A Model Describing the Required Digital and Green Competences of VET Educators for Practical Use

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***Abstract* - The study focuses on the development of a new combined model of digital and green competences for vocational training educators with the aim of its subsequent integration into a digital platform. The model meets the requirements of a green economy and is built in accordance with the DigCompEdu standard, considering specific digital competences determined by the requirements of the industry and relevant aspects of the e-CF standard.**

***Keywords* -** *competence; knowledge; skills; green; digitization; Use Case.*

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, while on the other hand, the number and quality of vocational education graduates is increasingly lagging behind the needs of industries.

The causes of this problem are widely studied in the European community and academia [1] to ultimately adjust educational systems to the immediate and realistic future needs of the market. In addition to this, there is now a new reason to provide additional assistance to vocational education - similar to the entire European economy, vocational education training (henceforth – VET), which might be viewed as blended with lifelong learning, has to go through the process of digitalization.

Vocational educators point to various problems in education. In one VET educators' survey, about half of respondents 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 local labour markets (26%), challenges in sustaining high instructional standards (24%) etc. [2]. Many of these issues can be solved through digitalization of vocational education. In fact, there is an opinion that virtual education, which proceeds in the digital reality, offers better opportunities than brick and mortar schools in such aspects as economic benefits, place, time, availability and resources of training [3]. For this purpose, it is necessary to create a special well-structured digital platform that will solve many problems of modern vocational education and will be integrated into the European green ecosystem.

A component of this transformation could focus on educators and their digital competences since their digital expertise sets the context of teaching. Therefore, this platform should be a digital representation of an innovative learning model capable of identifying and assessing the digital skills of VET educators and capable of offering training programs facilitating the enhancement of educators' digital competences.

Considering the current context of the development of green economies, promoted by the European Union (henceforth – EU) and Organisation of the Economic Cooperation and Development (henceforth – OECD) [4], on the one hand, and work orientation and sustainability of VET, on the other hand, it is important to integrate some aspects of green competences into a new model, yielding a combined model of VET digital and green competences. Thus, the aim of this paper is to offer an outline of a new combined model of digital and green competences for vocational education instructors.

II. THE IMPORTANCE OF DIGITALIZING VET EDUCATION

The 4th Industrial Revolution (also referred to as Industry 4.0) entails the integration of more advanced technologies into the workplace and education, including the Internets of Things and Services, block chain and big data, cloud computing, augmented reality and simulations, autonomous robotics and smart factories, computer-human interaction [5]. By 2050, many operations of the digital, physical and even biological nature are expected to be merged with the artificial intelligence, thus, becoming fully automated and leading to the eradication of many jobs of today [6]. Already at present 40% of employers in Europe lack properly qualified staff to use digital technologies at the workplace, which impedes economic growth, which is why the demand for such staff is predicted to continue to increase and will eventually result in a situation when all specialized workers will be expected to have proper digital skills [7]. The need to have more advanced digital skills and the pressure of losing a job to automatisation leads to the increased level of psychological stress at the workplace, absenteeism and burnout [8], which is a challenge not only to employees but also to companies that might suffer from reduced level of productivity and lower competitiveness caused

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by the decline in staff productivity. To ensure that employees continue to work productively, have essential digital skills to co-create with technologically advanced systems, they need proper training. Such digital needs of both staff and employers can be satisfied by relevant vocational training (VET) [9].

One of the impetus of VET evolution 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 has encouraged the European Commission to develop the Pact for Skills, which was launched in November 2020. 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. [10]. The acquisition of newly demanded skills is often a longitudinal and complicated process, which, for example, in some cases when integration of various areas, including (more advanced) computerized technologies, is anticipated, might take about 10,000 hours of practice [11]. Such skills might be expected because they will enable users to establish, monitor or correct activities from the Internet to equipment, from equipment to equipment and from equipment/Internet to a human being.

Evidently, without proper digital infrastructure, proper digital training of staff, longitudinal training strategies and adequate funding of digital training, it is hardly plausible for staff to acquire more advanced digital skills and subsequently implement digitalization at the workplace, which is made even more complicated by the fact that it is difficult to foresee for both employees and employers the type of digital skills that will be required in the future at their enterprise [12]. Apart from issues pertinent to selecting required digital skills for staff and related to the organization of relevant training, the problem might be the diversity of vocational education systems, programs and practices in Europe, which impedes the development of one VET model. For example, the initial VET training in Austria typically spans over the two-to-four-year period and includes either vocational training at the workplace (apprenticeship) or dual training, which integrates school training with apprenticeship practice, while the Czech system of vocational education does not offer dual vocational training [13]. The diversity of VET systems and programs presupposes various ways of digital transformation and enhancement of current VET systems and programs. All of them have their specific digitalization related challenges and potentials.

