such technologies include digital skills, which is why the development of digital skills and the ability to develop such skills throughout life is critical not only for specific professions but for all sectors of the economy. Some current technology that points to the necessity to promote the acquisition of more advanced computer and thus digital skills are the Internet of Things, driverless transport, big data, medical equipment, etc. [3]. The same technologies expect staff to collaborate with AI and robotics to various degrees and supervise machine-conducted activities [4], which means that low-skilled work of manual control will disappear in the future [5]. Already at present 40% of employers in Europe lack properly qualified staff to use digital technologies at the workplace, which impedes economic growth, and the demand for such staff is expected to continue to increase and eventually all specialized workers will be expected to have proper digitalized skills [4], [5]. Such digital needs of staff and employers can be satisfied by vocational education training [3].

One of the impetus of VET development is a frequent lack of employability skills of university graduates who have developed intellectual capacities but are unable to perform in a particular position, which is why it is not surprising that Google or Ernst & Young no longer view higher education as a must [3], which has encouraged the European Commission to develop the Pact for Skills, which was officially launched in November 2020 [6]. The Pact focuses on upskilling and reskilling of the workforce throughout life in various areas of the economy, such as manufacturing, e.g., automobiles and aerospace, tourism, construction, health, etc. The acquisition of newly demanded or expected skills is often a longitudinal and complicated process, which, for example, in some cases when integration of various areas, including computerized technologies, is anticipated, might take about 10,000 hours of practice or demand more advanced computer skills [3] establishing, monitoring or correcting activities from the

The Research is sponsored by ERASMUS+ Project "Digital and Online Learning in Vocational Education Training", INGENIOUS, Agreement No. 2014-2020-1-EL01-KA226-VET-094871.

Internet to equipment, from equipment to equipment, from equipment or the Internet to a human being.

Clearly, workers without institutional or employer support cannot be expected to master such skills on their own because such training requires diverse digital resources, proper contexts, time and funding. Without proper digital infrastructure, proper digital training of human resources, longitudinal training strategies and adequate funding of digital training, it is hardly plausible for staff to acquire digital skills and subsequently implement digitalization [4]. Another key problem lies with the fact that it is difficult to foresee which digital skills will be required in the future [4], which is why it is hard to organize proper training for the immediate and mid-term future. Yet another issue on the European scale pertains to the lack of a unified VET systems across Europe [3]. For example, Germany promotes the dual system when students receive vocational education and an undergraduate degree within the five-year period, whereas Denmark offers opportunities to secondary school students to obtain an occupation through combining secondary school education with apprenticeship [3]. VET might also focus on the needs of a specific employer, as it is often the case in the UK [3]. The diversity of VET systems and programs presupposes various ways to digitally transform and enhance the current VET systems and programs. However, all of them have their digitalization-related challenges and potentials [7].

First, let us start with Digital Competence Framework for Educators (DigCompEdu) framework [8]. VET digitalization calls for various new forms of teaching that is enabled by digitalization, including mobile learning and learning based on games and that affects the learning content, study curricula [7], learning outcomes and study resources. Digitalization of VET requires higher digitalized skills of VET instructors. DigCompEdu provides descriptions of 22 competences grouped in six areas [8]. DigCompEdu at the levels of C1-C2 establish the ability of educators to adjust, modify, program and create games and apps for education [8]. However, given the fact that most educators with the exception of those in IT and computer science related fields have not received formal training in IT and digital technologies, their level of digital competences varies from levels A1-B2, most of them probably being at levels A2-B1. This entails that they cannot use more advanced technologies to promote learning and they cannot teach the usage of more advanced technologies to their learners. This, obviously, hinders the development of digital competences of the workforce. Therefore, no wonder some researchers found that representatives of various sectors of the economy, such as banking, retail, automobile and food industries, concluded that e-learning is unable to replace face-to-face instructions and can be viewed only as complementary training despite the fact that often companies would prefer mobile learning due to the time and place constraints for working staff, the need for personalized learning enabled by digital technologies not being linked to a particular place of instructions but being linked to the moments of needs of staff, and incremental learning of limited content integrated into daily work practice [4], [7]. Digitalization breaks human connection between a student and a teacher, which makes learning disengaged and distant [4]. However, one reason why it might happen might be linked to mediocre digital skills of educators incapable or not having resources to create the digital world of training.

