strengthenINg diGital pEdagogy skills aNd competencIes Of edUcatorS

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1. RESEARCH ON STATE-OF-THE-ART DIGITAL COMPETENCE ASSESSMENT FRAMEWORKS

1.1 The importance of digitalizing VET education

One of the loci of contemporary educational policies focuses on the transformation of educational processes into digital counterparts to sustain the competitiveness of education and to expand training opportunities [1]. Recent years have demonstrated the need to develop digital skills at a higher level as instructors are often required to develop and deliver fully professional courses online, using software and various digital platforms, on the one hand, and on the other hand, students are expected to cope with content processing and task completion in the digital environment, which also requires digital skills and digital experience.

No wonder vocational education (henceforth – VET) instructors are also expected to be reasonably proficient in digital technologies to yield and participate in both blended and fully remote learning. VET education is considered one of the drivers of the digitalization of economies [1]. However, many VET instructors, similar to instructors at other education levels, might not have more advanced digital skills as a result of their prior teaching training and professional expertise, which impedes the student experience, resulting in students' reduced motivation, drop-out and absenteeism (41%), lack of strong connections between the labour market demands and vocational curricula, etc. [2]

Since the digital environment might include a myriad of digital aspects, both VET instructors and the institutions that receive their services might be confused about digital competencies that such instructors might need to create exciting digital content and to deliver them in a captivating manner. It is important to take into account the fact that VET instructors and VET providers should have access to coherent and cohesive informative resources, study materials and training contexts to enable them to integrate into Industry 4.0 contexts, which comprise such agents as the Internet of Things and the Internet of Services, cloud computing, adaptive spaces and augmented reality and computer-human-computer interlocution [3], all of which have been and will continue to be driven by artificial intelligence sometimes capable of completely eradicating the need for human labour [4]. The understanding and interaction with such computerized agents require some awareness and first-hand experience with computer sciences at some professional rather than the amateur level. But almost half of the European labour force lack digital skills to properly navigate through digital environments [5], which is why VET instructors as well as VET students cannot be expected to suddenly have relevant digital competencies without relevant training [6].

Therefore, it is not surprising that one of the essential objectives of European education has been the development of digital skills consistent with some frameworks, such as the European e-Competence

Framework (henceforth - e-CF) [7] and DigCompEdu [8]. To set the direction, the EU has proposed the Digital Education Action Plan for the years 2021-2027 [9].

Any training should commence with establishing proper objectives, contexts and providing information. The function of informing VET instructors and VET providers on relevant digital competencies and their levels for specific courses and programs might be taken over by a specially designed digital platform containing blocks of VET courses and blocks of pertaining digital teaching and digital professional competencies. The design and functions of such a platform should be includable in the European digital ecosystem.

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1.2 Core competencies of DigCompEdu required by VET educators

Digitalization of VET education is impossible without the development of more advanced competencies of VET instructors. VET educators' digital skills co-create learning in digital contexts and enable the use of various types of technologies [1]. Yet, there is hardly any framework for the assessment of digital competencies of specifically VET educators pursuing teaching practices [1].

However, there is one digital competence framework for educators of all areas and levels that have been promoted by the European Commission – the Digital Competence for Educators Framework (DigCompEdu). This framework is considered to provide a common vision of digital competencies of educators across Europe [2]. It could be used as a foundation for assessing VET educators' digital competencies. Earlier, DigCompEdu was combined with VET features to yield a framework for the assessment of VET educators' digital competencies in Switzerland [1].

The DigCompEdu framework includes 22 competencies spread across 6 areas of educators' activities, such as professional engagement, empowering learners, supporting learners' digital competencies, teaching and learning, assessment, maintaining and developing digital study resources [3] (see Table 1).

Table 1. DigCompEdu competencies and area ([3], p. 8)

	AREAS					
	Professional engagement	Empowering learners	Facilitating learners' digital competences	Teaching and learning	Assessment	Digital resources
COMPETENCES	Organizational communication	Accessibility, inclusion	Information, media literacy	Self-regulated learning	Assessment strategies	Selecting
	Professional collaboration	Differentiation, personalization	Communication	Guidance	Analyzing evidence	Creating, modifying
	Digital Continuous Professional Development	Actively engaging learners	Content creation	Collaborative learning	Feedback, planning	Managing, protecting, sharing
	Reflective practice		Responsible use	Teaching		
			Problem-solving			

Each of these competencies could be further divided into sub-competences. However, to determine the general command of digital teaching competencies consistent with this framework, it might be sufficient to summarize them to produce one competence per area. This approach was thought to be productive for designing a digital platform matching course requirements and digital competencies of educators because more detailed identification of digital competencies of educators was to be conducted in another part of the survey that focused on professional digital competencies. The outcome is the list of the following digital teacher competencies based on DigCompEdu (see Table 2).

Table 2: List of digital teaching competencies created based on DigCompEdu competences

No.	DigCompEdu area	Competence
1	Professional engagement	• I use digital tools for creating engagement with learners and colleagues.
2	Empowering learners	• I use digital tools for facilitating students' independent learning.
3	Teaching and learning	
4	Facilitating learners' digital competences	• I use digital tools for managing psychological aspects of communication in training
5	Assessment	• I use digital tools for formative and summative assessment
6	Digital resources	• I use digital tools for creating, customizing and updating the contents of training courses. • I use digital tools for copyright and licensing.

The resulted list combine competencies of two areas – *Empowering Learners* and *Teaching and Learning* - into one competence because the ability to facilitate students' independent learning covers competencies from these two areas – personalization, active learning, promotion of self-guarded learning and teaching at the very least. The area of digital resources has been supplemented by the competencies of copyright and licensing because they are crucial for using, creating and distributing resources.

The DigCompEdu framework also contains levels, ranging from beginners (A1) to pioneers (C2) capable of modifying and creating resources and teaching experience, including games and apps, in a new and complex way. This level requires some knowledge of programming languages and computer system management to handle databases of resources, to create and maintain teaching webpages, etc. To be able to match competencies with the level, the platform proposes levels based on the compilation of proficiency levels of DigCompEdu (see Table 3).

Table 3: Competence levels I based on DigCompEdu

Level	DigCompEdu level	Explanation
A1	Newcomer	Beginners' level: no or hardly any digital competences
A2	Explorer	Elementary level: able to use some basic digital functions
B1	Integrator	Lower-intermediate level: able to integrate resources
B2	Expert	Upper-intermediate level: able to use resources effectively
C1	Leader	Advanced level: able to use resources effectively with some creativity
C2	Pioneer	High proficiency level: able to use and create resources creatively, yielding innovation

Because in some cases, VET teachers might not have any competencies at all, while in some other cases the beginners' and elementary levels are significantly different in a functional way, competence levels could be assessed via another level system, aligned to foreign language proficiency levels that are widely known in the European Union thanks to language portfolios and international English language exams (see Table 4).

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Table 4: Competence levels II
based on DigCompEdu

Level	Level specification
0	Lack of knowledge
A1-A2	Basic
B1	Pre-intermediate
B2	Intermediate
C1	Upper-intermediate
C2	Advanced (proficient)

As for the expected level of competence, it should be aligned with a specific course description. Generally, if the area of training of VET educators is considered, most of them might be expected not to have advanced levels, except for specializations that require the knowledge of computer systems. At the same time, most educators complete at least basic tasks using digital tools. Therefore, the general range of VET educators' digital skills is thought to be between A2 and B2. These levels of proficiency indicate that educators might experience significant challenges in their independent work with digital technologies and might not have sufficient knowledge for the creation of materials, particularly interactive materials, 3D environments, etc., outside of specified software, which might not always be available at all institutions of their practice. Such levels also point to their inability to be fully creative with passing their knowledge to students.

The lack of advanced competencies at present might not yet be considered too great of an impediment; however, the situation might change in the future. It is important to understand that the development of advanced competencies might be a longitudinal action. The lack of such competencies also contributes to the gaps in teacher-student connection [4] and students' lack of concentration after a certain class duration. The lack of advanced competencies of educators might negatively impact their students as they might not be able to learn more advanced skills and practice them across varied digital contexts, which might be required in real-life work contexts.

On such grounds, businesses often consider face-to-face instructions as more productive than online learning [5], which should not be the case at least in some areas of training. However, businesses are interested in mobile learning, which is a form of digital learning, because such learning is not constraint by a specific time and location and is thought to have a greater capacity to personalize training context [4]. The need to sustain learners' motivation and attention, to create and adapt materials, to comprehensively assess students' progress, and in fact to create digital training contexts translates into the need to assess gaps in educators' competencies so that both them and institutions have a clear understanding of training that might be needed. The development of proper digital competencies has been suggested as a task for teachers' further professional development [6]. Therefore, one task of the designed platform is to encode a learning model having the capacity to inform, identify and assess the digital teaching skills of VET educators and to suggest competence gaps and training.

VET educators need and will need various DigCompEdu skills depending on their areas of specialization and the regional context of the country in which they practice, which is why the DigCompEdu model can be

used for further development of the model at a later stage consistent with the demands of the education and labour markets.

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1.3 State-of-the-art digital competence assessment frameworks

Digital transformation of the European Union (EU) nations is one of the priorities of development in the EU. Reports of the World Economic Forum and OECD suggest that the demand for digital skills across various sectors of economies will be on the rise [1]. To inform educators, institutions and the public of digital competencies and their levels, there have been developed several European digital competence frameworks that are currently available on the market. The European Digital Competence Framework (DigComp) has emerged as a general competence framework for all residents of the European Union [2]. This framework contains 5 areas (information and data literacy, communication and collaboration, digital content creation, safety, problem-solving) and 21 competencies.[1]

The digital skills of teachers are also considered an important area of development because they are indispensable for long-life learning [3]. For example, the national teacher training curricula of Norway and Sweden include digital competencies [4]. To convey the importance of digital skills for educators and educational institutions, the European Commission has been supporting the development of teachers' digital competencies through various projects. For example, the MENTEP project (2015-2018), funded by the Erasmus+ program, resulted in the emergence of the Technology Enhanced Teaching Self-Assessment Tool, which performs not only the assessment function but also carries the informative and motivational functions [5]. Another example of the European Commission's support of the development of teachers' competencies is the Digital Competence Framework for Educators (DigCompEdu), comprising 22 competencies across 6 areas (see section 1.2. for more detail). This framework has emerged in response to the need to assess teachers' digital competencies because teachers have the task of conveying knowledge through digital platforms and teaching students to use these digital platforms for acquiring knowledge [2]. There are also other frameworks, such as e-Competence Management (e-CM), offered by AICA in Italy, which offers various sets of knowledge and skills not only for higher education but also for the workplace.[2]

Overall, the more advanced the teachers' digital skills are, the more advanced the students' digital skills might be, and the longer the experience of teachers' implementation of digital skills and the more diverse the range of the applied digital skills, the higher the level of such skills [2]. Consequently, it can be concluded that the sooner the VET educators obtain proper digital training, the more diverse this training is, the higher the level of competencies will be acquired by VET instructors. In the future, the demands for levels of educators' digital competencies are expected to increase [6]. On such grounds, some VET institutions have taken the initiative to promote the acquisition of digital skills among teachers. For example, the Academy

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[2] www.aicanet.it

for Teacher Training and Personnel Management in Germany has a specialized track on teacher digital skills.[3] The Estonian BCS Koolitus school also offers tracks for VET educators identifying skills gaps.[4]

As for the digital competence frameworks related to the workplace, one well-known European framework is the e-CF framework which provides competencies for professions specializing in Information Technology tasks. The framework consists of 41 competencies, provided with titles and descriptions, which are spread across 5 areas – PLAN, BUILD, RUN, ENABLE and MANAGE. The organization of competencies in areas is subject to the waterfall approach and agility framework of the type Agile/ DevOps lifecycles. Importantly, the framework provides proficiency levels, ranging from basic to advanced, which cover issues such as context complexity, autonomy, influence and typical behaviour. This framework is used by various bodies, including the Italian Association of ICT Professionals to evaluate the digital competencies of assessed individuals and to admit new members to their community.[5] The e-CF framework competencies can be assessed by ICT-mastery.eu, which offers competence matching services based on the e-CF analysis of competencies based on candidates' profiles, CVs, course materials and curricula.[6] APMG Group International, accredited by the United Kingdom Accreditation Service (UKAS) and having the headquarters in the UK, also offers certification of various digital competencies and offers alignment of qualifications to e-CF competencies.[7]

To stimulate the transition to digital environments, not only do the markets develop competence frameworks, but they also encourage the emergence of new professions, whose competencies need to be assessed, too. One example of such a relatively new profession is the digital transformation officer. EXIN, an international company with headquarters in the Netherlands, has already developed a system of certifying digital transformation officers across various areas, such as artificial intelligence, blockchain, cloud computing and agile business, to ensure their international recognition.[8]

To conclude, the development of various digital competence frameworks for both education and work points to the necessity to inform teachers, students, educational institutions and employers about digital skills required in specified areas of employment as well as attempts to create standardized approaches to competence encoding and assessment.

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2. DESIGN ASSESSMENT TOOL FOR DIGITAL SKILLS

2.1 Identification of required digital competencies for the VET model

The construction of the VET model for digital contexts requires the expertise of VET instructors and course descriptions to identify digital teaching and digital professional competencies that VET educators should have to productively provide training in a specified area. The digital teaching competencies were discussed in section 1-1 of this report. As for digital professional competencies, it is important to identify relevant VET areas. This approach is consistent with the models of Technological Pedagogical Content Knowledge (TPACK) and Will Skill Tool Pedagogy which converge on the need to combine teaching methods, style and processes, use of technology, content area expertise and readiness to use all of that knowledge into one framework of educators' competences [1].

