DIGITAL SKILLS
accelerator

IO1: Digital skills research report

This programme has been funded with support from

Erasmus+ This project has been funded with support from the European Commission

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ABOUT THIS DOCUMENT

This document is the result of the Intellectual Output 1 (IO1) of the Digital Skills Accelerator (DSA) project, describing the results of the research activities undergone to identify and prioritize the most important digital skills required by the different stakeholders, and best practices in the provision of training for those.

The research conducted combined surveys targeted to the different stakeholder groups with focus groups. The results are intended to inform the contents, design and instructional approach of the training materials that are part of other Intellectual Outputs of the project.

Part of the research reported here has been published recently (Sicilia et al., 2018).

Note:

PART I. INTRODUCTION AND BACKGROUND

Motivation

DSA aims at improving the ability of young people entering the labor market to use Information and Communication Technologies (ICT) intelligently and creatively.

The key role of digital skills in employability is not a new concept, it has been the focus of different previous projects and initiatives. However, there is a need of a constant update on which are the key areas of competence required by employers, and which are the best ways of delivering effective training for those. In DSA, we depart from existing, established competence frameworks for the aim of identifying the current priorities in digital skills as perceived by different interest groups.

In addition to updating and prioritizing, DSA opens the dimension of needs to the broader spectrum of digital citizenship, and to skills required for continuous learning.

Stakeholders

The stakeholders identified in the project are described in Table 1 as part of broad groups. The information to be gathered from the different groups is also described.

Stakeholder group	Profile	Information to be gathered
Higher education students	University or school students that are close to enter the workforce, or individuals in similar situations.	Preferences on digital skill training based on their perceptions of employability or utility.
Employers	Employers of public and private organizations of any kind in which digital skills are a key	Digital skills most needed for an effective and creative work.

	component in daily work.	
Higher education institutions	Universities, Schools or training organizations that include digital skills in their offerings.	Digital skills perceived as most important for their students. Current practices in training related to digital skills.
Civic institutions	Other institutions that are concerned with the digital behaviour of individuals and groups in society.	Most important digital skills for digital behaviour.

Table 1. Description of the stakeholders groups in DSA

The different stakeholders may have different preferences, perceptions and expectations on the relative importance of the different digital skills, so that the contrast of the different views provides a better informed picture of the priorities for DSA.

State of the art

Digital skills, competences and related concepts

The rapid rise and evolution of the Internet and digital media resulted in the new notion of digital literacy, partially overlapping with Internet literacy, ICT literacy, media literacy and information literacy. Digital competences related to that notion of digital literacy are nowadays considered a requirement for the workforce, for learning competence itself (Ala-Mutka, 2008) and more generally, for citizenship (Van Deursen & van Dijk. 2009).

Competences are usually considered to group *skills, attitudes and knowledge required for a certain task*. 'Skills' can then be defined as the abilities to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework (EQF), skills are described as either cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments). We focus here on digital skills, that are cognitive skills that require the use of digital tools in purposeful activities and can be observed and assessed in the workplace when contextualized in particular

job roles or practical tasks.

While there is an overall consensus on the importance of digital skills development for the workplace across sectors (Benson, Johnson & Kuchinke. 2002), there have not been efforts to the best of our knowledge in assessing the perception of the different actors regarding the relative importance of those skills, and the extent to which they are effectively provided to Higher Education (HE) students that are near to enter the workforce through their curricular activities. Insights on that importance and perceptions would be key in informing how digital skill training is provided, the applicability of good practices, and eventually if the focus should be put on some particular areas rather than in others.

DigComp

There are different accounts of digital competences and their related skills, but we use here the DigComp 2.1. framework as a reference, as it was itself based on a review of previously proposed frameworks. DigComp is the result of the effort of the European Commission in identifying competence areas for digital competences, that have skills, knowledge and attitudes as components, and in its more recent versions is also structured in eight proficiency levels, from foundation to highly specialized.

The European Digital Competence Framework for Citizens (DigComp)1 is a major result in describing and sorting out digital competencies. The framework has been described on a series of reports, of which the latest at the time of this writing is DigComp 2.1. "The Digital Competence Framework for Citizens with eight proficiency levels and examples of use" (Carretero et al., 2017). Understanding the diversity of digital skills requires a framework providing the concepts that could guide research. DigComp identifies the key components of digital competence in five areas: information and data literacy, communication and collaboration, digital content creation, safety and problem solving (Ferrari, Brečko & Punie, 2014). A total of 21 competences are grouped in these five areas. The framework since its 2.1 version also includes eight proficiency levels for each of them. We have used competences rather than skills to guide research since there is not a catalogue of skills but only examples, and competences can be though as categories that help grouping skills.

[1] https://ec.europa.eu/jrc/en/digcomp

The DigComp Framework has 5 dimensions:

- Dimension 1: Competence areas identified to be part of digital competence
- Dimension 2: Competence descriptors and titles that are pertinent to each area
- Dimension 3: Proficiency levels for each competence
- Dimension 4: Knowledge, skills and attitudes applicable to each competence
- Dimension 5: Examples of use, on the applicability of the competence to different purposes

The competence areas (CAs) identified from version 2.0 of DigComp and their constituent competencies are listed in the following Table.