Thus, clearly, there is a need for VET educators to receive proper digital training to create proper digital resources, digital contexts and assessment tasks, after which they will be able to implement project-based learning, which according to some research [5], is the form of VET training that will permeate VET training due to its capability to integrate various areas of operations at a company.

One of the goals for the current ERASMUS+ project is creation of a specialized digital platform for VET education – VOOC. The Fig.1 below represents the current vision of the main functionality for this platform represented in the form of Use Case diagram.

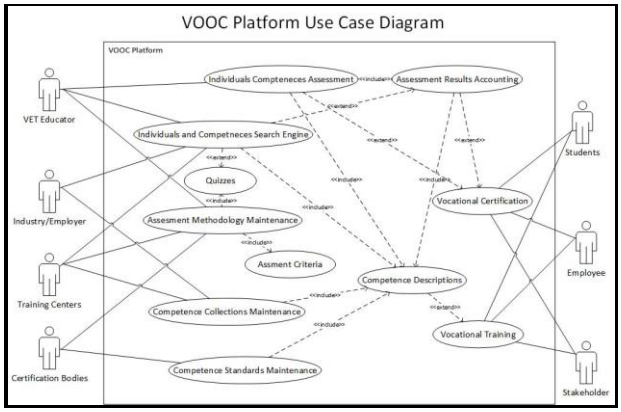


Fig.1. VOOC Platform Use Case Diagram

III. DigCompEdu core competencies that VET educators may need

In recent years one of the key objectives of the EU education has been the development of digital and green skills. The EU has set frameworks, such as e-CF and DigCompEdu [8]. The Digital Education Action Plan for the years 2021-2027 was made public in September 2020 [9]. According to this and other documents, the EU vision is to promote training, including digital and vocational education to adapt to the Covid-19 reality and the post-pandemic future and to boost economic and social growth and greener economies consistent with the European Green Deal, which was launched in December 2019 [10]. Therefore, in November 2020, the EU Commission organized a week focusing on Vocational Education Training aimed at the development of green skills to facilitate green transition.

All such frameworks have been developed in order to ensure training of workforce capable of producing outputs in the digital world to create green economies. As most of the workforce have already completed formal training, such transition is ensured by vocational education training. Such training is provided by professionals in all sectors of the economy, and in order to sustain its agility to meet the current and future demands of the labour market, it is important to properly train professionals working in VET so that they are

capable of promoting digital and green transformation at the workplace.

Being professionals, VET instructors have at least some awareness of the knowledge, skills and context that are required for the transition to digital green contexts of teaching. Therefore, it is important to obtain information on their perspective and knowledge on the implementation of digital green skills into VET training. Therefore, a survey has been developed on the basis of DigCompEdu (see Fig.2) [8], e-CF standards and green competences.

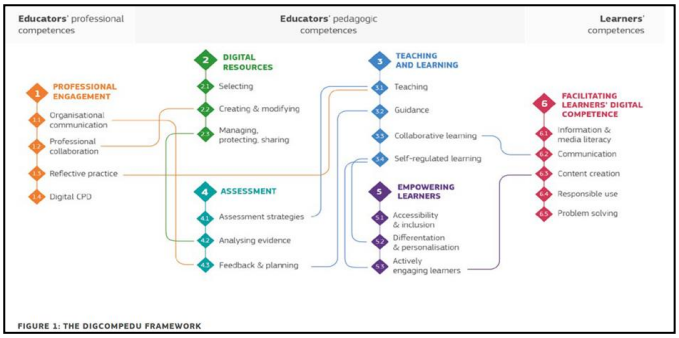


Fig. 2. DigCompEdu framework [8, p.8]

In any case, VET educators' competences will have to include more advanced digital and green skills, particularly, in case of the agro-sector, manufacturing and transport.