As any educational system, VET addresses digitization through the prism of digital skills and competences to be taught to students and to be used by VET educators as a tool in any course. There are various definitions of digital competences focusing on specialized skills enabling users to deploy digital technologies (knowledge of digital tools and processes), on the one hand, and on general skills essential for mastering the use of digital technologies, e.g. cognitive skills [14]. In this paper, digital competences are considered within the former (specialized) approach. The contents of digital competences vary depending on the level of a user. Since this paper focuses on digital competences of VET educators, first, it is important to consider the EU Digital Competence Framework for Educators (henceforth - DigCompEdu).

DigCompEdu identifies 22 competences grouped in 6 areas and spread across 6 levels from A1 (beginners) to C2 (pioneers) [15]. According to this framework, the most advanced users (levels C1-C2) are able to adjust, modify, program and create games and apps for education. 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 proficiently use more advanced technologies to promote learning and they cannot teach the usage of more advanced technologies to their learners. This hinders the development of digital competences of the workforce. Therefore, no wonder that representatives of various sectors of the economy, such as banking, retail, automobile and food industries, have 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 theoretically prefer mobile learning due to the time and place constraints of staff and various needs of staff and employers, such as the need for personalized and incremental learning integrated into various work routines of staff at one enterprise (which is enabled by digital technologies), the need for instructions not to be fixed to a particular location, the need for instructions to be available at the moments of needs [16]. One specific reason why despite benefits of digitalization of training, it is approached with caution relates to possible gaps in human connection between a student and a teacher in digital realms, which makes learning disengaged and distant [12]. However, one reason why it might happen might be linked to mediocre digital skills of educators incapable or not having sufficient resources to create the engaging digital world of effective training.

Thus, there is a need for VET educators to receive proper digital training to create proper digital resources, digital contexts and assessment activities. Proper digital skills will equip educators with tools to implement project-based learning which might be viewed as the form of VET training [7] and which might be expected to permeate VET training due to its capacity to immerse learning in contexts highly similar to real work environment.

One of the goals of the current ERASMUS+ project “Digital and Online Learning in Vocational Education Training”, INGENIOUS, (Agreement No. 2014-2020-1-EL01-KA226-VET-094871) is the creation of a specialized digital platform for VET education – VOOC. Fig.1 below represents the current vision of the main functionality of this platform, represented in the form of the Use Case diagram.

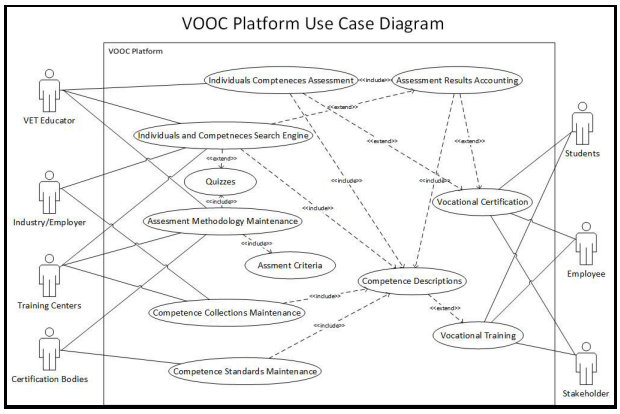

Fig.1. VOOC Platform Use Case Diagram

III. Core competences of DigCompEdu required by VET educators

In recent years one of the key objectives of the EU education has been the development of digital and green skills, for which the EU has set frameworks, such as the European e-Competence Framework (henceforth - e-CF) [17] and DigCompEdu [15]. The Digital Education Action Plan for the years 2021-2027 was made public in September 2020 [18]. 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, on the one hand, and on the other hand, to boost economic and social growth and to transit to greener economies consistent with the European Green Deal, which was launched in December 2019 [19]. The importance of integration of green skills into VET has been acknowledged by the European Commission, which in November 2020 organized a series of a week-long events promoting the transition to Green VET.

All such frameworks and action plans have been developed to ensure training of workforce capable of producing outputs in the digital world for the purposes of creating green economies. Since the majority 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 the agility of such training and 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 contexts that are required for the transition to digital green contexts of teaching. Therefore, it is essential to gain information on their perspective and their knowledge on how to implement digital green skills into VET training. Such information has been obtained through a survey that was developed on the basis of DigCompEdu, e-CF standards and green competences. DigCompEdu is an open source. In contrast, e-CF is a commercial product, while green competences lack a unified framework.

For VET to facilitate the transition to green and digital economies, obviously, VET educators' competences should include more advanced digital and green skills, particularly, in cases of agricultural and farming sectors, manufacturing and transport.