Dimension 1 Competence areas (5)	*Dimension 2* Competences (21)
1. Information	1.1 Browsing, searching, & filtering information 1.2 Evaluating Information 1.3 Storing and retrieving information
2. Communication	2.1 Interacting through technologies 2.2 Sharing information and content 2.3 Engaging in online citizenship 2.4 Collaborating through digital channels 2.5 Netiquette 2.6 Managing digital identity
3. Content creation	3.1 Developing content 3.2 Integrating and re-elaborating 3.3 Copyright and Licences 3.4 Programming
4. Safety	4.1 Protecting devices 4.2 Protecting data and digital identity 4.3 Protecting health 4.4 Protecting the environment
5. Problem solving	5.1 Solving technical problems 5.2 Expressing needs & identifying technological responses 5.3 Innovating, creating and solving using digital tools 5.4 Identifying digital competence gaps
http://is.jrc.ec.europa.eu/pages/EAP/DIGCOMP.html	

Table 2. Competence areas and competences in DigComp 2.1

As it can be seen, the CAs are made up of broad competences, and particular skills are associated to those in Dimension 4. This represents the point of departure for our inquiry. The definition of “skill” is the ability to apply knowledge and use know-how to complete tasks and solve problems. In the context of the European Qualifications Framework (EQF), skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Other relevant models

While some of the skill descriptions in DigComp documents may appear as not updated to very recent trends in use of digital tools, the framework is a solid basis that enables further inquiry in specific areas, as done for example in the *All-Digital* project[2]. Pérez-Escoda et al. (2016) revised DigComp together with the UNESCO and ACMA frameworks highlighting commonalities and concluding that the important issues are:

- access and use media and new media,
- communication and creation through new media,
- critical understanding about media and new media and
- digital competence domain.

All of them are covered by DigComp in different areas. It is interesting also to highlight the expert study by Janssen et al. (2013) in which twelve areas are identified, following a different decomposition to that of DigComp, and could be used as an alternative model, if elaborated in the same level of detail as DigComp. Other sets of concepts could also be mapped to DigComp as the one by Ilömaki et al. (2016), but we found that DigComp covers them under a different (and arguably more consistent) structure. For example, "technical competence" in Ilömaki et al. is a generic, difficult to assess ability, similar to the ability to "use digital technologies in a meaningful way for working, studying and in everyday life" that appears as a too broad-encompassing concept.

There are a number of frameworks related do DigComp but covering the digital skills required for certain contexts that may be useful to contextualize learning activities. It is worth mentioning here EntreComp (Bacigalupo et al., 2016) that focuses on "Entrepreneurship Competencies" and DigCompEdu (Redecker &, 2017), the "Digital Competence Framework for Educators". The former is relevant since entrepreneurship is also an option for HE students, and the latter since educators need to be aware of the use of these competences if we aim at quality education. However, we are here interested in the core digital skills, regardless of their applications or use, so that these have not been included in the discussion.

[2] www.all-digital.org

Studies on digital skill training

There are related terms and concepts that overlap to some extent with that of digital competences (as including digital skills). Notably, information literacy referring to abilities required to understand and fulfil information needs, and media literacy that focus on understanding and handling media overlap to a certain extent and should arguably be taught together (Fernandez-Villavicencio,2010). This makes more challenging the identification of best practices, as they may be included in studies using different conceptual frameworks and terminologies. Some authors as Eshet (2004) define "digital literacy" as a set of abilities that overlap to a large extent to the concept of "digital competences" in DigComp and thus may be considered as very close concepts.

It should be noted that the concept of digital skills and competences is nowadays related to effective use of digital tools, rather than the formal, operational training on the tools themselves. This is for example reported by Van Deusen & Van Dijk (2011) when studying Internet use, pointing out that the "level of information and strategic internet skills is questionable" despite that "level of operational and formal internet skills appeared quite high". There is also a problem with evaluating the extent to which digital skills are achieved. Helsper and Van Deusen (2015) state that "the measurement of digital skills is still contentious and lacks nuance, as evidenced by its lack of inclusion in large-scale European surveys".

There are very few studies about the contrast of the perceptions on digital skill training among different stakeholder groups. Torres-Coronas (2015) reported a study aimed at measuring the gap in perception between students and employers in digital competences across different domains, finding that employers have a significant worse perception of these than students for most areas, except for "Hardware" and "Social Networks". This points in the same direction as the findings of our study, but they can't be compared since the descriptions used in that work are a mix of generic ones as "online communication" or "software" with others that are product or tool specific as "Excel", "Word" or "PPT".

As we are interested here digital skills in Higher Education, we have not discussed their acquisition at School level. However, that may be relevant in multi-national comparisons since the level of support of teachers and schools affect the confidence of students in the digital realm, and this varies across countries (Wastiau et al., 2013). Also, it is taken from granted that digital skills are important for employment, but it is difficult to find studies on the topic. Garrido et al. (2010) analyze the importance of ICT skills in improving opportunities for low income groups, and the aspects related to the social context might also be relevant for other groups.

PART II. RESEARCH

Methodology

We report here the results of a multi-national inquiry (with convenience sampling from the partners of the DSA project from Spain, Poland, UK, Ireland and Belgium) on the perceptions of the relative importance of digital competences and on the degree of preparedness of HE students in those, accounting for different stakeholder groups: students, staff of HE institutions, employers and civic organizations. We have combined survey research to gather responses from qualified actors with focus groups as a supplement of qualitative information. The results have provided evidence of some divergences in perception across stakeholder groups and concerns on the effectiveness of training provided by HE institutions. Qualitative research has also highlighted the need of some particular instructional approaches that emphasize the situated nature of digital skills.