IV. The Need for a Teacher's Information and Behavioral VET Model in Terms of the Required Digital Competencies

To clarify the requirements for the platform developed by the VOOC, it is necessary to present the behavior of educators in the process of assessing their competencies. At the same time, we must understand that assessment "in general" in this case is not suitable. For example, probably it is not necessary to evaluate every teacher in all 22 DigComEdu competencies [8] and 41 competencies of the e-CF 4.0 framework [11]. Therefore, we propose a scenario for assessing digital competencies with the issuance of an appropriate certificate, but which allows the teacher to predictably form a set of competencies to be assessed.

The proposed estimation scenario is shown in Fig. 3.

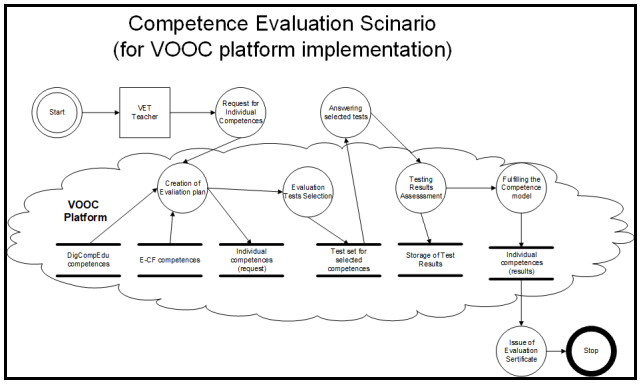


Fig.3. Suggested Scenario for competence evaluation.

V. Proposal for the Composition of Such a Model, Suitable for Subsequent Implementation in Software

Before launching the digital platform development, we need create a king of a model for VET teacher's behavior description in terms of the required digital competencies. The research in this direction is a continuation of iSECRET project (2015-2017) [12].

To illustrate the general approach for the description of the digital competence model, this paper has borrowed a widely acknowledged scheme described, for example, in CC2020 document [13], which is represented by the following simple formula of the competency concept:

Competency = [Knowledge + Skills + Dispositions] in Task

Knowledge stands for understanding of key concepts and concept content and therefore represents the dimension of "*knowing-what*".

Skills pertain to abilities and strategies that students acquire over a specific period of time through practice and interactions with others and therefore stands for the dimension of "*knowing-how*".

Dispositions represent socioemotional skills, conduct and attitudes describing the inclination to engage in tasks and the awareness of the time and approach to completing those tasks. This component stands for the "*knowing-why*" dimension.

Task is the construct building and constraining the skilled application of knowledge and specifying dispositions. The Task enfolds the purposeful environment of competency, exposing the integral nature of knowledge, skills and dispositions.

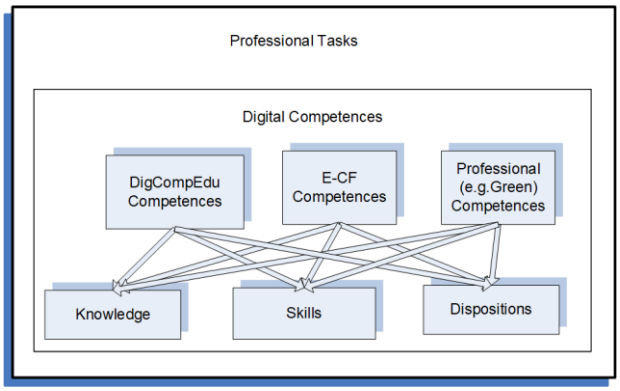
However, interested parties should be knowledgeable about details and differences in the meaning of various terms used to describe competencies. It is essential that global diversity and cultural differences be recognized across all sectors of economies, including vocational education, which itself is remarkably diverse.

Therefore, the authors propose a universal model of competencies for a digital platform for VET, which at an upper level of abstraction distinguishes between three categories of digital competencies: educational, information technology and professional (including green competencies).

The suggested model is depicted in Fig.4 below. Fig. 4. Suggested Competence structure model.