While the pedagogical component of the teaching competencies could be developed based on DigCompEdu, the content area expertise requires a focus on specific areas of selected sectors. The areas of content knowledge for this project were selected under the umbrella of green economies because the development of green economies has been set as a priority by the European Union [2], [3]. Green Economies are driven by the workforce with general green competencies and specific green competencies. General green skills are the skills that should be possessed by workers who do not necessarily work in green sectors or do green jobs. Instead, these are the skills that all workers should have to contribute to green economies [4], such as the ability to use digital products to reduce pollution. In contrast, specific green competencies characterize professions and jobs that create green or greener products and services [5], such as the generation of renewable energy or recycling of materials. Because this project aims to develop a digital platform for shifting VET education online, both general greening and specific green competencies are tailored for digital learning, thus, becoming general digital green and specific digital green competencies.

The foundation of general digital greening competencies was laid by e-CF standards. E-CF is a product developed specifically for businesses to boost their transition to digital processes, such as customer service, management of resources, planning of operations. These competencies create a circular economy. Europe emphasizes the importance of greening of professions due to the lack of green professions in Europe and the need to transit to greener economies [5]. As for specific digital green competencies, they lack a unified framework. Specific areas require their unique set of competencies, which is why this project has focused on a selection of specific digital green competencies.

The starting point of the project is the identification of competence needs of specific professions, areas and institutions, which were selected based on course descriptions for specific professions. General digital greening competencies were extracted from course descriptions of a circular economy by using the discourse analysis method of hits and concordances, which was conducted using the software AntConc.

The competencies, extracted from the above-mentioned course descriptions, were then grouped in several areas based on their key features (see Table 5).

Table 5: Area and competences of general digital greening competences

Areas	Competences
Data collection and use	Able to use digital tools for: • data collection, analysis (incl. visualization) and data flow management; • decision-making; • producing forecasts; • modelling, optimization, simulation and visualization; • visual design; • data protection.
Workflow management for efficiency and transparency	Able to use digital tools for effective work/business management: • creation of a business strategy; • work-flow; • tracking of activities, report, processing; • planning, monitoring and measuring performance. Able to use digital tools for: • producing and using quality management systems; • risk management; • document creation and management.
Communication	Able to use digital tools for: • customer service; • communication with colleagues and partners.
Financial and legal aspects	Able to use digital tools for: • accounting; • procurement; • selecting and analyzing green legislation
Research and development	Able to use digital tools for: • the development of green products, services and processes; • problem-solving of green problems and solving problems in a green way; • research and self-development for professional purposes, such as market research, etc. • lab work.

The obtained areas were then compared to e-CF competencies, which contain 40 competencies grouped in 5 areas (see e-CF 3.0), such as planning, building, running, enabling, managing products, services and processes, to align them to e-CF standard to the degree possible. The alignment of competencies across areas based on some features of competencies, constituting these areas, is provided in Table 6.

Table 6: Alignment of e-CF areas with the areas of general digital greening competences

e-CF areas	Areas of general digital greening competences
Planning	Data collection and use
Building	Research and development
Running	Workflow management for efficiency and transparency
Enabling	Financial and legal aspects
Management	Communication

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As for specific digital green competencies, they were obtained by applying the same method to the analysis of course descriptions on resource and water management, recycling, farming, agriculture, transport, energy production and manufacturing (see Table 7).

Table 7: Area and competences of general digital green competences

Areas	Competences
Agriculture/farming management	Able to use digital tools for: • identification and assessment of organic agriculture/farming and replacement of non-organic agriculture/farming with organic; • smart agriculture/farming for sustainability; • hydroponic and vertical farming; • green breeding; • microbiology; • food hygiene; • management and assessment of geographic information.
Supply chain and transport	Able to use digital tools for: • supply chain management • traceability of sources of supplies; • keeping a transport diary; • green traffic management, incl. drones; • green vehicle management.
Manufacturing	Able to use digital tools for: • modelling, optimization and simulation of manufacturing processes; • transition to green systems, their management, assessment; • green operating and management of engines, equipment; • providing relevant technical support and maintenance for green issues; • ensuring compliance with green requirements and safety regulations.
Energy production and management	Able to use digital tools for: • renewable energy production, supply and use; • energy production biomasses; • management and monitoring of wind turbines; • management and monitoring of solar systems; • management and monitoring of wave exploitation; • management of energy at hydropower stations.
Reducing pollution and negative effects of climate change	Able to use digital tools for: • reducing emissions from waste and other products; • reducing pollution from agricultural/farming activities; • water cleaning; • air cleaning; • transition to practice reducing negative effects of climate change in manufacturing; • modelling and forecasting of climate and weather change

Areas	Sub-areas	Competences
Use of resources	Water management	Able to use digital tools for: • green water resource management in agriculture/farming; • classification, management, treatment and cleaning of wastewater.
	Waste management	Able to use digital tools for:

		• classification, management (incl. recycling), use and assessment of non-hazardous waste; • management and treatment of special industrial waste.
	Management of recycled materials	Able to use digital tools for: • recovery and use of recycled materials; • recovery chain and production of secondary raw materials; • management of recycling facilities.
	Management of integrated resources	Able to use digital tools for: • integrated use of renewable resources (energy, water, materials, etc.); • management and use of green materials and resource flows in engineering/construction; • integrated use of non-renewable resources for greening purposes.
	Land and soil management	Able to use digital tools for: • green turf cultivation; • green soil/land fertility and management; • reducing land degradation and use of chemicals; • green crop growth and harvest management; • green nutrient management; • preservation of rural territories; • green land use; • green management of invasive exotic species.

Based on the proposed general digital green and specific digital green competencies, there was designed a questionnaire for VET educators comprising the above-mentioned competences and digital teaching competencies. Each competence-related question was presented in the form of a statement that respondents were expected to match with their level of expertise, which was outlined in section 1.2 on digital teaching skills. The created questionnaire was then reduced to cater for the needs of specific courses.

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

The VET competence model to be created must be useable for the development of software. The first step in the creation of such a model was the visualisation of the interaction of participants and components of competencies that select, provide, assess and inform on competencies. The outcome of this visualization is the Use Case Diagram of the VOOC Platform (see Fig.1)

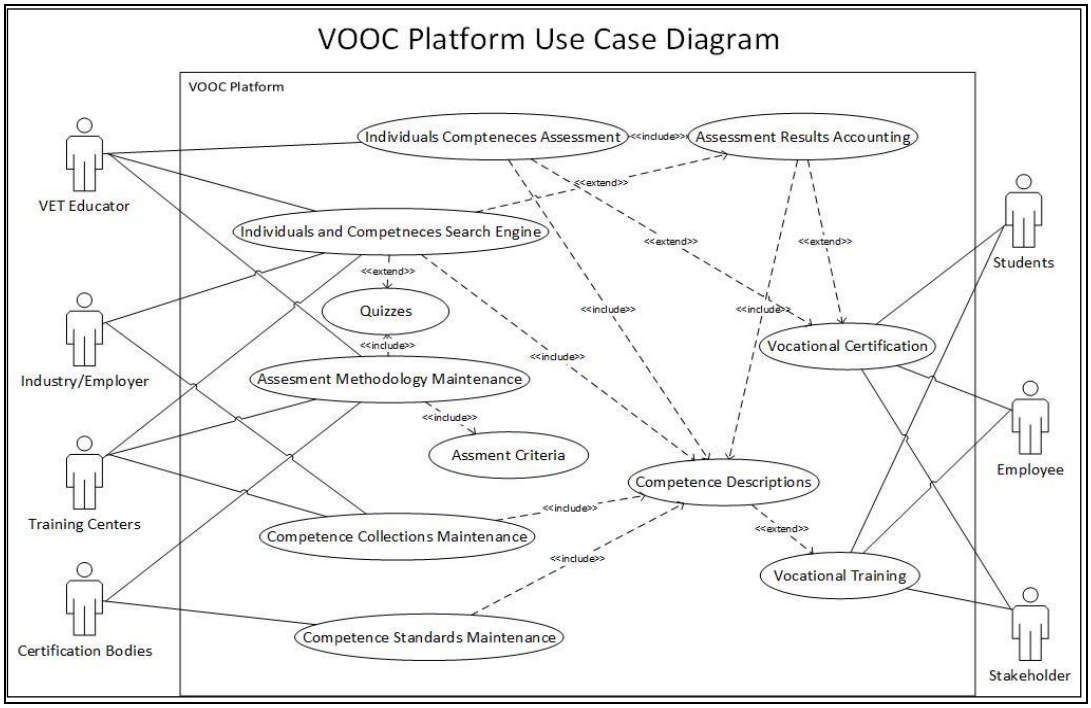

Fig.1. VOOC Platform Use Case Diagram [1]

As it is evident from this diagram, the users, engaged in the process, form a diverse group of participants that are represented at the individual (student, employee, etc.) and collective levels (e.g. certification bodies, training centres, etc.). All of them participate in the process via different paths and therefore access different blocks via direct routes. However, all of these routes lead to all necessary components depending on the requirements of users.

Since the model was developed following the framework set out in the iSECRET project (2015-2017) [2], it requires a definition of competence, because without it the selection and creation of competencies might be inadequate or too diverse for the model to select and generate competences in a more or less unified manner comparable across national borders. Considering the cross-national feature of the model, it was important to adopt the definition that might be followed or considered by different nations. One such

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definition comes from the European document "CC2020" [3], which proposes to view competencies in the following manner:

Competency = [Knowledge + Skills + Dispositions] in the context of a task

In this formula, *Knowledge* refers to the comprehension of concepts, which can be abridged to the concept of "knowing-what". The concept of *Skills* encompasses the ability to acquire practical knowledge of doing something through time, practice and interaction with others and therefore it can be referred to as the dimension of “knowing-how”. *Dispositions* are formed by socioemotional skills, behaviour and attitudes to completion of assignments through the prism of time, which is why *Dispositions* tap into the concept of “knowing-why”. As for the *Task* element, it is introduced to constrain the application of the previous three components to a specified context, which aligns the entire formula of competencies to real-life work demands.

It is important to understand that knowledge, skills and dispositions should be selected, measured, assessed within one information space; otherwise their comparison and identification of gaps might be flawed. This common information space might be encoded through the notion of competencies, the accumulation of which creates the collective concept of competency.

The concept of competence was specifically defined for VET instructors, and it is quite similar to the above definition. Competencies are viewed as skills allowing to utilize and manage situational tasks consistent with the set objectives and available resources [4].

Considering the tasks of the given model, which need to cover VET educators' digital teaching, general digital greening and specific digital green competencies, all competencies have been grouped into three blocks consistent with their features and functions and considering existing digital competence models (see Table 8).

Table 8: Competence blocks of the model and their sources

Blocks of competencies of the designed model	Sources of competences
Digital teaching competences	DigCompEdu
General digital greening competences	e-CF
Specific digital green competences	Professional green digital competencies specified for concrete professions

Visually, the connections among competency components, selected for this VET model, are represented in Figure 2.

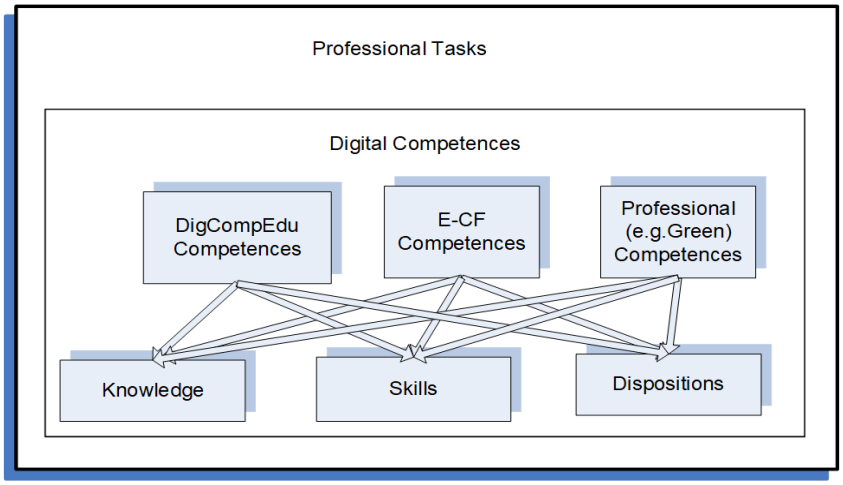

Fig. 2. Suggested competence structure model [1]

The key focus of the VET model is on the identification of digital greening and digital green skills. Digital teaching skills are viewed as complementary because VET instructors have teaching competencies, whose usage might be flawed in case of insufficient digital competencies. If instructors have appropriate digital competencies in the other two areas, they are considered to have appropriate digital skills to apply to teaching challenges.

Since general greening and specific green competencies might be very different for various sectors of the economy and consequently professions, it was thought hardly possible to construct one unified model filled with specific competencies for all sectors of the economy. Therefore, the model concentrates on specific professions in specific sectors of the economy. To identify specific competencies for the model, VET course descriptions were analysed for the extraction of such competencies. These competencies were then included in a survey distributed to VET educators across four European nations – Greece, Italy, Bulgaria and Slovenia. Since green competencies were the key focus, teaching competencies were superficially represented in the survey.

References

[1] B. Misnevs, I. Kabashkin and K. Uzule, "A Model Describing the Required Digital and Green Competences of VET Educators for Practical Use", Proceedings to the 6th South-East Europe Design Automation, Computer Engineering, Computer Networks and Social Media Conference of IEEE Computational Intelligence Society, 2021.

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

[3] 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, accessed on 4 July 2021.
[4] A. A.P. Cattaneo, C. Antonietti, and M. Rauseo, "How digitalised are vocational teachers? Assessing digital competence in vocational education and looking at its underlying factors." Computers & Education, vol. 176, 2022.

3. IMPLEMENTATION OF ASSESSMENT PROCEDURE

3.1 Survey aim

The survey aimed to develop a new methodology for creating, identifying and self-assessing general greening digital competencies and specific green digital competencies of VET instructors.