Research was conducted using a combination of surveys and focus groups. Survey research was essentially targeted at gathering preference information on the most important competences for the different stakeholders, together with their perception on the effectiveness of current practice. A questionnaire per stakeholder group was devised, with some common parts and others specific to the concerns of the group, using an online tool (Survio). The questionnaires are available in the deliverables of the DSA project (provided in the acknowledgments section).

Insights from survey administration were then complemented by the qualitative outcomes of focus groups. Our focus group method consisted on small, but demographically diverse groups of people whose reactions are studied in guided discussions - in our case around a set of questions different per each stakeholder group - to determine the reactions that can be expected from a larger population. As the focus group was guided by a set of questions, the recommended practice was dual moderator, with one moderator dedicated to smooth progress and the other to guarantee all the issues are discussed.

The methodology for the required research is structured around the following steps or phases:

- Phase I. Desk research and setting up
- Phase II. Partner research
- Phase III. Consolidation of findings

In what follows, the activities in each of the phases are described.

Setting up

The research conducted departed from an identification of relevant previous digital competence frameworks and experiences and information sources available as publications. The result of this initial setting up is described in the state of the art section above.

Partner research

In the partner research phase, each individual partner first identified the stakeholder groups that were on their reach. The result of this identification phase is provided in Table 3. The following is the description of the codes and fields used in the Table.

participant profile	
STUDENT	Higher Education students
HEINST	Members of HE institutions, e.g. teaching staff or other officials
EMPLOYER	Employers
CIVICORG	Civic organizations, e.g. Associations or NGOs.
OTHER	

action type	
FOCUS GROUP	Consultation using structured interviews, according to IO1 guidelines
SURVEY	Questionnaire distribution, according to guidelines in IO1.
OTHER	

size	For FOCUS GROUPS, indicate approximate number of experts. For SURVEYS, the approximate total population that will receive the questionnaire.

aim	
SKILLS_EMPLOYERS	The digital skills required by employers in participating regions
SKILLS_CITIZENS	The digital skills which best enable active and informed citizenship
SKILLS_LEARNING	The digital skills necessary to fully engage with online learning
BP_TRAINING	Best practices in the provision of digital skills training
SKILLS_STUDENTS	The preferences and needs of student learners

UAH

ACTION TYPE	DATES	PARTICIPANTS	PROFILE	SIZE	DEMOGRAPHICS	AIM
FOCUS GROUP	february-march 2018	Professionals	EMPLOYER	5-10 experts	Senior executives	SKILLS-EMPLOYERS
SURVEY	february-march 2018	UAH students	STUDENT	>200	Graduate students	SKILLS-STUDENTS
FOCUS GROUP	february-march 2018	Educational experts	HEINST	2-5 experts	Senior instructors	BP-TRAINING/SKILLS-LEARNING

EUCEN

ACTION TYPE	DATES	PARTICIPANTS	PROFILE	SIZE	DEMOGRAPHICS	AIM
SURVEY	February-March 2018	Higher education experts and staff	HEINST	approx. 50 experts	Senior executives	BP-TRAINING/SKILLS-LEARNING
SURVEY	February-March 2018	Representatives of SMEs and Chambers of Commerce	EMPLOYERS	Approx. 10	Senior executives	SKILLS-EMPLOYERS
SURVEY	February-March 2018	Representatives of NGOs	CIVICORG	Approx. 10	Senior executives	SKILLS_CITIZENS

MMS

ACTION TYPE	DATES	PARTICIPANTS	PROFILE	SIZE	DEMOGRAPHICS	AIM
FOCUS GROUP	jun-18	Entrepreneurs	EMPLOYER	5-10 experts	Senior executives	SKILLS-EMPLOYERS
FOCUS GROUP	jun-18	Lifelong Learning VET	STUDENT	10	Graduate students	SKILLS-STUDENTS
FOCUS GROUP	jun-18	Civic Institutions	Park Organisation, Libraries, Community Groups, Labour Unions, Charitable Organisations, CSO, Community Based Learning	5-10 experts	Senior executives	Civic Institutions

ZUT

ACTION TYPE	DATES	PARTICIPANTS	PROFILE	SIZE	DEMOGRAPHICS	AIM
FOCUS GROUP	february-march 2018	Members of klaster IT	EMPLOYER	5-10 experts	Senior executives	SKILLS-EMPLOYERS
SURVEY	february-march 2018	ZUT students	STUDENT	>200	Graduate students	SKILLS-STUDENTS
FOCUS GROUP	february-march 2018	Educational experts	HEINST	4-8 experts	Senior instructors	BP-TRAINING/SKILLS-LEARNING

Table 3. Summary of partner research carried out

The identification was contrasted with the aims of the project to check if the groups involved were significant and covered all the information needs of this research report. That consolidated view was the blueprint for the individual activities of the partners.

Then, the partners conducted individual research activities according to the plan. There are two fundamental methods for collecting data:

- Surveys, oriented fundamentally to find evidence about the importance of different types of skills for the different stakeholders groups.
- Focus groups, that in addition to the aims of the survey provide a qualitative input for particular actors.