Since there are three different sets of competences, it is important to conduct three different surveys, which certainly, can be distributed as one combined survey or three different surveys. In any case, the survey/s can be organized either in block design in which each block focuses on a specific set of competences and its sub-sets or alternatively, consistent with the cognitive science approach.

Statements can be distributed randomly or semi-randomly, possibly with fillers distracting the respondents from the key issues, and thus, increasing the likelihood of obtaining more representative answers.



In order to verify the reliability of answers, it might be advisable to distribute the survey in various formats.

Another feature of the survey design is the data collection via the Linkert scale, yes/no questions and questions requiring specific knowledge of digital technologies.

To boost the validity of the survey/s, the survey/s contain/s the combination of self-reports of general and specific questions and objective testing of knowledge of the reported answers. Additionally, the questionnaire collects data on whether the inquired knowledge and skills have been acquired at the workplace or via VET educators' own initiatives. The answers received on these aspects will clearly indicate the degree of involvement of institutions in developing digital, professional and green competences of VET teaching staff.

The DigCompEdu framework contains general descriptions of 22 competences across 6 areas – professional engagement, digital resources, teaching and learning, assessment, empowering learners and finally facilitating learners' digital competences [8]. The proposed survey of DigCompEdu explores all competences at a deeper level as each competence is analyzed via 2 – 6 questions. The more technical the competence is, the more questions are asked. Some examples of questions are provided in table 1.

TABLE 1. SAMPLES OF QUESTIONS

Digital resources	**Fluent**	**Interme-diate**	**Basic**	**No**
Preparing effective VET presentations using Microsoft Office				
Able to insert extracts from longer *Youtube* videos into presentations				
Able to prepare VET presentations using a programming language				
Able to prepare VET presentations using Vismo or other software				
	Write down your answers			
What programming languages do you use in your VET teaching?				
If you use programming for your VET teaching, for what purposes?				
What software packages do you use in your VET teaching?				

As for e-CF competences, they cover 5 areas and 40 competences in e-CF 3.0 Competence framework [14] (see table 2).

TABLE 2. E-CF COMPETENCES [14, p.11)

Areas	**Number of competences**	**Samples of competences**
Planning	9	product management, innovation
Building	5	tesing, solution deployment
Running	4	user support, service delivery
Enabling	12	information security strategy development, information and knowledge management
Managing	9	forecast development, process improvement

When comparing DigCompEdu and e-CF competences, it becomes clear that they both complement each other. E-CF is designed for IT pofessionals to support business operations, whereas DigCompEdu focus on the needs of educators [8]. In VET, educators' task is to train students to work at the workplace, which is why they are supposed to be familiar with e-CF standards to familiarize their students with technology used in professional settings and with basic principles of performance at the workplace (such as KPI, business strategy, etc. in relation to their area of VET). In contrast to IT professionals, VET instructors are not supposed to achieve high proficiency levels, but basic and in some cases intermediate levels would be an advantage.

The green competences, being different from the previous two sets of competences that focus on digital skills, are discussed in a separate section below.

VI. GREEN SKILLS IN VET

The Pact for Skills includes the agri-food sector whose future lies with the integration of digital and green competences [15]. The same document states that it is crucial to boost young people's motivation to pursue their career in agriculture and food chain supplies, and one of such tools can be digitalization of work processes in the sectors. One approach to stirring and sustaining the youth's interest in the digitalized agriculture is to have VET educators fluent in using at least some more advanced digitalized skills to create and manage a digitalized ecosystem in their courses. This was one of the reasons for the inclusion of DigCompEdu and e-CF competences into the model (see the previous section).

Furthermore, to cover the requirements stated by the Pact, the Model must be extended to include a proper set of green skills.

Fortunately, the challenges encountered by agri-food sectors are suitable for technology transfer from other sectors and industries. The illustration Fig. 5 below, partially taken from [13], demonstrates some ideas transferred from adjacent industries and implemented in the agri-food sector. Obviously, the use of newly adapted technologies requires specific digital competences for agriculture professionals.