IV. Identification of required digital competences for the VET model: information provided by VET educators and their behavior

To clarify the requirements for the platform developed by VOOC, it is necessary to register the behavior of educators when their competences are being assessed. At the same time, the assessment "in general" terms is unsuitable in this case. For example, it might not be necessary to evaluate every VET instructor in all 22 DigCompEdu competences [15] and 41 competences of the e-CF 4.0 framework [20]. Therefore, this paper proposes a scenario for assessing digital competences with the issuance of an appropriate certificate, when a VET educator can be issued a specific (required) set of competences to be assessed.

The suggested estimation scenario is displayed in Fig. 2.

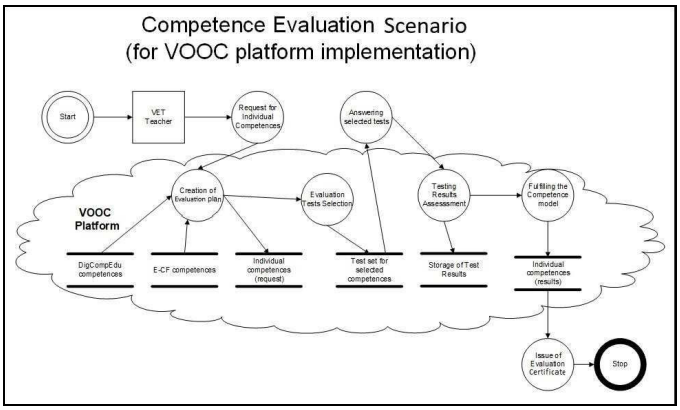

Fig.2. Suggested scenario for competence evaluation.

V. Proposal for the composition of the VET model suitable for subsequent implementation in software

Prior to launching the development of this digital platform, a model describing VET instructors' behavior in terms of the required digital competences should be proposed. The development of such a model is a continuation of the iSECRET project (2015-2017) [21].

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 [22], 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.

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

Those interested in using the components of this formula should be knowledgeable about details and differences in the meaning of various terms used to describe competences. It is essential that global diversity and cultural differences be recognized across all sectors of economies, including vocational education, which is remarkably diverse.

Therefore, the authors propose a universal model of competences for a digital platform for VET, which at an upper level of abstraction distinguishes between three categories of digital competences - educational (DigCompEdu), information technology (e-CF) and professional (including green competences), and at the bottom level incorporates the components of the competency formula described above. The suggested model is depicted in Fig. 3.

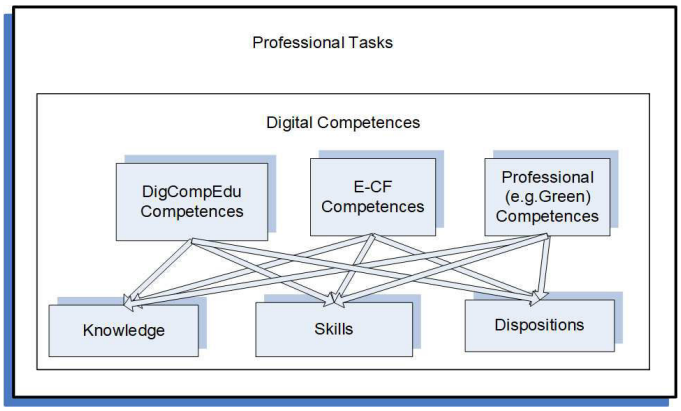

Fig. 3. Suggested Competence structure model.

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 in block design in which each block focuses on a specific set of competences. Alternatively, consistent with the cognitive science approach, all questions (targets) can be mixed in one survey together with unrelated information (fillers) whose purpose is to distract respondents in order to tap into true representations of conceptual information in the respondents' mind rather than tapping into constructs primed by specific stimuli formed by the block design. Either approach has benefits and drawbacks, which is why the choice of the survey design is expected to depend on the hierarchical structure of priority of the survey goals.

As for data collection in the survey, it will be obtained via the Linkert scale questions, yes/no questions and questions requiring specific knowledge of digital technologies.

In order to verify the reliability of answers, it might be advisable to distribute the survey in various formats and designs. To boost the validity of the survey/s, the survey/s contain/s the combination of self-reports of general and specific questions, on the one hand, and include/s objective testing of knowledge of the reported answers, on the other hand.

Additionally, the questionnaire collects data on whether the inquired knowledge and skills have been acquired at the VET 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.

As for integrating the components of specific competence frameworks into the survey, the DigCompEdu framework contains general descriptions of 22 competences across 6 areas, such as teaching and learning, assessment, empowering learners, professional engagement, facilitating learners' digital competences and crucially digital resources [15]. 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	**Proficiency level**			
	Fluent	**Average**	**Basic**	**No**
Preparing effective VET presentations in Microsoft Office				
Able to insert extracts from *Youtube* videos into presentations				
Able to prepare VET presentations by programming				
Able to prepare VET presentations in various software				
	Write down your answers			
What programming languages do you use in your VET teaching?				
Why do you use programming for your VET teaching, if at all?				
What software packages do you use in your VET teaching?				