The guidelines for these two forms of partner research are provided in the Annex to this document.

Table 2 provides the questions about the issues per stakeholder that guided focus group sessions. Note that there were also guiding questions for civic institutions, but this was not covered in the first phase of partner research reported in this paper via focus group research, so the considerations on that particular profile are more limited.

Stakeholder group	Key research questions
Higher education students	• Are digital skills perceived as important for entering the job market? • Do you think the University is providing sufficient digital skills training?
Employers	• Are digital skills perceived as important for the daily work activities in your organization? • Which are the key skills that are most critical for a typical employee in your company? • Is the Higher Education system providing the needed digital skills to students? • Which are the most important digital skill gaps that you find in students coming from the University?
Higher education institutions	• Are digital skills perceived as important for entering the job market? • Do you think the University is providing sufficient digital skills training?

	• How is your organization providing such training? • Do you think there are training methods that could improve the provision of digital skills?
Civic institutions	• Are digital skills perceived as important for engagement in civic activities in the digital? • Do you think the University is providing sufficient digital skills training for those needs?

Table 2: Guiding questions for focus groups per stakeholder profile.

Consolidation of findings

The results from the partner research phase were collected and contrasted in a common view of the results. This consolidation was carried out in the secondo project meeting, and via teleconferencing among the partners in a second round.

Results

Survey research results

The survey was designed to gather three kinds of information: (a) demographics and descriptive data of respondents, (b) perceptions about the preparation of students in digital skills and (c) perception of the relative importance of different digital competences for the workplace. The last one was key in gaining insights of the differences among stakeholder groups. The instrument showed the DigComp competences and allowed the respondent to sort them by simply dragging and dropping them in the preferred order, from the most to the least important. This allows for contrasting the different views by correlation or ranking. The ranking was based on average ranking computed as the average of the product of:

- w_i: weight of ranked position (inverse index of the position in the survey)
- x_i: response count for answer choice.

Averages were then normalized to allow for comparison among groups. Table 1 presents a comparison of the competences considered most important per stakeholder group, indicating competence area: INFO for “information”, COMM for “communication”, CONT for “content creation”, SAF for “safety” and PROB for “problem solving”.

Employers	HE staff	Students	Civic institutions
[Evaluating information] INFO	[Browsing, searching and filtering information] INFO	[Evaluating information] INFO	[Managing digital identity] COMM
[Interacting though technologies] COMM	[Evaluating information] INFO	[Storing and retrieving information] INFO	[Interacting though technologies] COMM
[Browsing, searching and filtering information] INFO	[Storing and retrieving information] INFO	[Protecting devices] SAF	[Engaging in online citizenship] COMM
[Collaborating though digital channels] COMM	[Interacting though technologies] COMM	[Sharing information and content] COMM	[Browsing, searching and filtering information] INFO
[Sharing information and content] COMM	[Sharing information and content] COMM	[Interacting though technologies] COMM	[Collaborating though digital channels] COMM
[Developing content] CONT	[Collaborating though digital channels] COMM	[Engaging in online citizenship] COMM	[Evaluating information] INFO

Table 4: Highest-ranked DigComp competences per stakeholder profile

The analysis of Table 4 points out to a degree of coherence of the perceptions of importance in the Employers and HE staff groups, with an emphasis on information and communication skills. However, the perceptions of students are different and include safety issues (connected to cybersecurity issues) that are not considered as important by the other groups. Further, civic institutions appear to prioritize other competences, not surprisingly, engaging in online citizenship and managing digital identity are seen as highly important for the group. It is also noticeable that communication and information are equally valued by civic institutions. Evaluating information appears as the most important cross-cutting concern among the groups.

The following Figure shows the summary and helps in appreciating the overall differences in ranking. It is also remarkable that “problem solving” is not highly ranked in any of the cases. It is especially thought-provoking the fact that “Innovating, creating and solving using digital tools” is ranked low, as it appears to be a critical competence in adapting to new situations.

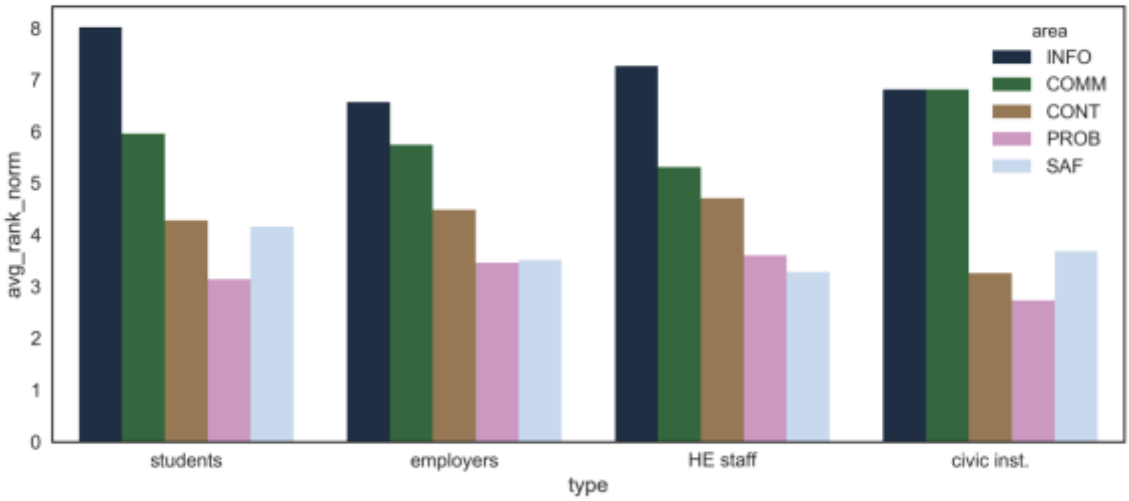


Figure 1: Average ranking per stakeholder group and competence area.