The following needs justified the aim:

- creation of general greening digital and specific green digital competencies for VET instructors;
- identification of greening and green digital competencies that VET instructors need for teaching in VET areas;
- identification of the readiness of VET instructors to teach in remote education contexts;
- identification of gaps in green and digital skills of VET instructors for further professional development;
- informing VET instructors and institutions about greening and green digital competencies for VET;
- recruitment of properly qualified VET instructors;
- assessment of VET instructors' professional and teaching competencies;
- development of new courses on circular economy and specific green topics;
- development of students' greening and green digital competencies through the spreading activation processes "from-teaching-to-student", etc.

3.2 Roles of institutions in the design and administration of the survey

The survey resulted from the collaboration of five European educational institutions. To represent the European scale of responses, a set of countries, represented by specific institutions, created and administered the survey. Their roles are outlined in Table 9.

Table 9: Participation of institutions in the survey development

Country	Institution	Common responsibilities	Institution-specific responsibilities
Latvia	Transport and Telecommunication Institute (TTI)	Development of the master copy of the survey	• Implementation of review comments • Creation of nation-specific surveys from the survey master-copy • Translation of the surveys into Latvian • Writing the overall report on the survey, including national reports in appendices
Greece	University of Ioannina	• Review of the master copy of the survey • Analysis of the survey data and writing the national report on the analysed data	• Identification of survey questions to be included in the Greek version of the survey • Translation of the surveys into Greek • Administration of the selected surveys to VET instructors in Greece
Italy	Sistemi Formativi Confindustria		• Identification of survey questions to be included in the Greek version of the survey • Translation of the surveys into Italian • Administration of the selected surveys to VET instructors in Italy
Bulgaria	Cleantech Bulgaria		• Identification of survey questions to be included in the Greek version of the survey • Translation of the surveys into Bulgarian • Administration of the selected surveys to VET instructors in Bulgaria

Slovenia	Styrian Technology Park		• Identification of survey questions to be included in the Greek version of the survey • Translation of the surveys into Slovenian • Administration of the selected surveys to VET instructors in Slovenia

3.3 Survey design

To construct the survey, it was important to determine the sets of competencies to be assessed. There are no universal competence frameworks for greening digital and green digital competencies, similar to DigComp, e-CF or DigCompEdu. Therefore, to obtain such competence sets, VET course descriptions were analysed to identify general greening digital competences and specific green digital competencies. The list of the analysed course descriptions is available in Table 10.

Table 10. Course descriptions by country

Country	Institution	Courses
Italy	Higher Technical Institute "Territory Energy Building Foundation"	Energy Supply
		Waste Management
	High Technician Institute “Ignazio Calvi”	Agri-Food Systems
Slovenia	University of Maribor	Ecology Problems of Vehicle and Internal Combustion Engines
		Sensible Use of Energy
		Technological and Waste Waters
	University of Nova Gorica	Environment and Agriculture
		Environmental Impact Assessment
		Land Ecosystems
		Environmentally Friendly Technologies
	Environment Protection College	Waste Management
		Rational Energy Use
		Development of Sustainable Products, Services and Processes
		Waste Water Treatment
Bulgaria	Cleantech Bulgaria	Waste Management in the Construction Industry
		The transition towards Circular Economy as a New Business Opportunity
Greece	University of Ioannina	Not applicable
Latvia	Transport and Telecommunication Institute	

The course descriptions were collected into one corpus and were then analysed using the AntConc software. The analysis focused on keywords and keyword concordances. The criteria for the selection of keywords included the lexical and conceptual pertinence of course description concepts to digital, green and greening skills, skills for sustainable operations, environment-oriented operations, rational use, recycling, management and treatment of resources and waste as well as repeated use of concepts.

Almost all course descriptions contained skills, knowledge and competencies that could be applied to any course and any profession, on the one hand. On the other hand, these courses were specific to a given course and profession. The former courses laid the foundation for competencies labelled as *general greening digital competencies*, whereas the latter courses provided the information on *specific green digital competencies*. These different types of competencies were introduced into two separate sections of the survey – Sections 4 and 5, respectively, bearing identical labels. Section 4 "General Greening Digital Competences" was partly consistent with the European framework "Digital Competences" (DigComp), which was designed for commercial applications. The survey contained also other sections. Section 1 provided general information on the survey, such as the survey goal and data processing information. Section 2 collected general information on participants, such as their work experience and country of teaching. Section 3 focused on obtaining general information on teaching competencies. This section was designed by integrating general provisions of the European framework "Digital Competencies for Educators" (DigCompEdu) and the obtained course descriptions. These sections were referred to as blocks. The summary of the survey blocks is provided in Table 11.

Table 11. Survey blocks

Block #	Block title	Block areas	Number of questions
Section 1	General information about the survey	• Survey goal • Data privacy statement	0
Section 2	General questions about you	• Work experience	4
Section 3	Teaching digital competences	• Designing the teaching content • Creating engagement with students and colleagues • Facilitating students' independent learning • Communication • Assessment • Copyright and licensing	7
Section 4	General digital greening competencies for sustainability	• Data collection and use • Workflow management for efficiency and transparency • Communication • Financial and legal aspects • Research and development	20
Section 5	Specific digital green competences	• Overall agriculture management • Supply chain and transport, including drones • Manufacturing • Energy production and management • Reducing pollution and negative effects of climate change	49

		• Use of resources (water management, waste management, management of integrated resources, management of recycled materials, land and soil management)	

Competences were encoded in self-assessed statements, similar to the design of the DigCompEdu survey. Answers were collected via the multiple-choice or Linkert scale questions. Earlier, the Linkert scale was used in a study assessing digital competencies of Swiss VET teachers [1]. In this study, the Linkert scale questions ranged from 1 to 5 and 0 to 6 and were aligned with the level of competencies (see Table 12).

Table 12: Range competence levels

Range of competence levels	
1 - lack of knowledge 2 - basic (A1-A2) 3 - pre-intermediate (B1) 4 - intermediate (B2) 5 - upper intermediate (C1) 6 - advanced (proficient) (C2)	0 – lack of knowledge 1 – basic (A1) 2 - elementary (A2) 3 - pre-intermediate (B1) 4 - intermediate (B2) 5 - upper intermediate (C1) 6 - advanced (proficient) (C2)

The full survey is provided in Table 13.

Table 13: Survey block, areas and questions[9]

Block	Block specialization	Area	Sub-area	Question No.	Statement
1	General questions about you			G10	What is your work position?
				G20	What level of International Standard Classification of Education (ISCED-2011) do you teach at / work in?
				G30	What is your status of employment in VET?
				G40	Years of employment in VET
2	Teaching digital competences			T10	What is your level of digital teaching competence? (A1 - beginners, whereas C2 - professionals capable of yielding innovations) (the level name is taken from DigCompEdu
				T20	I use digital tools for creating, customizing and updating the contents of training courses, incl. presentations
				T30	I use digital tools for creating engagement with learners and colleagues
				T40	I use digital tools for facilitating students' independent learning
				T50	I use digital tools for managing psychological aspects of communication in training
				T60	I use digital tools for formative and summative assessment
				T70	I use digital tools for copyright and licensing
3	General digital greening competences	1. Data collection and use		GDGC10	I use digital tools for data collection, analysis (incl. visualization) and data flow management
				GDGC20	I use digital tools for decision-making (analyzing the situation, ranking of options, selection of most optimal options, synthesizing solutions etc.)
				GDGC30	I use digital tools for producing forecasts
				GDGC40	I use digital tools for modelling, optimization, simulation and visualization of processes, products and services
				GDGC50	I use digital tools for visual design
				GDGC60	I use digital tools for data protection
		2. Workflow management for efficiency and transparency		GDGC70	I use digital tools for effective work/business management (creation of a business strategy, workflow, tracking of activities, reports, processes, planning, monitoring and measuring of performance etc.)
				GDGC80	I use digital tools for producing and using integrated quality management systems (quality measuring and quality assurance, assessment of performance and processes, customizing options and solutions, designing and mapping of processes, etc.)
				GDGC90	I use digital tools for risk management (analyzing various degrees of risks of decisions, distributing risks between options, suppliers, etc., making business more visible and stable, etc.)
				GDGC100	I use digital tools for document creation and management (preparation, updating, managing, etc.)

[9] The different colours, used in the table, signal a new block of competencies.

		3. Communication		GDGC110	I use digital tools for acquiring, engaging and sustaining customers (creating and maintaining e-billing, customer self-service, customization of offers, increasing transparency of operations, boosting sales, etc.)
				GDGC120	I use digital tools for effective communication with colleagues and partners (collaborative work, transparent and effective oral and written communication, incl. professional presentations, road-maps, timely obtained data for decision-making, dashboards for workflow automation, etc.)
		4. Financial and legal aspects		GDGC130	I use digital tools for accounting.
				GDGC140	I use digital tools for procurement
				GDGC150	I use digital tools for relevant (green) legislation analysis and reviews.
		5. Research and development		GDGC160	I use digital tools for greener product development, flawless maintenance – use - monitoring, management (e.g. creation of products and their components (including machinery, energy-saving devices, etc.) and their design, branding, labelling (incl. RQ code), online marketing and positioning)
				GDGC170	I use digital tools for greener service development, flawless maintenance – use - monitoring, management, branding, online marketing and positioning
				GDGC180	I use digital tools for (technical/green) problem-solving.
				GDGC190	I use digital tools for research and self-development for different professional purposes, incl. production technologies, market research
				GDGC200	I use digital tools for lab work
4	Specific digital green competences	1. Overall agriculture management		SDGC10	I use digital tools for identification and assessment of organic agriculture/farming and replacement of non-organic agriculture /farming with organic agriculture/farming
				SDGC20	I use digital tools for smart agriculture/farming and sustainability, incl. remote sensing/sensors and data analysis for precision agriculture /livestock modelling
				SDGC30	I use digital tools for hydroponic and vertical farming
				SDGC40	I use digital tools for green/sustainable breeding techniques
				SDGC50	I use digital tools for microbiology and food hygiene
				SDGC60	I use digital tools for identification and assessment of organic agriculture/farming and replacement of non-organic agriculture /farming with organic agriculture/farming
				SDGC70	I use digital tools for geographical information management and assessment

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		2. Supply chain and transport (incl. drones)		SDGC80	I use digital tools for supply-chain management and traceability of the source of products and supply
				SDGC90	I use digital tools for the creation, keeping and updating of a transport diary
				SDGC100	I use digital tools for unmanned aerial vehicle (drone) applications in the agriculture
				SDGC110	I use digital tools for green traffic management
				SDGC120	I use digital tools for green optimization of operating modes in real operating conditions of vehicles
		3. Manufacturing		SDGC130	I use digital tools for modelling, optimization, simulation of manufacturing (machines, devices, products), service facilities
				SDGC140	I use digital tools for transition to green (eco)systems and their management and assessment
				SDGC150	I use digital tools for green optimization of operating modes in real operating conditions of engines
				SDGC160	I use digital tools for providing relevant technical support and maintenance for green issues
				SDGC170	I use digital tools for compliance with green requirements, safety regulations, etc.
		4. Energy production and management		SDGC180	I use digital tools for the overall green (renewable) energy supply, production (incl. recovery from waste), use and management in agriculture/farming/infrastructure maintenance (circular economy)
				SDGC190	I use digital tools for energy production from biomass
				SDGC200	I use digital tools for managing and monitoring wind turbines
				SDGC210	I use digital tools for managing and monitoring solar systems
				SDGC220	I use digital tools for managing and monitoring wave exploitation
				SDGC230	I use digital tools for managing and monitoring any other specific type of renewable energy
				SDGC240	I use digital tools for managing energy at hydropower stations
		5. Reducing pollution and negative effects of climate change		SDGC250	I use digital tools for reducing emissions from waste
				SDGC260	I use digital tools for reducing environmental pollution produced by agricultural/farming activities
				SDGC270	I use digital tools for water cleaning
				SDGC280	I use digital tools for air cleaning
				SDGC290	I use digital tools for transition to practices reducing negative effects of climate change in production
				SDGC300	I use digital tools for modelling and forecasting climate and weather change

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		6. Use of resources	6.1. Water management	SDGC310	I use digital tools for green water resource management in agriculture: obtaining water, irrigation, drainage, defence, water use control and management
				SDGC320	I use digital tools for characterizing, classifying, identifying, treating and cleaning (by various methods, e.g. physical, physicochemical and biological traits) wastewater and for managing wastewater
			6.2. Waste management	SDGC330	I use digital tools for waste classification, sorting and non-hazardous waste use, assessment, management (incl. of waste cycles), reuse/recycling/recovery/treatment, reducing waste, green disposal, prevention / minimizing of waste accumulation (circular economy)
				SDGC340	I use digital robotics for waste sorting and non-hazardous waste use, recycling, recovery, treatment, reducing waste, green disposal, prevention / minimizing of waste accumulation (circular economy)
				SDGC350	I use digital tools for special industrial waste treatment and management (e.g. chemical-physical treatment of liquid waste and wastewater)
			6.3. Management of integrated resources	SDGC360	I use digital tools for the integrated use of renewable resources (energy, water, materials, etc.)
				SDGC370	I use digital tools for using and managing green material/resource flows in engineering
				SDGC380	I use digital tools for managing green material/resource flows in the construction
				SDGC390	I use digital tools for the integrated use of non-renewable resources (energy, water, materials, etc.) for greening purposes
			6.4. Management of recycled materials	SDGC400	I use digital tools for recovery chain and production of secondary/recycled raw materials and recycling from the waste
				SDGC410	I use digital tools for material recycling, incl. recycles construction materials
				SDGC420	I use digital tools for the management of recycling facilities
			6.5. Land and soil management	SDGC430	I use digital tools for green turf cultivation techniques
				SDGC440	I use digital tools for green/sustainable soil fertility/land management (incl. land classification), reducing land degradation, soil erosion, managing pesticide residues, using nitrates and phosphates
				SDGC450	I use digital tools for green crop growth, protection, harvesting and management, incl. crop tracking
				SDGC460	I use digital tools for identification and assessment of nutritional and ecological product footprint
				SDGC470	I use digital tools for nutrient management
				SDGC480	I use digital tools for the preservation and enhancement of rural territory use and management
				SDGC490	I use digital tools for effective/green land use for the management of invasive exotic species

Since some questions of the survey were irrelevant to the needs of some institutions and courses, each participant selected a set of questions for their unique course requirements. This resulted in shorter questionnaires. Each questionnaire, tailored for the needs of specific institutions, contained all information and questions from Sections 1-3. The sections that were trimmed were Sections 4 and 5. Trimming was conducted based on the comments of the institutions for which the questionnaires were created. The resulted questionnaires were translated into local languages – Greek, Italian, Slovenian and Bulgarian, whereas the master copy was translated into Latvian and is presented in English in Table 4 above. More information on country-specific questionnaires and their results are available in country-specific appendices.