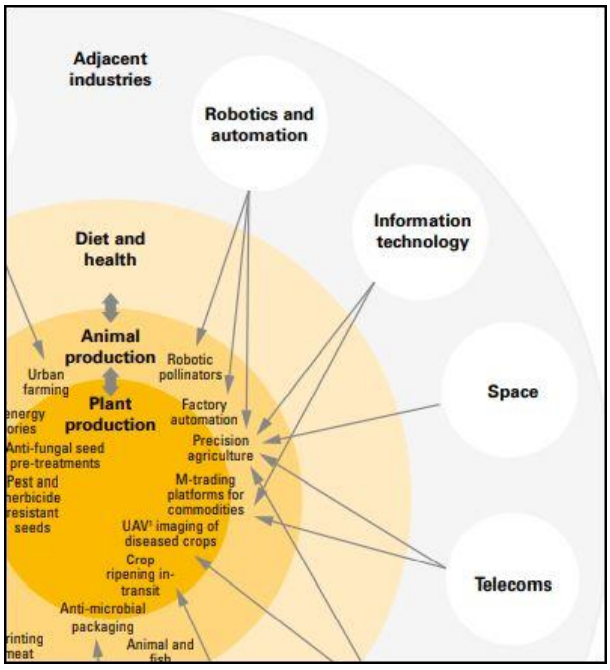


Fig.5. Adjacent industries ideas are entered the agri-food sector [13].

One difficulty of integrating green skills pertains to the lack of one unified model of green skills, which might be explained by various degrees of connection of green technologies. There might be *green jobs* [16], [17] and standard jobs that require awareness and implementation of certain aspects of environmentally friendly policies, which are commonly known as *green tasks* [16]. Green tasks can be general and thus pertaining to a wide range of professions and activities, whereas green tasks of specific nature relate to specific occupations [16]. Another categories of green skills might relate to sectors and types of professional activities. Green skills can be grouped into two major categories – engineering green skills to create and manufacture products and technology and managerial green skills aimed at implementation and supervision of business and environmental operations [16].

Another issues with creating a unified approach to green competences lies with the fact that the definition of green economies, and thus green skills and competences, might be different across sectors and nations [17].

As for VET sectors in Europe, due to the lack of green occupations in Europe, VET focuses on greening of existing professions [17]. Most importantly, traditional sectors, including agriculture, can gradually transit to green economies [17].

Due to the lack of clear green skills and competences, this project focused on general green skills for agricultural sectors and included skills on using natural resources to grow food, green decisions in farming, green packaging and marketing.

VII. Recommendations for filling such a model with real data collected by practitioners

After data has been collected from the survey/s, it is important to properly enter it into the model. To clearly see the gaps of specific instances of performance to suggest effective improvement, data entry is designed in layers and blocks. The layers will include the level of knowledge, skills and dispositions, whereas blocks will be DigCompEdu, e-CF and green competences.

VIII. DigCompEdu, e-CF and green core competencies that VET educators may need

VET educators will need various DigCompEdu, e-CF and green skills depending on their areas of specialization and the regional context of the country in which they practice. Yet, they might be summarized as follows (see table 3):

TABLE 3. KEY COMPETENCES

Framework	Key competences
DigCompEdu	1. Able to create advanced digital resources, including presentations, and assessment tasks 2. Able to modify available resources to digital contexts and to integrate them into the available digital ecosystem 3. Able to teach necessary digital skills to students to work with digital resources, platforms and ecosystems 4. Able to acquire new software or programming skills independently or with assistance to meet new digital demands of the profession
e-CF	1. Able to use relevant digital systems for showing how to manage business operations (e.g. planning, production, sales, paperwork management) 2. Able to use relevant digital systems for digital marketing (if applicable) 3. Able to use relevant digital systems for staff management (if applicable) 4. Able to use relevant digital systems for supply management and delivery 5. Able to use relevant digital systems for managing and improving processes 6. Able to use relevant digital systems for forecasts
GreenComp	1. Able to use digital systems for greener process management 2. Able to use digital systems to ensure greener food growing 3. Able to use digital systems to ensure greener packaging and delivery 4. Able to use digital systems to ensure greener supply chains

Obviously, as educators, VET instructors are expected not only to use such skills in own practice but to teach such skills to their students.