In any case and in spite of the differences, the correlation among normalized averages is in all the cases relatively high. HE staff and employers have a Pearson correlation of 0.9, employers and students of 0.82 and students and HE staff of 0.87. This suggests that having a consolidated ranking including the perceptions of the three groups will capture to a large degree the perceptions of the three collectives. The overall correlation of civic institutions is also high with employers (0.81) but it is lower with HE staff and students, 0.64 and 0.63 respectively. This latter finding is interesting in that it can be used to hypothesize that there may be somewhat as a divide between digital competence as oriented to the workplace (it should be noted that in the survey students and HE staff were asked for importance of digital skills for the workplace) or as a broader concept of participation in society.

In addition to the relative importance, there were items in the surveys to assess the global opinion on the preparation of students for digital skills. In the case of the employer group, 28% of respondents consider HE students are not properly trained in DS. For HE staff, this was assessed using three 10-point scale questions, and “are properly trained in DS” has a mean of 5.5 (standard deviation of 2.8), and the opinion that they “are trained to some extent” has a mean around 4. Both results point out to a perception of a mismatch in the needs and actual training of students that deserve further research. In the case of civic institutions, the perception of “proper training” has a mean of 4 and that of “trained to some extent” slightly above 5. That perception tends to the negative as in the case of HE staff.

Qualitiative research results

Outcomes of focus groups with employers included the following:

- Emphasis on autonomy to learn and use digital tools.
- Difficulty on evaluating digital skills at recruiting time.
- Perception that HE does not train with sufficient intensity.

The discussion on autonomy have implications that are directly connected to instructional design. This can be linked to main outcomes of focus groups with HE staff:

- Digital skills not considered in job posting.
- Uneven training in different competence areas.
- Concrete case: "transferable skills" courses, with no systematic curricular approach.
- Situated learning and PBL.

The mentions to situated learning and problem-based learning (PBL) is connected to the mention to "autonomy" appearing in the discussion with employers and is the most important finding regarding the training approach. An approach based on concrete settings is also proposed by Martin and Grudziecki [17] in their model to developing digital literacy, that considers that the "[learning] task or problem arises out of the individual's life context; it may concern work, study, leisure, or any other aspect of the life context.". For example, in the context of military education, it has been pointed out that digital skills should take place in context and adapt to different profiles via collaboration and mentoring [18], and that consideration may be applicable also to non-military contexts, as the contents can be regarded as similar. Further, constructivist, real world contexts are mentioned as preferred in the same study. This was coherent with the outcomes of the focus groups with HE staff, in which the role of situated learning appeared as key as the competences to be acquired can only be meaningful when inserted in the context of real or realistic setting. This, according to the ICAP framework described by Chi & Wylie, [19] of engagement in learning, corresponds to constructive and interactive modes.

Other interesting insights obtained included the applicability of problem-solving instructional design close to real world and provided with the necessary supportive information [20]. Digital skills are seen as cross-cutting and for that reason, instruction is not oriented to particular contents, but to skills that need to be realized on particular contexts that may be different for different students. For example, DigComp elements could be used in a context of medical education, or in the context of entrepreneurial education, in that latter case maybe combined with EntreComp concepts and ideally, taking place in the most realistic environment possible, as in a real business incubator.

The focus groups with employers support the perception of a gap in digital skills

training evidenced in the survey. In the case of HE staff, that gap was put in connection with the need of an approach to develop a systematic training in the curriculum, rather than the offering of isolated, independent courses that may be to some extent overlapping, disconnected or not covering all the competence areas evenly.

Focus groups with students were also critical with the approach of the training rather than with the intensity, concretely pointing out to a need of an approach that focus more on workplace situations and less on concrete tools. It also revealed a perception of uncertainty on the level of digital skills required, similar to the one appearing in the collective of HE staff.

Limitations

Survey results are limited in sample size and subject to convenience, non-representative sampling among the dissemination channels of the project partners. While it has been stratified by stakeholder group, it should be considered only as a pilot for future research informed by the results gathered so far. In consequence, the results of the survey and also obviously of focus groups should not be directly generalized to other regions without further inquiry. However, they clearly show that exploring relative importance of competences to different stakeholder groups is worth studying.