Reference

[1] A. A.P. Cattaneo, C. Antonietti, and M. Rauseo, “How digitalised are vocational teachers? Assessing digital competence in vocational education and looking at its underlying factors.” Computers & Education, vol. 176, 2022.

3.4 Determining the boundaries of the test group

The criteria for the selection of test groups were determined by the institutions distributing the survey. They were the participants of the project. Details on the criteria for the selection of participants for test groups are available in national reports, included in appendices. However, the general requirements included the following key parameters:

- teaching experience in VET education;
- teaching courses on circular economies, sustainability, agriculture, farming, management of resources, land, waste and energy production and management.

National teams, other than the Latvian one, provide VET courses requiring general greening digital (e.g. courses on the circular economy) and specific green digital competencies (e.g. courses on land management and land ecosystems), which is why they were able to distribute the survey among different VET instructors, including those working at their institutions.

Table 14 summarizes the number of survey respondents by country.

Table 14: Respondents' number by country

Country	Number of the survey respondents
Greece	48
Italy	22
Bulgaria	27
Slovenia	22
Latvia	6
Total number of respondents	125

As Table 14 demonstrates, the number of VET survey respondents by country was about 30 individuals. The actual number of respondents per questionnaire was lower than 30 as most countries had at least two customized surveys completed by their respondents.

The purpose of the questionnaire was not to collect data on particular greening or green digital competencies of VET instructors and the prevailing or required level of competencies in the specified countries or across a set of European countries. Instead, the survey focused on verification of the survey reliability and validity. Therefore, the number of respondents exceeding 100 participants was considered appropriate.

3.5 Formation of criteria and instructions for conducting a survey

Similar to any survey, this one has a purpose. Therefore, the criteria for conducting the survey derive from the survey purpose, which is the identification and self-assessment of general greening digital and specific green digital competencies of VET instructors. The list of such criteria is provided below:

- the need to enhance existing VET courses;
- the need to develop new existing VET courses;
- the need to assess acting VET instructors' competencies to deliver specified VET courses;
- the need to assess the qualifications of new VET instructors during recruitment;
- the need to identify competence gaps of VET instructors for further professional development and teaching;
- the need to boost VET institutions' competitiveness;
- the need to align the needs of the workplace, market and VET students;
- the need to train professionals capable of completing greening and green tasks at the workplace;
- the need to align VET education standards and practices to the specified competencies across the European Union.

Once VET institutions and VET instructors decide to identify and assess the specified digital competencies and possibly their lack, they should:

- tailor the master copy of the survey for their needs by selecting only the questions they need or by expanding the selected sections or questions;
- determine the preferred levels for each competence and the overall level of competencies.

3.6 Collecting and storing survey data

The survey was created in Google Forms on the Google drive of the INGENIOUS project. The survey respondents were asked to choose the most appropriate answer, referring to their personal professional experience and expertise, either in multiple-answer questions or via the Linkert scale (see Section 1-3.3 for more detail on the survey design).

The survey data was collected anonymously from November to December 2021. The participants were informed that the survey was anonymous and the data was used only for research purposes within the framework of the Erasmus+ INGENIOUS project.

The data has been stored on the Google drive of the INGENIOUS project.

4. EVALUATION OF ASSESSMENT PROCEDURES' FEEDBACK

4.1 Calculation of quantitative data and analysis of the information received

Calculation of quantitative data and analysis of the information received was performed by partners using the following information structure:

1. General information.
2. Digital Teaching Competencies.
3. General Digital Greening Competencies (GDGC) for sustainability.

All information obtained as a result of the conducted Survey 2 was placed in a Google Drive cloud storage. Copies of quantitative data sets were saved in Excel (.xls) files on local partners' servers.

As mentioned earlier, the need to conduct research was justified by a division of professional activities into 5 areas, which differed in the content of competencies. Therefore, the collection of information and its analysis in the national reports was carried out with a division into 5 areas. Specific study areas were pre-selected by partners at the stage of developing a methodology, considering the specialization of national VET teachers.

The following professional areas were studied during IO1:

1. Agriculture/farming management
2. Supply chain and transport
3. Manufacturing
4. Energy production and management
5. Reducing pollution and negative effects of climate change

At the first stage of the project (IO1), this information was mainly used to identify the level of proficiency in digital competencies of VET teachers via self-reports and to assess the suitability and validity of the proposed methodology and the developed survey for solving the tasks set in the project.

A detailed analysis of the obtained quantitative data is presented in the national reports of partners, which are annexed to this report in separate files.

4.2 Expansion of Survey 1: Proposals for Survey 2

In the process of validation of the developed methodology and in an attempt to create a follow-up of Survey 1, which could be viewed as an expansion of Survey 1, there were made proposals for Survey 2, some of which were accepted and subsequently introduced.

Survey 2 is suggested to aim at deeper testing of digital teaching competencies consistent with DigCompEdu as Survey 1 contains only 7 questions of this type. The limited number of such questions was due to the focus of the survey on digital greening and digital green competencies. The format of questions is suggested to encompass not only multiple-choice options but also open-ended questions when respondents are asked to provide their answers.

SUGGESTIONS

Some questions of Survey 1 are suggested to allow for multiple answers.

Question (Q) 1.

Question G1 could be complemented by the additional option of response - adjunct (it is important to add the adjuncts position because often it does not lead to full-time or permanent employment and does not provide sufficient income, which is why adjuncts might perceive their employment as either a temporary career path or financial reinforcement. Therefore, the degree of investment of resources (e.g. allocated time, level of preparation to classes) into such employment might be significantly lower. This question would help to clarify if VET employment for at least some VET instructors is a Gig job or a traditional form of employment.

Q2.

G2. At what level of International Standard Classification of Education (ISCED-11) do you teach? *

- [ ] 1. Primary education
- [ ] 2. Lower secondary education
- [ ] 3. Upper secondary education
- [ ] 4. Post-secondary non-tertiary education
- [ ] 5. Short-cycle tertiary education
- [ ] 6. Bachelor's or equivalent level
- [ ] 7. Master's or equivalent level
- [ ] 8. Doctoral or equivalent level

It is suggested to introduced another question or options into Q2 - permanent vs. contract-based employment, full-time vs. part-time employment. Having such options is important because the status and the prospects of continuous employment or their lack might negatively impact the communication and collaboration with colleagues or students, their wish to invest resources into more advanced digital self-training and into the utilization of more advanced digital resources for teaching, which consequently afflicts the teaching outcomes.

The following set of questions is taken from DigCompEdu (Q3 – Q18).

Q3. It is suggested to include a question on specifics of collaboration and creation of materials. The following question was included in the first version of Survey 1, which was later excluded due to the focus of Survey 1 on greening and green competencies.

1.2. I use digital technologies to work together with colleagues inside and outside my educational organisation *

- ◯ I rarely have the opportunity to collaborate with other lecturers
- ◯ Sometimes I exchange materials with colleagues, e.g. via e-mail
- ◯ Among colleagues, we work together in collaborative environments or use shared drives
- ◯ I exchange ideas and materials, also with professionals outside my organisation, e.g. in an online professional network
- ◯ I jointly create materials with other lecturers in an online network

This suggested multiple-choice answers might be viewed as insufficiently specific. The first issue pertains to the necessity to clarify the context of the question – does it pertain to digital competencies or the context of academic activities? One can create materials in the e-learning environment Moodle, but the context of work does not create the grounds for co-creating teaching aids together with other lecturers. Another issue refers to the suggested answer - **sometimes I exchange materials with colleagues, e.g. via e-mail.** Nowadays the majority of teachers use e-mails to exchange communication messages and materials, which is why it might be possible that the only instance when e-mail communication does not take place is when a VET institution does not create such a context, which is why the question seems to focus more on the organization of the teaching environment rather than teachers' competences. Thus, it is suggested to remove the e-mail option and introduce more advanced solutions, e.g. capacities of Moodle, google docs. Yet another option - **among colleagues, we work together in a collaborative environment** – might also be regarded as ambiguous and the validity of the question and answers are questionable, therefore. The first concern is, does the question tap into a collaborative digital environment (and therefore the teachers' ability to co-create collaborative digital environment) or collaborative environment at work in general, which is facilitated by using some digital primary skills, such as e-mail? Another concern is, if this is the question about general collaboration at the workplace, then, the level of such collaboration is going to be lower for part-time temporary adjunct positions signed only for the duration of one specific course (at least under some circumstances).

Q4.

1.3. I actively develop my digital teaching skills *

- ◯ I rarely have the time to work on my digital teaching skills
- ◯ I improve my skills through reflection and experimentation
- ◯ I use a range of resources to develop my digital teaching skills
- ◯ I discuss with peers how to use digital technologies to innovate and improve educational practice.
- ◯ I help colleagues in developing their digital teaching strategies

One concern that this question might raise is whether the intention of this question (multiple-answers) is to record respondents' abilities to use digital resources and digital skills, in which case the statements should be modified to include the modal concept of "can", or whether it focuses on the work environment,

status and promotion of respondents at their workplace. For example, an instructor might be able to help colleagues to develop their digital skills if his/her VET institution has made the decision to organize training for his/her colleagues led by this specific instructor.

Q5. Another concern related to the previous question is that it shifts the responsibility for acquiring proper digital competencies away from VET institutions and to VET instructors. As it was mentioned in the theoretical part of this report, the development of more advanced digital skills requires resources (including financial means and time) and proper training and such might not be fully available to VET instructors if they attempt to acquire such skills independently. Thus, a new question is suggested:

Q5. To what extent does your VET institution help you develop your digital competences? *

- ◯ My institution regularly/often supports the development of my digital competences
- ◯ My institution occasionally supports the development of my digital competences
- ◯ My institution rarely supports the development of my digital competences
- ◯ My institution never supports the development of my digital competences

Q6. Another question should relate to the involvement of an educational institution in providing a proper e-learning environment:

Q6. The education provider invests in updating and improving the technical infrastructure *

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Somewhat disagree
- ◯ Disagree
- ◯ Other: _____

This question might be specified to make it relevant to a particular instructor's teaching needs:

Q6. The education provider invests in updating and improving the technical infrastructure that is required for the delivery of my classes. *

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Somewhat disagree
- ◯ Disagree
- ◯ Other:

Q7-Q8.

1.4. I participate in online training opportunities *

- ◯ This is a new area that I have not yet considered
- ◯ Not yet, but I am definitely interested
- ◯ I have participated in online training once or twice
- ◯ I have tried out various different online training opportunities
- ◯ I frequently participate in all kinds of online training

This question is suggested to have a follow-up question aiming to clarify the reasons that might impede the development of digital skills. The new question might be as follows:

Q7. The reasons impeding the further development of my digital skills:

- ◯ Financial
- ◯ Lack of interest
- ◯ Lack of time
- ◯ Lack of instructional support
- ◯ Learning difficulties in acquiring digital skills
- ◯ My work does not require more advanced levels of digital skills
- ◯ Other:

Another follow-up question, tapping both into needs and levels of VET instructors might be as follows:

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Q8. I am interested in improving the following digital skills:

- ◯ Visualisation
- ◯ Data analysis
- ◯ Animation
- ◯ Programming
- ◯ Data safety
- ◯ Other: _____

Q9.

2.1 I use different internet sites and search strategies to find and select a range of different digital resources *

- ◯ I only rarely use the internet to find resources
- ◯ I use search engines and resource platforms to find relevant resources
- ◯ I evaluate and select resources on the basis of their suitability for my learner group
- ◯ I compare resources using a range of relevant criteria, e.g. reliability, quality, fit, design, interactivity, appeal
- ◯ I advise colleagues on suitable resources and search strategies

Q10

It might be important to check what exactly educators know and use to subsequently identify their level of digital competencies. Therefore, the new question might be as follows:

Q10. I use the following portals for searching information for my teaching:

- ◯ Science Direct
- ◯ Web of Knowledge
- ◯ Google Scholar
- ◯ Google
- ◯ Library of my institution
- ◯ National library
- ◯ Other: _____

Q11 – Q12.

2.2. I create my own digital resources and modify existing ones to adapt them to my needs *

- ○ I do not create my own digital resources
- ○ I do create lecture notes or reading lists with a computer, but then I print them
- ◉ I create digital presentations, but not much more
- ○ I create and modify different types of resources
- ○ I set up and adapt complex, interactive resources

In an attempt to obtain evidence for their real level and knowledge forming digital competencies, it might be reasonable to introduce more specific questions. One question might be more specifically attributed to digital activities in the e-learning environment of the VET institution, e.g.

Q11. I create and modify different resources in Moodle, Blackboard or any other e-learning platform of my institution *

- ○ I use all the functions of the e-platform frequently to create and modify resources
- ○ I use most of the functions of the e-platform frequently to create and modify resources
- ○ I use some of the functions of the e-platform on occasion to create and modify resources
- ○ I rarely use the e-platform to create and modify resources
- ○ Other: _____

Another question might focus on digital tools as they tap into the level of digital competencies.

Q12. I use the following digital tools when creating digital materials and resources: *

- ○ Visualisation, e.g. Visio
- ○ Statistical data analysis software, e.g. SPSS
- ○ Discourse analysis software
- ○ Simple animation
- ○ 3D animation
- ○ Digital mind maps
- ○ Other: _____

Q13.