In pertinence to e-CF competences, they cover 5 areas and 40 competences in e-CF 3.0 The outline of the competence framework is provided in Table 2 [17].

TABLE 2. E-CF COMPETENCES [17, 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 professionals to support business operations, whereas DigCompEdu focus on the needs of educators. 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 be able to familiarize their students with technology used in professional settings and with basic principles of performance at the workplace (such as key performance indicators, 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 rudiments of IT knowledge and in some cases intermediate levels of IT competences would be an advantage.

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

VI. Green skills in VET

As any discussion on skills, this one should start with the definition of green skills. There is a lack of one unified model of green skills, which might be explained by various degrees of connection of green technologies. Some authors view green skills as a combination of general cognitive, motor and affective skills, knowledge and attitudes supporting and promoting sustainable development of an enterprise and the economy overall [23], whereas other authors view green skills as skills enabling workers to perform in green jobs and promoting the greening of existing jobs [24].

Be it a green job or a standard job, its green aspects relate to the awareness and implementation of specified components of environmentally friendly policies, which are commonly known as *green tasks*, which can be general and thus pertaining to a wide range of professions and activities, whereas green tasks of specific nature relate to specific occupations [25]. The amount of green tasks and their characteristics will depend on the type of a job [26]. Since the EU and OECD have been advancing the transition to green economies [10], which entails the continuous introduction of green tasks into business operations, it is not surprising that some authors suggest interpreting the concept of "green" as a continuum rather than a binary concept [27]. Such diversity of green tasks and their continuous evolution make it difficult to introduce unified standards and definitions of green skills and green competences, and thus the development of a universal model of green competences. Instead, what might be possible is the development of a model of general green competences for professions that are not considered to be green, on the one hand, and a model of green competences for specific green sectors and green occupations, on the other hand.

As for VET sectors in Europe, due to the lack of green occupations in Europe, VET focuses on greening of existing professions and on ensuring that traditional sectors, including agriculture, can gradually transit to green economies [24].

Due to the lack of clearly identified green skills and competences as well as the need to focus on a specific sector, this project has focused on general green skills for agricultural sectors and included skills of using natural resources to grow food, passing green decisions in farming and related areas, green packaging and green marketing.

Agricultural sectors are included into the European Pact for Skills as the agri-food sector whose future lies with the integration of digital and green competences [28]. 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).

Fortunately, the challenges encountered by agri-food sectors are suitable for technology transfer from other sectors and industries. For example, such adjacent industries include robotics and automation, information technology, space and telecoms, which create the possibilities of taking images of diseased crops by unmanned aerial vehicles, using m-trading platforms, delivering precision agriculture, etc. [28]. The deployment of newly adapted technologies requires the agri-food sector professionals to have specific digital competences.

VII. Recommendations for filling the VET 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 and to suggest effective improvement, data entry is designed in layers and blocks. The layers will include the levels of knowledge, skills and dispositions, whereas blocks will encompass DigCompEdu, e-CF and green competences.

VIII. DigCompEdu, e-CF and green core competences required by VET educators

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. The inclusion of DigCompEdu is justified on the grounds of it being developed for educators, teachers, who work with students remotely or in a class and have to face teaching

challenges, whereas e-CF model has been designed to support business operations at the workplace and therefore is set to equip workers with work-related competences. Combining digital and green competences is important not only for the evolution of green competences in teaching and at the workplace but also for the development of IT sectors which have been focusing on green transformation. The Green IT trend has been incrementally permeating the sector [29].

The key skills and competences, included in the suggested Model, are summarized below considering the tasks that workers in agri-food sectors typically complete (Table 3):

TABLE 3. KEY COMPETENCES

Framework	Key competences
DigCompEdu	Able to … 1. create advanced digital resources, including presentations, assessment tasks, homework assignments, assignments for independent work, etc.; 2. modify available resources for digital contexts and to integrate them into available digital ecosystems; 3. teach students specific digital skills to enable them to work with digital resources, platforms, ecosystems; 4. acquire new software or programming skills independently or with assistance in order to meet new digital demands of the profession.
e-CF	Able to use relevant digital systems for the purposes of … 1. showing how to manage business operations (e.g. planning, production, sales, paperwork management); 2. digital marketing (if applicable); 3. staff management (if applicable); 4. supply management and delivery; 5. managing and improving processes; 6. producing forecasts.
GreenComp	Able to use digital systems to ensure … 1. greener process management; 2. greener food growing; 3. greener farming; 4. greener packaging and delivery; 5. 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, this study proposed and discussed a new combined model of digital and green competences for vocational educators with the aim of subsequent integration of such competences 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 specific digital competences identified in the requirements of the industry. Formulation of tasks for designing a digital platform for educators in vocational training was facilitated by various diagrams that had been developed in the Unified Modeling Language, which is a visual modeling language.

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