Another important limitation is the understanding of competences and competence areas, that may affect the validity of the research carried out. Concretely, the description of areas of DigComp may be hypothesized to be ambiguous to some extent which may affect the results, even though it has been found adequate in previous qualitative research for healthcare education by Evangelinos & Holley (2014). In order to investigate that potential limitation, we carried out two experiments with members of the consortium (that were in consequence aware of DigComp categories). In the experiments, we took a random sample of 20 digital skill descriptions directly extracted from the guides of DigComp and asked the participants (two groups of 6 people each) to cluster them into the 21 DigComp competences. We analyzed the agreement of the participants using Fleiss' Kappa measure, with results of 0.28 and 0.43 which denotes "fair agreement" and "moderate agreement" respectively. This provides an evidence that there is a degree of agreement but deserves further research into the understanding of DigComp competences as clusters of digital skills. In that direction, the use of alternative frameworks as the one described by Alkali & Amichai-Hamburger (2014) may provide different views on the topic but require an understanding of the core dimensions: photo-visual, reproduction, information, lateral and socio-emotional, which may become even more challenging to interpret by the non-expert that DigComp categories.

PART III. CONCLUSIONS AND OUTLOOK

Main conclusions

The research phase of the DSA project has resulted in a better understanding of the priorities and differences among stakeholder groups. Notably, surveys have provided evidence on gaps in the relative importance of competences as perceived by different stakeholder groups, which may be used to inform educational offerings. Nonetheless, correlation between preferences among groups is high (>0.8) except for the case of civic institutions with students and HE staff, which deserves separate attention. Also, it is remarkable that the perception of employers and civic institutions alike is that digital skills are not completely accomplished by HE curricula or programs.

With regards to HE institutions, the limited evidence gathered points out to the need to understand curriculum design in digital competences, as it may be the case that the design is not systematic, jeopardizing its effectiveness or neglecting key areas while overemphasizing others.

Future work should start by inquiry in the specifics on how digital skills are covered across the curricula, and which are the best teaching methods for them. There is a lack of research on the application of integrated, situated instructional approaches for these skills (with some exceptions addressing digital literacy as (Garrido, Sullivan & Gordon, 2010)), while they appear as the best candidates since they are considered as basic, transferable building blocks for domain-specific competences, and can hardly be approached without a realistic context, ideally one that is close to the work environment that students will be faced with when entering the workforce. Further, it should also address how uses of different technologies by HE students (Vassilakaki, Moniarou-Papaconstantinou & Garoufallou, 2016) can be applied to digital skill training.

The following is a summary of the main findings in list form:

1. DigComp provides an adequate reference framework for research and inquiry on digital skills, albeit it requires explanation and the separation in areas in not in all cases clear-cut.
2. Both employers and HE staff perceive a clear gap between training and needs in digital skills. Among the reasons, a lack of a systematic approach to design training was identified.
3. Different stakeholder groups have different perceptions of the relative

importance of digital competences, but the correlation is high. An exception is that of civic organizations, which (not surprisingly) have a different stake at some competences as engaging in online citizenship and managing digital identity.

4. In overall terms, information competences are considered the most important across all stakeholder groups, followed by communication skills.
5. Other important competences ranked high are developing content for employers and in the case of students, protecting devices.
6. Training digital skills is training transferable skills, and as such, the guidelines need to be generic, that should be adapted to meaningful contexts.
7. Situated, realistic training settings are considered good practice so that students are able to work with open, ill-defined problems that challenge their ability to be effective in real-world situations.

The findings have implications in training design and organization. From an organizational perspective, the differences in importance shall be taken into account when recommending training paths. The implications on training design are described in what follows.

Implications for training design

The results of the research conducted has implications for the design of training on digital skills in different aspects that are described in what follows.

Content

Digital skills are in nature transferable, i.e. they could be reuse across domains or contexts. In consequence, the emphasis should not be in the contents or particular tools, but in acquiring the right skills. That opens the possibility of tailoring the training to the background, context or interest of students by varying the actual content but not the type of tasks to be performed.

In consequence, resources to foster digital skill training for instructors need to be actually lesson plans and guidelines, that are intended as templates and guidance for the creation of actual training content that shall be specific to the background or intended context of the learning experience.

Evaluation

As digital skills are transferable, student evaluation should focus on applying the skills to open-ended situations rather than recalling facts or being able to carry out tasks that are simple variations of those that were part of the training.

A possible approach to measuring the acquisition of the skills is that of pre- and post-assessment comparison using contextualized cases. This enables first an assessment of the initial degree of competence of participants, and the change experimented after the training took place. In any case, evaluation shall be based on complex situations and not on simple instruments as tests.

Instructional approach

As digital skills are intended to be fundamental in daily working with technologies across domains, the preferred approaches are those that set the training in a context that is close to workplace activity, and that requires the use of actual tools or information seeking strategies.

Situated learning and Problem-Based Learning (PBL) are examples of instructional methods that allow for setting a context in an open problem. For example, PBL starts from setting the context of a problem, and the students in groups reason about the gaps in their knowledge that shall be filled to progressively resolve a complex problem or ill-defined situation. This goes beyond evaluating simple proficiency with computer based tools, which are seen as a pre-requisite but not as the key ability to resolve the situation. For example, being able to use some Internet tool may require proficiency with browsers, navigation and use of spreadsheet-like data, but this is not enough to solve a problem in which the key is that of contrasting different pieces of information on the basis of its credibility.