3.2. I monitor learners' activities and interactions in the collaborative online environments we use *

- ○ I do not use digital environments with my learners
- ◉ I do not monitor learner activity in the online environments we use
- ○ I occasionally check on learners and their discussions
- ○ I regularly monitor and analyse learners' online activity
- ○ I regularly intervene with motivating or corrective comments

It is suggested to provide an additional answer on the teacher's action in motivating students and checking their progress (see the option immediately above "Other").

Q13. I monitor learners' activities and interactions in the collaborative online environment we use *

- ○ I do not use digital environments with my learners
- ○ I do not monitor learner activity in the online environments we use
- ○ I occasionally check on learners and their discussions
- ○ I regularly monitor and analyse learners' online activity
- ○ I regularly intervene with motivating or corrective comments
- ◉ I intervene by motivating students or providing corrective feedback when required (e.g. following tests, essays, etc.)
- ○ Other: _____

Q14.

3.3. When my learners work in groups, they use digital technologies to acquire and document evidence *

- ○ My learners do not work in groups
- ○ It is not possible for me to integrate digital technologies into group work
- ○ I encourage learners working in groups to search for information online or to present their results in digital format
- ○ I require learners working in teams to use the internet to find information and present their results in a digital format
- ○ My learners exchange evidence and jointly create knowledge in a collaborative online space

A new question is suggested to follow up on learners' engagement in digital contexts:

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Q14a. The degree of my engagement in classes ..... in the digital environment *

- ○ considerably increases
- ○ somewhat increases
- ○ somewhat decreases
- ○ considerably decreases
- ○ does not change
- ○ Other:

Q15.

5.1. When I create digital assignments for learners I consider and address potential digital problems *

- ○ I do not create digital assignments
- ○ My learners do not have problems with using digital technology
- ○ I adapt the task so as to minimize difficulties
- ○ I discuss possible obstacles with learners and outline solutions
- ○ I allow for variety, e.g. I adapt the task, discuss solutions and provide alternative ways for completing the task

Answers 2 and 3 might be confusing as it does not specify the digital technologies used and the tasks to be accomplished with their deployment. For example, some learners might not experience problems using Moodle, but might be reluctant to use SPSS due to the lack of experience with it. Therefore, it might be useful to expand the range of answers (see the two options provided immediately above "Other"):

Q15. When I create digital assignments for learners I consider and address potential digital problems *

- ☐ I do not create digital assignments
- ☐ My learners do not have problems with using digital technology
- ☐ I adapt the task so as to minimize difficulties
- ☐ I discuss possible obstacles with learners and outline solutions
- ☐ I allow for variety, e.g. I adapt the task, discuss solutions and provide alternative ways for completing the task
- ☑ My learners do not have problems using Moodle, Blackboard or any other e-learning environment of the institution
- ☑ My learners experience issues using data analysis software when asked to analyse statistical data
- ☐ Other:

Q16.

6.5. I encourage learners to use digital technologies creatively to solve concrete problems *

- ◯ This is not possible with my learners, in my work environment
- ◯ I rarely have the opportunity to foster learners' digital problem-solving
- ◯ Occasionally, whenever an opportunity is available
- ◯ We often experiment with technological solutions to problems
- ◯ I systematically integrate opportunities for creative digital problem-solving
- ◯ Other: _____

It might be reasonable to add another option to tap into the level of digital competencies (see the option immediately above "Other"):

Q16. I encourage learners to use digital technologies creatively to solve concrete problems *

- ◯ This is not possible with my learners, in my work environment
- ◯ I rarely have the opportunity to foster learners' digital problem-solving
- ◯ Occasionally, whenever an opportunity is available
- ◯ We often experiment with technological solutions to problems
- ◯ I systematically integrate opportunities for creative digital problem-solving
- ◉ I do not have sufficient knowledge to solve digital problems creatively, which is why I cannot advise students on this matter
- ◯ Other: _____

Q17 – Q18.

F9. What percentage of the courses you teach are online or distance courses *

- ◯ 0-10%
- ◯ 11-25%
- ◯ 26-50%
- ◯ 51-75%
- ◯ 76-100%

It is suggested to divide this question into two to determine if there was any shift in the need to acquire digital competencies as a result of the COVID-19 pandemic.

Q17. What percentage of courses did you teach online or via distance learning before the COVID-19 pandemic? *

Your answer

Q18. What percentage of courses are you currently teaching online or via distance learning? *

Your answer

4.3 Expansion of Survey 1: Proposals for Survey 3

Survey 3 is suggested to aim to clarify details of digital competencies and obtain some evidence that some of the claimed competencies in self-reports in Survey 1 are indeed possessed by respondents. To attain this aim, a new set of questions has been proposed. The format of questions is suggested to encompass not only multiple-choice options but also open-ended questions when respondents are asked to provide their answers. This is one of the major differences between Survey 1 and Survey 3 – elicitation of respondents' knowledge.

SUGGESTIONS

The new survey might have three key content blocks: general questions about digital experience, software and purposes of its usage as well as platforms, programming languages and purposes of their usage.

Content Block I: General questions about digital experience

Q1. What digital apps do you use for your collaboration with colleagues (e.g. course development, assessment, research projects, etc.)? *

Your answer

Q2. What digital tools of visualization do you use in your teaching? *

Your answer

Q3. To what extent do you use the functions of the e-learning environment of your institution? *

- ◯ All functions
- ◯ Most functions
- ◯ Half of all functions
- ◯ Some functions
- ◯ Only a few functions
- ◯ None of the functions
- ◯ Other:

Q4. I use the following portals for communication with my colleagues (including the international community) *

- ◯ Facebook
- ◯ Linkedin
- ◯ ResearchGate
- ◯ Other: _____

Q5. It is suggested to introduce a new question to collect more information on the need to acquire the knowledge of digital safety when using digital technologies because, like any other act of behaviour, digital activity is subject to safety constraints. It might be formulated as follows:

Q5. I am interested in learning more about digital safety for teaching *

- ◯ Strongly agree
- ◯ Agree
- ◯ Neutral
- ◯ Disagree
- ◯ No need

Content Block II: Software and purposes of its usage

S1. What statistical software do you use in your teaching?

- ◯ SPSS
- ◯ None
- ◯ Other...

S2. What software do you use for the analysis of text (discourse analysis)?

- ◯ AntConc
- ◯ None
- ◯ Other...

S3. What software do you use for simulations?

- ◯ MatLab
- ◯ Other...

S4. What software do you use for presentations

- ◯ Power Point
- ◯ None
- ◯ Other...

S5. What software do you use for crop management?

- ◯ Intellias
- ◯ None
- ◯ Other...

S6. What software do you use for farm management?

- ◯ Agrivi
- ◯ None
- ◯ Other...

S7. What software do you use for waste management?

- ☐ Waste Logics
- ☐ None
- ☐ Other...

S8. What software do you use for managing wind and solar energy?

- ◯ Greenbyte
- ◯ None
- ◯ Other...

S9. What software do you use for circular economy tasks?

- ◯ Isb-global
- ◯ None
- ◯ Other...

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S10. What software do you use for business recycling?

- Isb-global
- None
- Other...

S11. What software do you use for waste and recycling management?

- Tegos
- None
- Other...

S12. What software do you use for client management?

- Bitrix24 CRM
- None
- Other...

S13. What software do you use for business management software?

- Scoro
- None
- Other...

S14 What software do you use for accounting?

- Scoro
- None
- Other...

S15. What software do you use for developing digital tools?

- None
- Other...

S16. What other software do you use and for what purposes?

- None
- Other...

Content Block III: Platforms, programming languages and purposes of their usage

P1. What digital teaching platform do you use?

- ◯ Moodle
- ◯ None
- ◯ Other...

P2. What digital platform/s related to circular economy do you use?

- ◯ Autodesk.eu
- ◯ None
- ◯ Other...

P3. What green agriculture platform/s do you use?

- ◯ Fastplatform.eu
- ◯ None
- ◯ Other...

P4. What waste management platform/s do you use?

- ◯ WINPOL Interreg Europe
- ◯ None
- ◯ Other...

P5. What other platform/s do you use and for what purposes?

- ◯ None
- ◯ Other...

P6. What programming languages do you use for teaching?

- ◯ Python
- ◯ C++
- ◯ Java
- ◯ Other...

P7. What programming languages do you use for carrying out professional activities related to computer science, agriculture, farming, resource management, etc.?

- ◯ Python
- ◯ C++
- ◯ Java
- ◯ Other...

P8. Why do you use programming skills for teaching?

- ◯ Necessity caused by resource lack
- ◯ Interest
- ◯ Necessity caused by school administration
- ◯ Other...

P9. Why do you use programming skills for carrying out professional activities related to computer science, agriculture, farming, resource management, etc.?

- ◯ Necessity caused by resource lack
- ◯ Interest
- ◯ Necessity caused by school administration
- ◯ Other...

4.4 Generating a report with visual diagrams

To present and visualize the survey results, the project used traditional forms of presenting quantitative data in the form of various diagrams. Some of these diagrams were generated using Google Forms.

Some examples of data presented in bar and pie charts are provided in Figures 3-9. A detailed description of the collected data is available in National Reports (see APPENDICES I-IV).