IX. Conclusion

In conclusion, it should be noted that this study proposed and discussed a new combined model of digital and green competencies for vocational educators with the aim of subsequent integration of such competencies into a digital platform. The model meets the requirements of a green economy. The proposed model integrates DigCompEdu and relevant e-CF standards as well as green skills specific for a particular industry, in this case agriculture, considering the

specific digital competencies determined by the requirements of the industry. Various diagrams have been developed in the UML visual modeling language, which allows formulating a task for designing a digital platform for educators of vocational education.

REFERENCES

[1] Vocational education and training in Europe, 1995-2035. Scenarios for European vocational education and training in the 21st century. https://www.cedefop.europa.eu/files/3083_en.pdf

[2] Public Secondary School Teacher Survey on Vocational Education. https://nces.ed.gov/surveys/frss/publications/94409/index.asp?sectionid=8

[3] E.S. Madsen, A. Bilberg, and D. Grube Hansen, "Industry 4.0 and digitalization call for vocational skills, applied industrial engineering, and less for pure acdemics," Proceedings of the 5th P&OM World Conference, 2016.

[4] M. M. Veres, C. Veres, A. M. Rauca, L. O. Marian, and A. Sigmirean, "Research on qualified vocational training development in the context of digitalization," MDPI Proceedings, vol.63(68), 2020.

[5] J. Gebhardt, A. Grimm, and L. M. Neugebauer, "Developments 4.0. Prospects on future requirements and impacts on work and vocational education," Journal of Technical Education, vol.3(2), pp. 116-133, 2015.

[6] The European Commission Pact for Skills (10 November 2020). https://ec.europa.eu/social/main.jsp?catId=1517&langId=en

[7] J. Busse, A. Lange, and M. Schumann, "Effects of digitalization on vocational education and training: first results of a qualitative study," In DELFI Gesellschaft für Informatik, 2019, pp. 67-72.

[8] C. Redecker, "European framework for the digital competence for educators (DigCompEdu)," Y. Punie, Ed. Luxembourg: Publications Office of the European Union, 2017, available at: https://ec.europa.eu/education/education-in-the-eu/digital-education-action-plan_en.

[9] European Commission, "The digital education plan 2021-2027," available at: https://ec.europa.eu/education/sites/default/files/document-library-docs/deap-communication-sept2020_en.pdf, 2021.

[10] European Commission, "European Green Deal," https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en

[11] Cenelec, "New EN 16234-1:2019 provides a common framework to assess ICT skills all across Europe," available at: https://www.cencenelec.eu/News/Brief_News/Pages/TN-2020-001.aspx.

[12] V Liagkou, and C. Stylios, "A trustworthy and privacy preserving model for online competence evaluation system," International Conference on Dependability and Complex Systems, pp. 338-347, 2018.

[13] Computing Curricula 2020 (CC2020). A Computing Curricula Series Report, December 31, 2020, available at: https://www.acm.org/binaries/content/assets/education/curricula-recommendations/cc2020.pdf

[14] Cen and European Commission, "European e-competence framework 3.0," available at: http://ecompetences.eu/wp-content/uploads/2014/02/European-e-Competence-Framework-3.0_CEN_CWA_16234-1_2014.pdf, 2014.

[15] Ph. Webster, F. van Oene, M. Maki Kurosawa, and L. Guillodo, "The future of agri-food. Harnessing innovation from adjacent industries to meet global challengess," available at: https://www.adlittle.com/sites/default/files/prism/The_Future_of_Agri-Food.pdf

[16] F. Vona, G. Marin, D. Consoli, and D. Popp, "Environmental regulation and green skills: an empircal exploration," Journal of Association of Environmental and Resource Economists, May 2018.

[17] Cedefop, "Skills for green jobs: 2018 update," Luxembourg: Publications Office of the European Union, 2019.