Example context

As part of the discussion of IO1 outcomes in the second transnational meeting, the concrete setting of entrepreneurial activity was discussed as a meaningful context for digital skill training. This context is adequate for the following reasons:

- It is related to workplace activity and can be adequately framed in business objectives or organizational aims, clearly connecting digital competence with realistic needs.
- Its range of activities is broad, as it encompasses all the activities of a new enterprise, which range from ideation and market analysis, to actual marketing

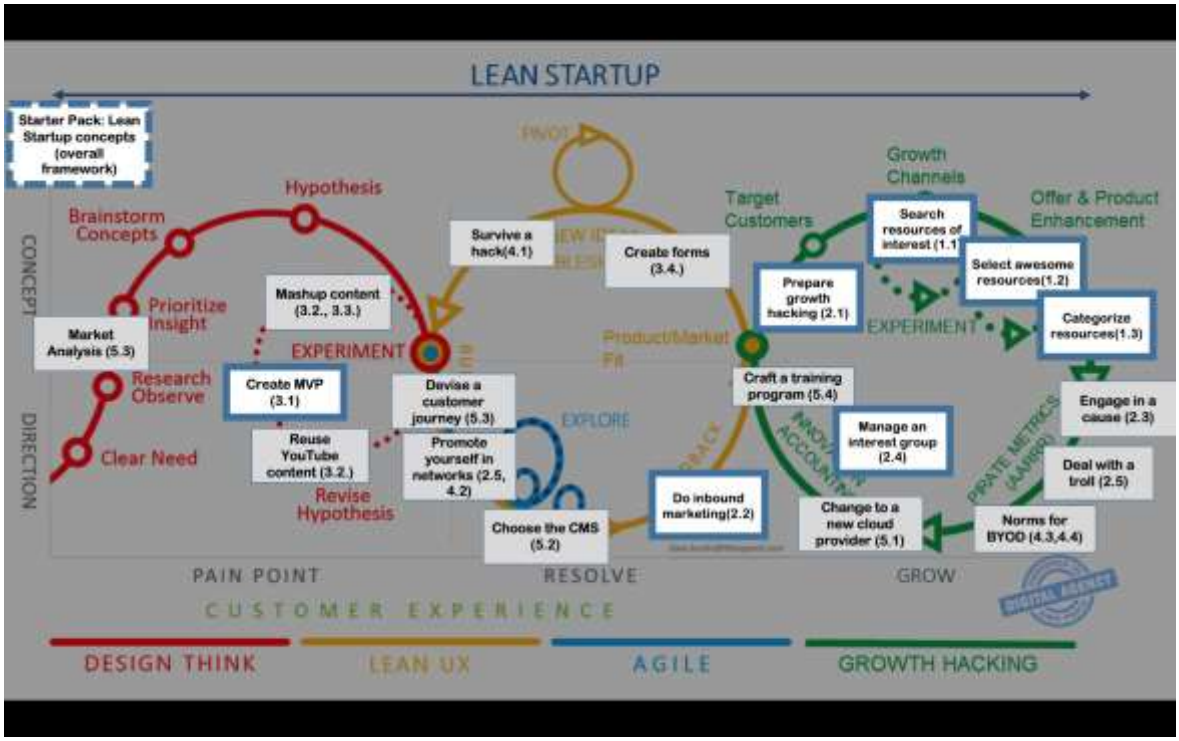
and customer interaction and communication, and it also can be used to frame aspects as security or safety.

- The content can be easily adapted, as the actual sector, business area and context of a hypothetical start-up can be tailored to the background of the students, or to local or regional needs, e.g. it can be focused on a tourism startup or on a startup providing services to industrial processes, depending on the country, region and/or socioeconomical circumstances of the participants.
- It allows for group-based, collaborative and project or problem-based instructional approaches, including role playing, providing instructors with a flexible context to adapt their strategies.
- It may include citizenship and civic aspects, in the context of social responsibility or ethical concerns when for example, dealing with user data.
- It is well suited to young graduates and potentially appealing to students that consider entrepreneurship or creative creation in their present or future horizon.

The Lean Startup method for entrepreneurs provides an adequate context, as it is well known and widely applied across business schools and incubators. It is simple to understand, and training programs are widely available. That is the reason why that method was considered as the framework for devising example lessons or learning situations.

The following Figure shows how particular lesson plans can be inserted into a Lean Startup life cycle[3] that applies also concepts from design thinking, agile methods and growth hacking.

[3] Using the infographic from Stephane Delbecque: https://twitter.com/sdelbecque/status/640935035198152704



The Figure shows how different possible practical tasks (the names are just examples, not a final definition of the tasks) can be contextualize in different steps of the lean startup life cycle. The boxes with the tasks have a reference to the DigComp competence number. Those with a thick border are those considered more important for the hypothetical context of the training. A first "starter pack" is used to provide the required background information on Lean Startup to students not familiar with the concepts and methods. The following are initial ideas discussed on some of the training topics, as statements of possible learner tasks or situations (at a high level of definition, not concrete tasks), and connected to the startup context discussed:

- Content creation (competence 3.1):
  - "Create the Web page selecting the most appropriate and cost-effective applications, combining media and using tools for information architecture (e.g. wireframing, card sorting, etc.)"
  - May be considered as an MVP for validation.
- Interacting via digital means (2.1):
  - "Find social networks and forums relevant to the audience of X to engage and attract them to the new community. Identify and follow potential influencers. Keep track of communication and leads."
  - Considered as part of the marketing strategy and bootstrapping (even "growth hacking").
- Sharing via digital means (2.2):
  - "Create and reuse content with proper licenses to nurture the community. Engage in response to the content"

    - Considered as inbound marketing actions.
- Collaborating digital means (2.4):
    - “Create an interest group in one of the aspects of X and manage and drive it towards producing a shared statement, document or report. Track changes and versions and use tools for gathering opinions and reporting statistical findings, e.g. Survey tools”.
    - Requires actual collaboration, maybe simulated among the students themselves.