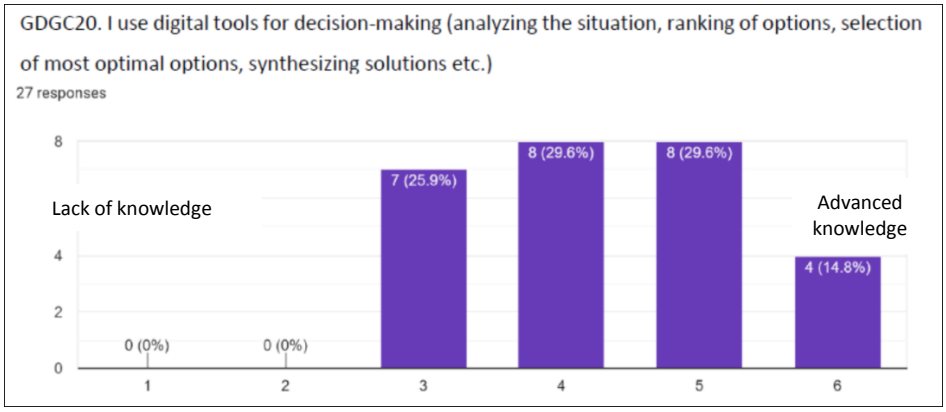

Fig. 3. Range of competence levels (Bulgaria) – an example

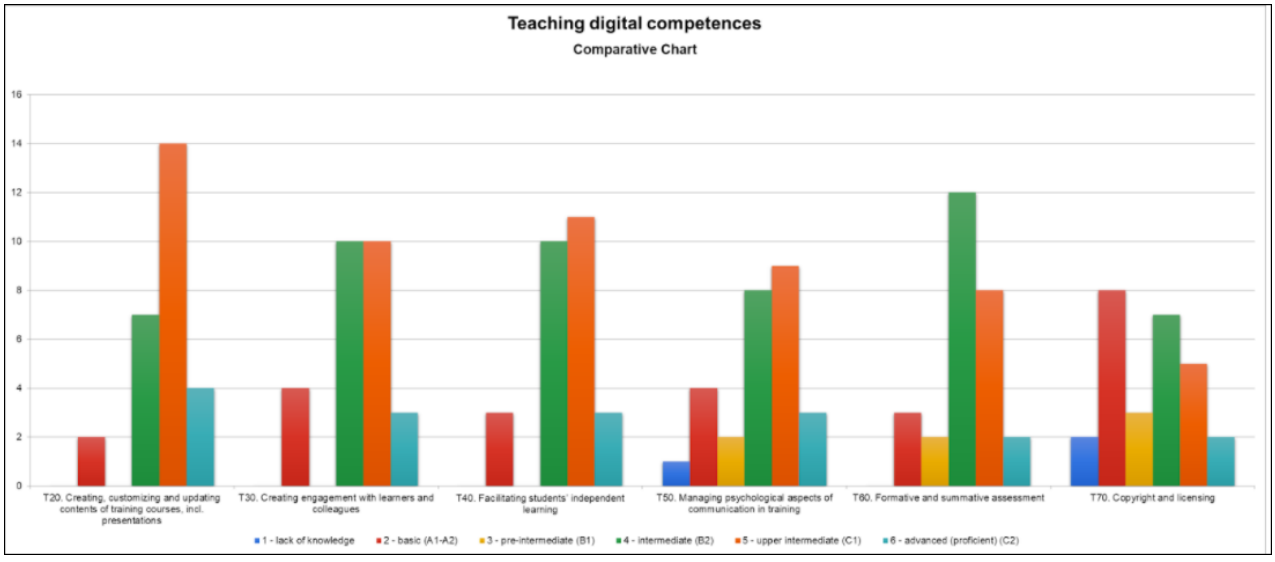

Fig. 4. Teaching digital competencies (Greece) – an example

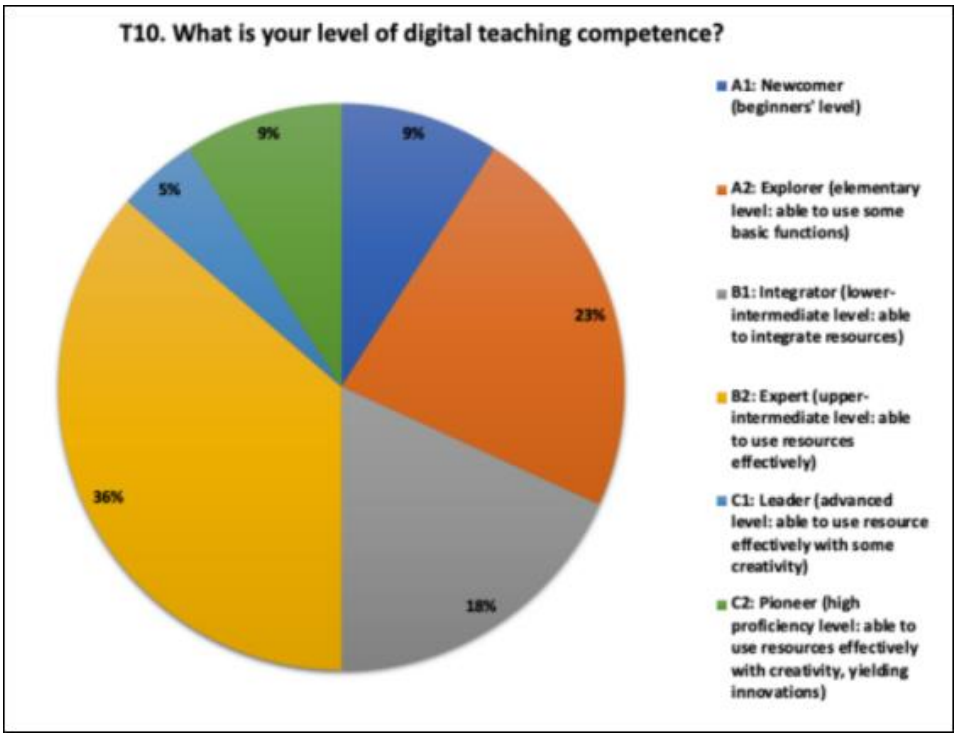

Fig. 5. Levels of digital competencies of VET instructors (Italy) – an example

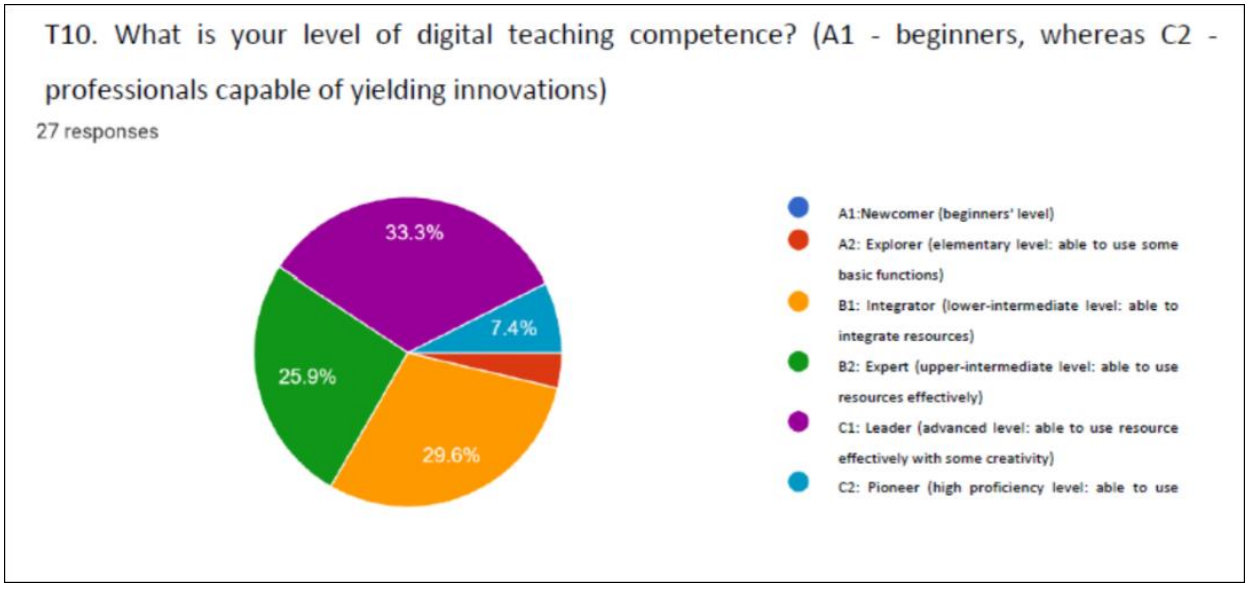

Fig. 6. Levels of digital competencies of VET instructors (Bulgaria) – an example

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In the process of data collection, it turned out that the quality of the analysis of the assessment of the competencies of educators is significantly influenced by individual factors. This is because the courses taught are very specific and require unique combinations of teacher competencies. For these purposes, it seems appropriate to evaluate the collected data by using a visual representation of the individualized data (charts should display data for a specific course or specific area of training).

Therefore, the data are grouped by different areas of training (selected by partners).

For example, after examining the interests and needs in their areas, Greek partners decided to focus on the following areas:

- Area 4: Energy Production and Management
- Area 5: Reducing Pollution and Negative Effects of Climate Change

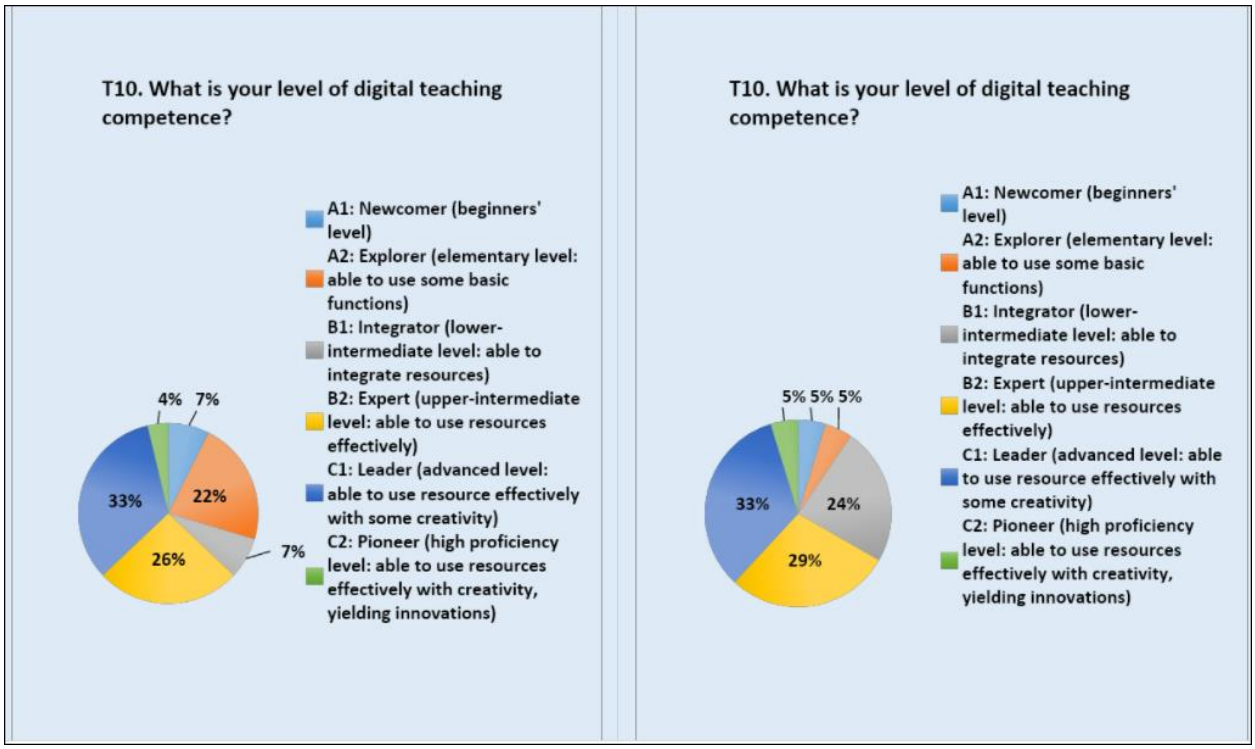

Fig. 7. Levels of digital competencies of VET instructors by Training Area 4 and 5 (Greece) – an example

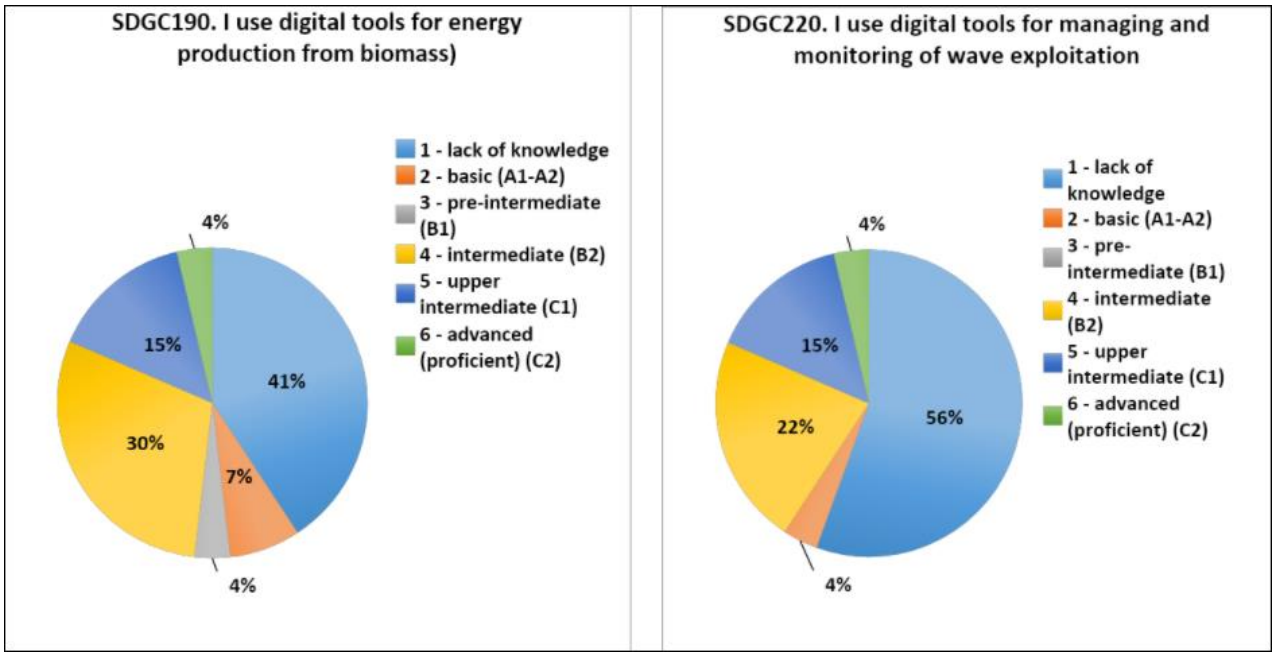

Fig. 8. Levels of digital tools usage by Training Area (Greece) – an example

In the future, to conduct a comparative analysis of digital and green competencies of various groups of VET instructors, it is planned to use more complex forms of presentation of quantitative data. One possible form could be a spider chart or a polar chart in Excel.

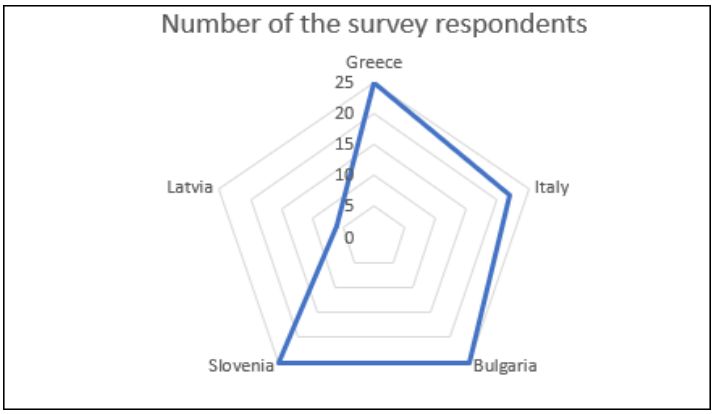

Fig. 9. Number of the survey respondents by country

To better demonstrate the basic capabilities of the visual (graphical) presentation of the data obtained as a result of the surveys, we have prepared several generalizing diagrams. These charts integrate some data from different partners.

GENERAL QUESTIONS ABOUT YOU:

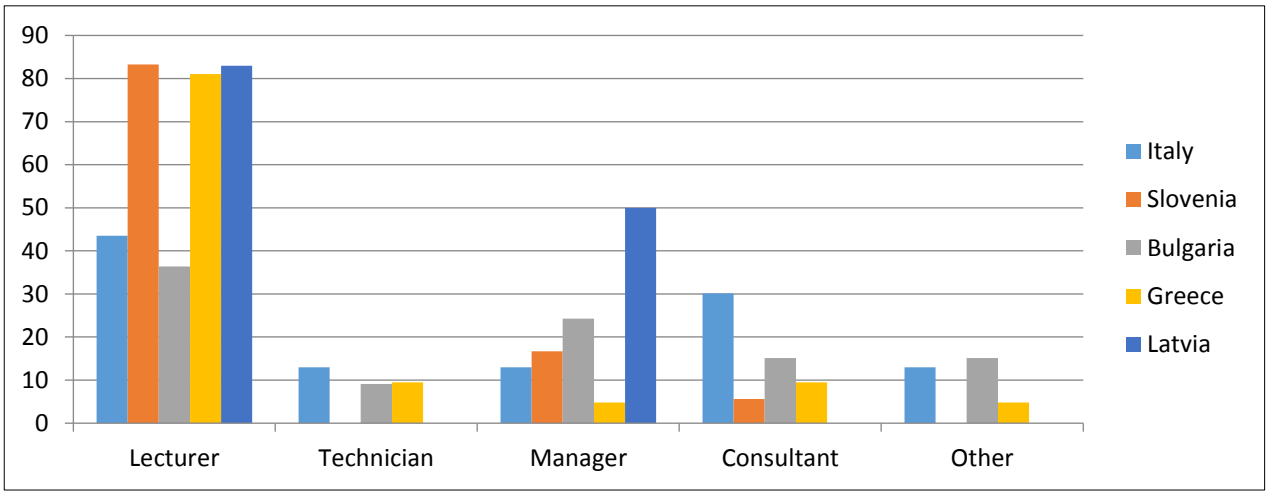

Fig. 10. G1. What are your work positions?

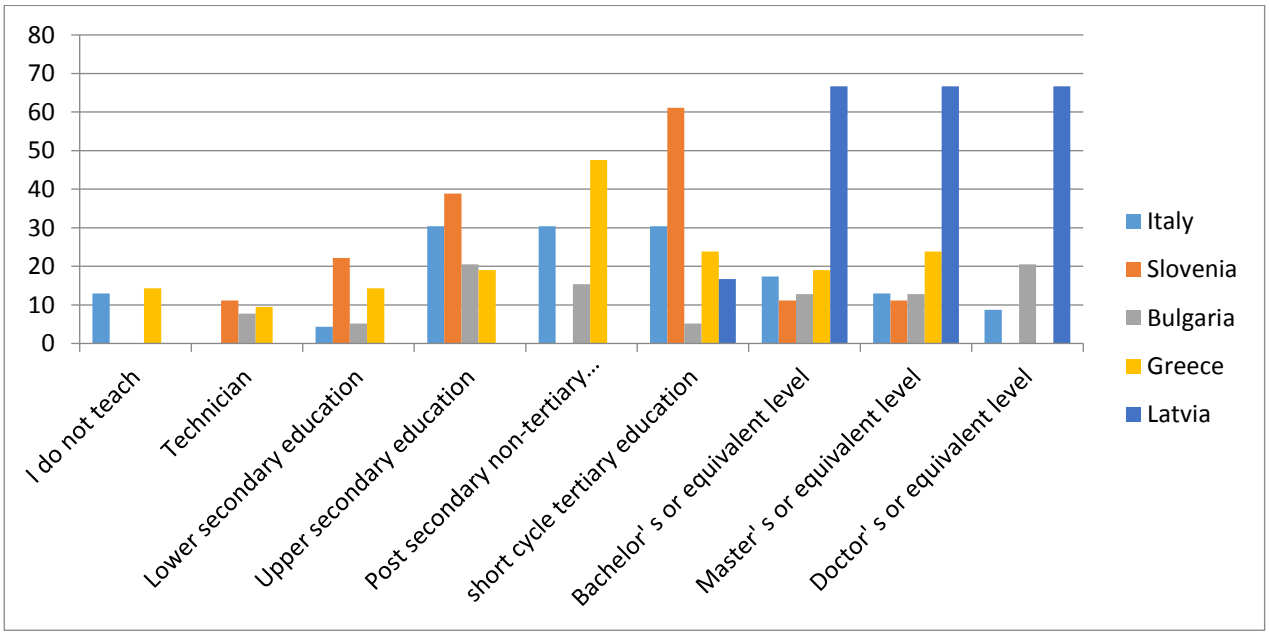

Fig.11. G2. What level of International Standard Classification of Education (ISCED-2011) do you teach at/work in?

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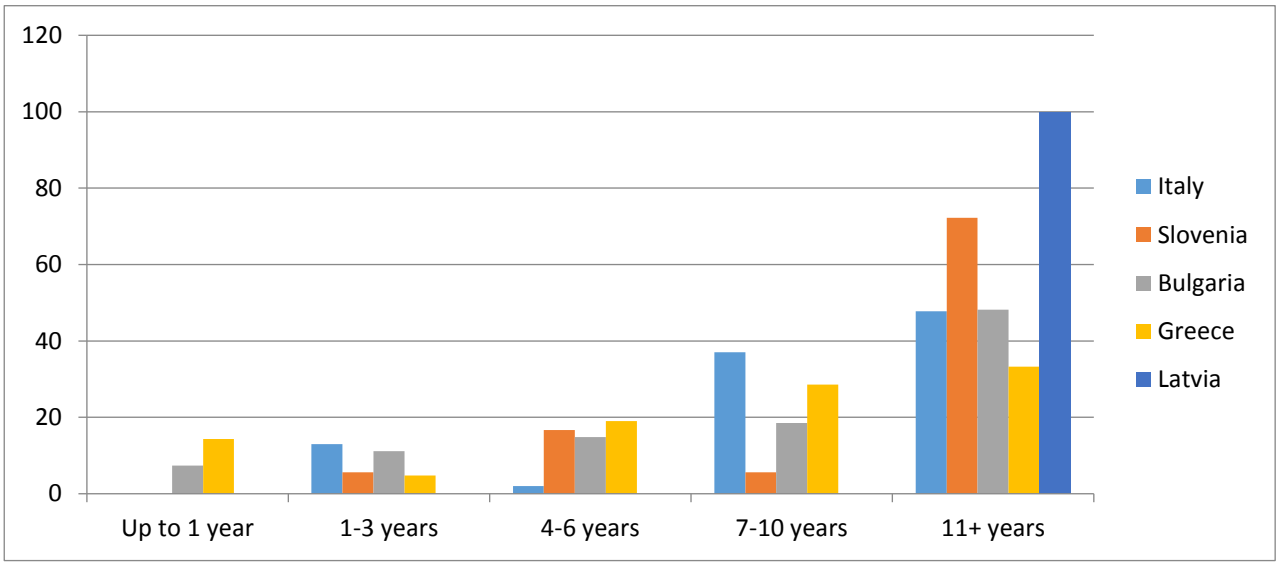

Fig.12. G4. Years of employment in VET

DIGITAL TEACHING COMPETENCIES (DTC):

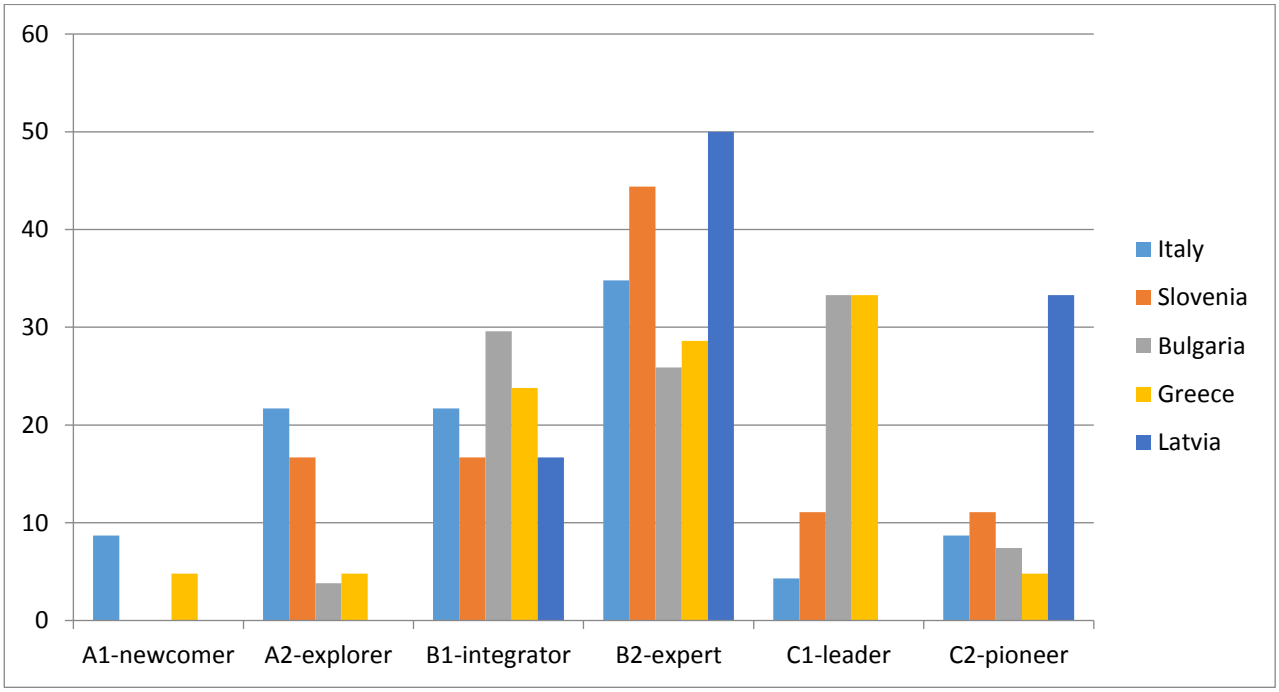

Fig.13. DTC1. What is your level of digital teaching competence? (A1 - beginners, whereas C2 - professionals capable of yielding innovations) (the level name is taken from DigCompEdu)

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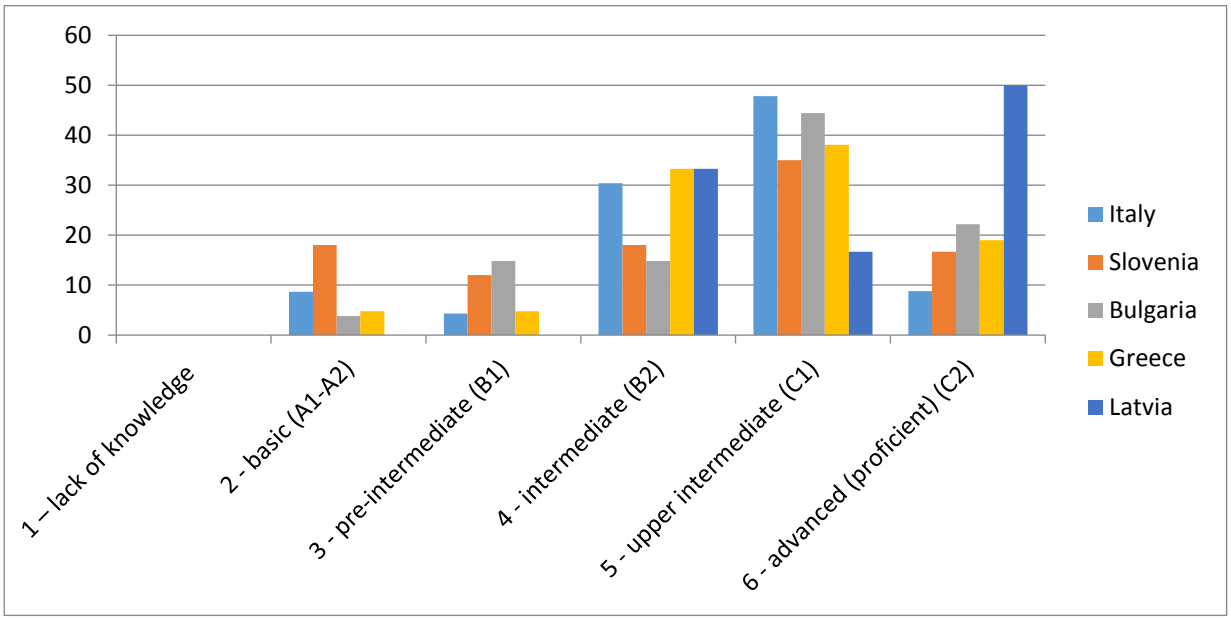

Fig.14. DTC2. I use digital tools for creating, customizing and updating the contents of training courses, incl. presentations

AREA 1. DATA COLLECTION AND USE:

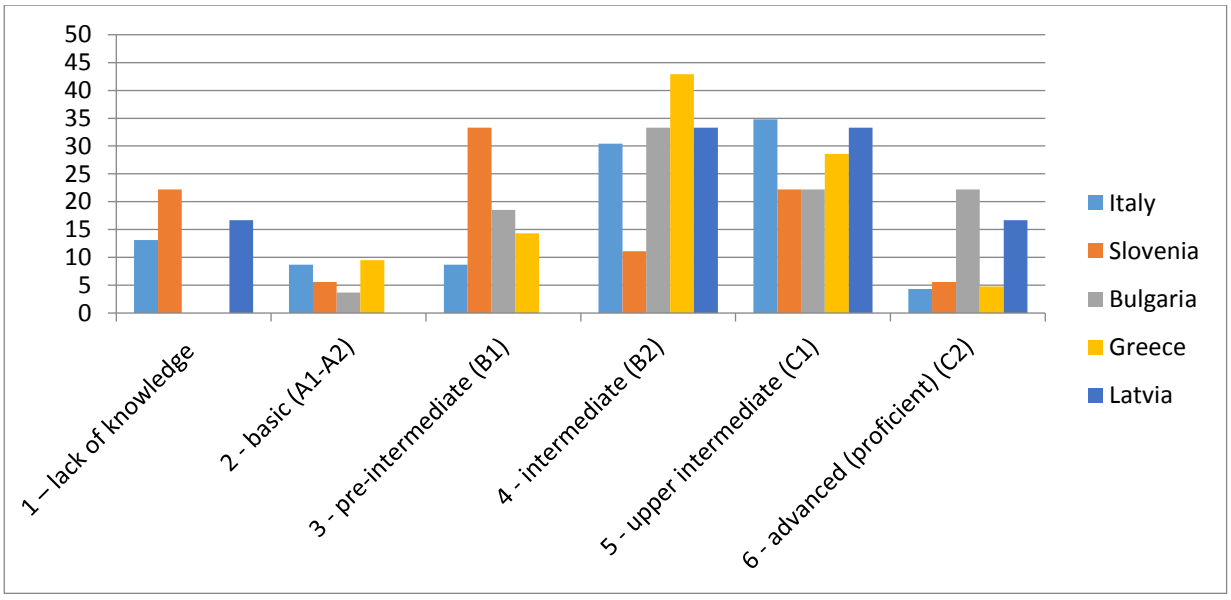

Fig.15. GDGC1. I use digital tools for data collection, analysis (incl. visualization) and data flow management

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AREA 2. WORKFLOW MANAGEMENT FOR EFFICIENCY AND TRANSPARENCY:

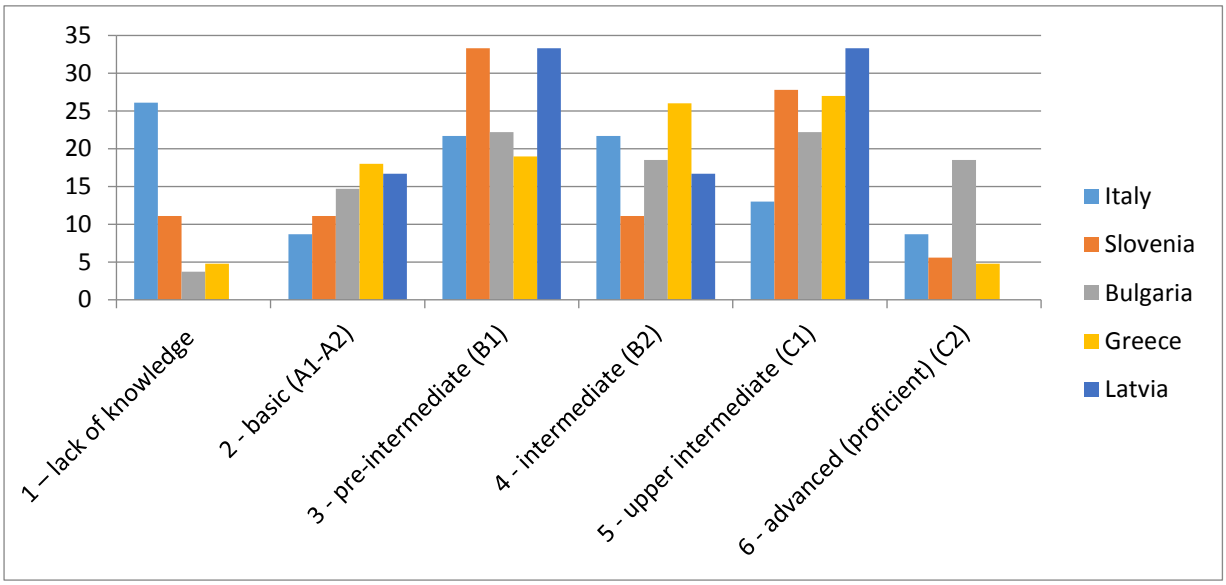

Fig.16. GDGC7. I use digital tools for effective work/business management (creation of a business strategy, workflow, tracking of activities, reports, processes, planning, monitoring and measuring of performance etc.)

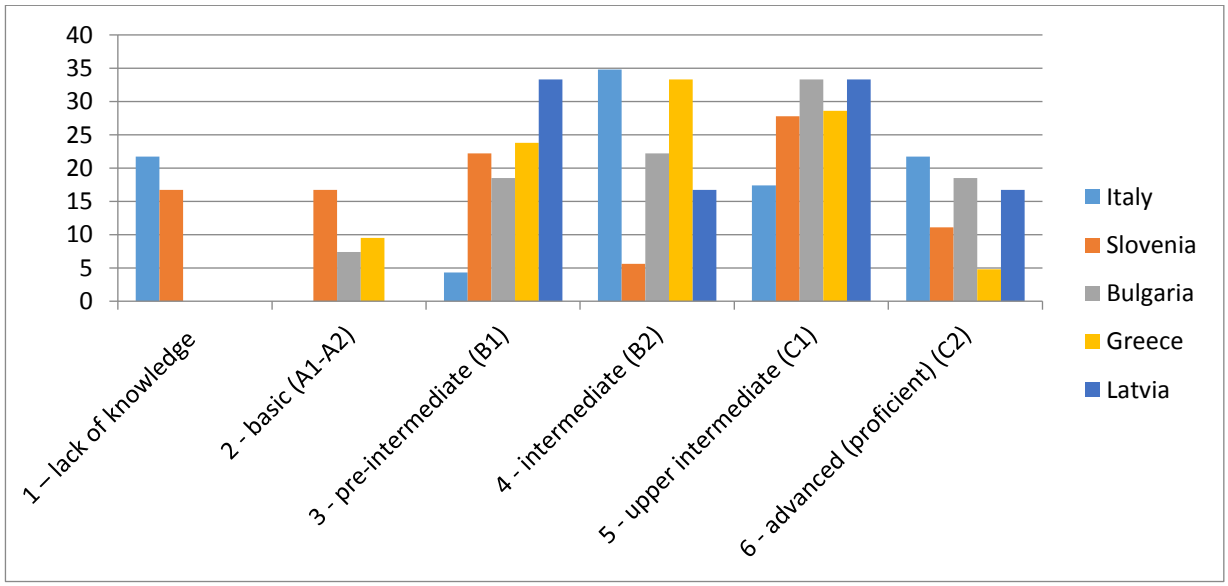

Fig.17. GDGC10. I use digital tools for document creation and management (preparation, updating, managing, etc.)

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AREA 3. COMMUNICATION:

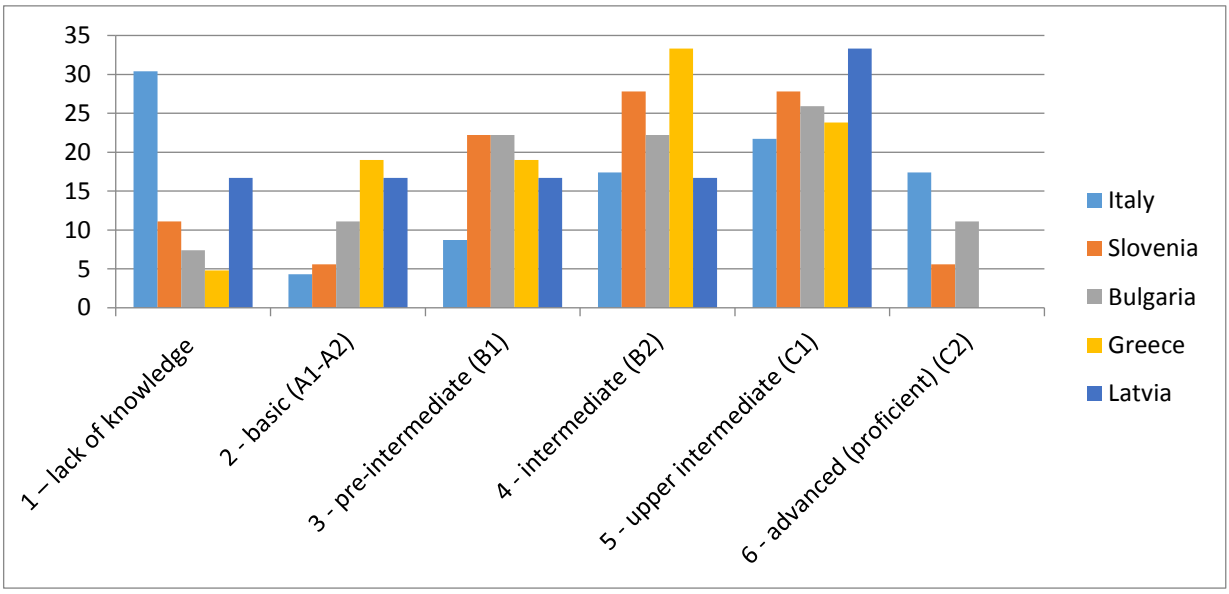

Fig.18. GDGC11. I use digital tools for acquiring, engaging and sustaining customers (creating and maintaining e-billing, customer self-service, customization of offers, increasing transparency of operations, boosting sales, etc.)

AREA 4. FINANCIAL AND LEGAL ASPECTS:

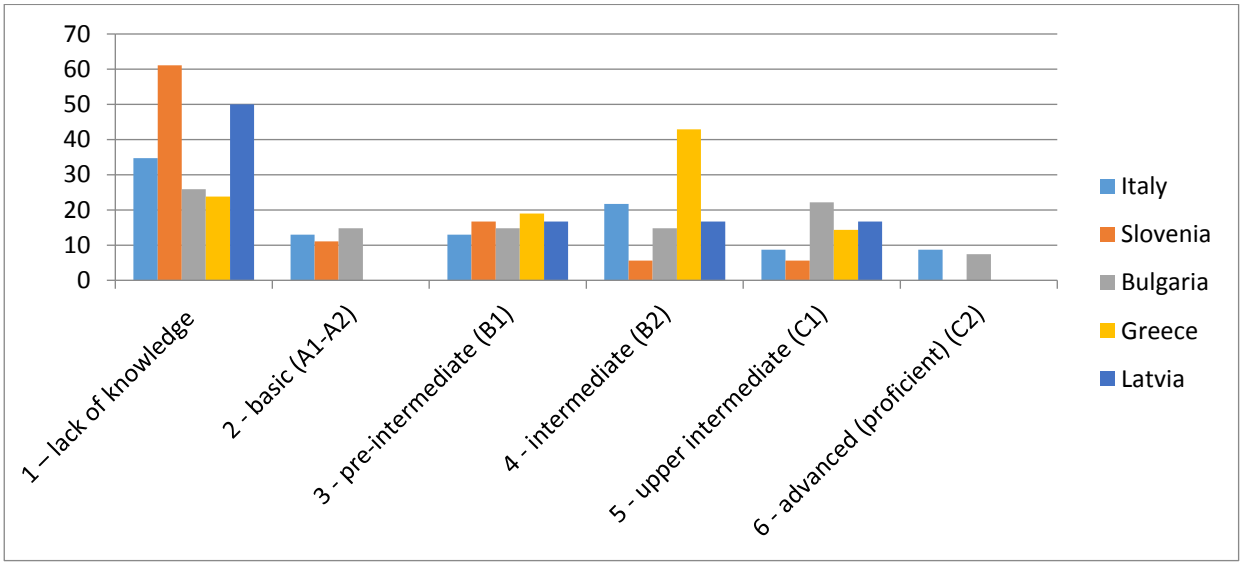

Fig.19. GDGC15. I use digital tools for relevant (green) legislation analysis and reviews

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AREA 5. RESEARCH AND DEVELOPMENT:

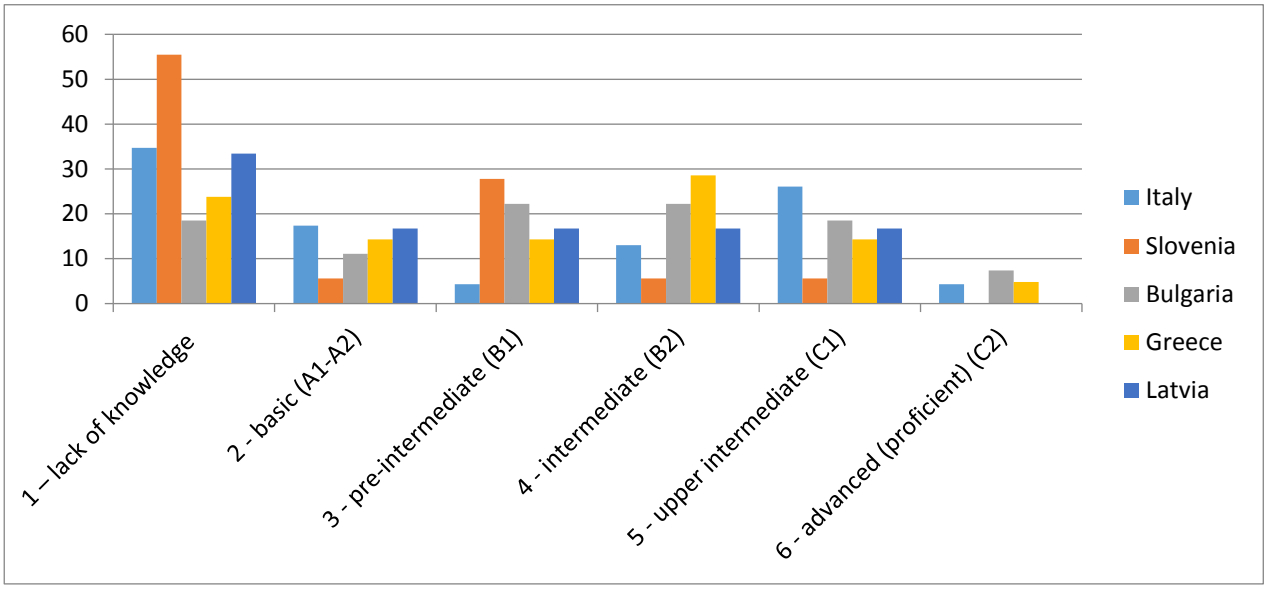

Fig.20. GDGC16. I use digital tools for greener product development, flawless maintenance – use - monitoring, management (e.g. creation of products and their components (including machinery, energy-saving devices, etc.) and their design, branding, labelling (incl. RQ code), online marketing and positioning)

It is assumed that during the implementation of the IO1 stage of the project, specific requirements for the analysis of digital and green competencies for the pilot project and its implementation on the VOOC digital platform will be formulated. Following these requirements, specific forms of presentation of survey results will be developed and tested.

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4.5 Conclusion on evaluation of assessment procedure

The study showed that all the developed survey options are workable, allow to identify and differentiate the required competencies of VET teachers to measure and improve them. The obtained test data of the surveys revealed a great diversity in the competence of teachers in different countries and different areas of VET education. These data, in principle, make it possible to carry out a comparative measurement of competencies in the implementation of pilot training on the VOOC platform at the next stages of the project.

Each partner of the project addressed only those specific areas of competencies that applied to them. Therefore, the national reports submitted by partner institutions reflect the results limited to chosen specific areas and therefore cannot be compared with the results of the other countries represented in the project. Each national report in the APPENDICES provides a detailed analysis of the data obtained from the survey distributed in the country of the partner institution.

Although there are significant differences in both the profile of respondents and the level of their competencies in different areas, the results of the survey have made it possible to conclude that the survey instrument developed within the framework of the INGENIOUS project is valid and can be used to assess different areas of digital competences, such as general digital teaching competences, general greening digital competences and specific digital green competences.

APPENDICES

APPENDIX I. Bulgaria national report IO1.

See enclosed file ***Bulgaria_national report_IO1.pdf***

APPENDIX II. Greece: National Report IO1.

See enclosed file ***Greece_national report_IO1.pdf***

APPENDIX III. Italy: National Report IO1.

See enclosed file ***Italia_national report_IO1.pdf***

APPENDIX IV. Slovenia: National Report IO1.

See enclosed file ***Slovenia_national report_IO1.pdf***

APPENDIX V. Latvia: National Report IO1.

See enclosed file ***Latvia_national report_IO1.pdf***