As it can be appreciated in the list of initial ideas, the tasks require proficiency with digital tools but all they require critical consideration and contrast of options, as they are open tasks that are bound to a particular context that can be tailored or described in full by the trainer. This allows a combination of autonomy of the student, working independently or in groups, with clear criteria for assessment of the outcomes on the basis of the rationale provided for the selection made for a number of decisions, including platforms, tools, methods or messages.

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ANNEX I. GUIDELINES FOR PARTNER RESEARCH

Survey preparation and dissemination

Survey design

The survey aim is that of prioritizing or sorting the digital skills that are perceived to be more important for the different stakeholder groups.

A first problem is that the notions of knowledge, skill and competence are sometimes used informally interchangeably and it cannot be taken from granted that the respondents would share a common understanding. This is why instead of gathering data via open questions or open-ended lists, the competencies of DigComp are used as "skill categories" that can be understood broadly. This provides also the added benefit of getting data using a consistent, coherent and widely adopted framework, avoiding the introduction of ambiguity in manual coding or grouping of responses.

A second problem is that competences in DigiComp are rather broad categories that may be difficult to interpret by respondents. This is why in the description of the competences, the examples provided in Dimension 4 of DigComp have been incorporated in the questionnaire.

Regarding the categories of the questionnaire, there are three sections in it responding to three information needs:

- **Demographics**: This section characterizes the respondent. This varies with the kind of stakeholder group. For example, when directed to students, it collects personal information and the study area for example, but in the survey for companies and organizations, it takes sector and company size among other information elements. These demographics will then be used to cluster the responses and contrast sub-groups of respondents in search of differences.
- **Importance of digital skill categories**. This is the main section, gathering the relative importance of competence areas (understood as skill groupings).
- **Open comments and rationale**. This section allows for gathering additional information that can't be captured in the preceding section.

The type of question in the main section has been chosen to be "sorting" in which the respondent, using "drag and drop" simple sorts the competences by importance. Using

a numeric or ordinal scale instead would have brought the problem that it is difficult to estimate importance using a scale, so the simpler approach of capturing relative importance have been used instead. This fits well with the aim of the research done that is essentially that of prioritizing skills.

Determining the survey for the right stakeholder

Partners should first identify the version of the questionnaire to be submitted. This depends on the stakeholder. While the surveys are similar, the information gathered is of a different nature and there are slight differences in the wording of the survey.

Survey tool used

Survio.com

Guidelines for focus group research

What is a focus group?

We can take this generally accepted definition of the method:

"A **focus group** is a small, but demographically diverse group of people whose reactions are studied especially in market research or political analysis in guided or open discussions about a new product or something else to determine the reactions that can be expected from a larger population"[4]

In consequence, a focus group emphasizes the qualitative aspect of research, in a setting in which the participants are asked about their opinions and beliefs and can freely interact and talk with each other.

Preparing focus group research

Focus group research is an establish practice in social science research. As such, there are a considerable number of books, articles or Web guides available that describe the steps and format of a focus group. It is important to differentiate focus groups from other research techniques as surveys (that are also used in DSA). A quick reference and comparison with other methods can be found in (Grudens-Schuck et al., 2004), the following Table from that guide summarizes the format and typical setting of a focus

[4] https://en.wikipedia.org/wiki/Focus_group

group.

For more detailed accounts of focus group meetings, the references (Bloor, 2001) and (Bader & Rossi, 2002) can be used. The first one is more technical and provides a good account of different pitfalls in focus group research. The second one is of a more practical, "hands-on" nature, so that it is a preferred starting point for the preparation of the research.

Element	Focus Groups
Format	Group session
Size	8-12 per session; invite twice as many
Length	1.5 to 2 hours
Number of sessions	Varies; should be more than 1
Participants	1. Selected; by invitation only 2. Similar characteristics
Forms of data	1. Conversation, including tone of voice 2. Silences (words and issues) 3. Body language
Data collection	1. Audiotape 2. Transcribe
Moderator	1. Flexible yet focused 2. Uses interview guide; modify based on early sessions
Formats for reporting	1. Selected quotations 2. Analysis of repeated themes

Description of the focus group and recordings

Each partner will detail the specifics of each session to be included in an Annex to this document. Focus groups are typically recorded for later analysis of the conversations, the partners shall plan for that data gathering. After each session, the partner will study and analyze the transcripts and records of the meeting and produce a short summary of the findings, details on how these reports can be done are in the literature selected.

Those summaries will then be consolidated, and the common findings will be summarized in this document.

Recommended variant

We recommend whenever possible using a **dual moderator focus group** in which one moderator ensures the session progresses smoothly, while another ensures that all the topics are covered.

ANNEX II. QUESTIONNAIRES

Questionnaire for students

Dear Sir / Madam,

Many thanks for participating in this survey. This survey is part of the **Erasmus+ Digital Skills Accelerator Project**, you can find more information here: http://www.digitalskillsaccelerator.eu/

The main aim of the survey is identifying the **needs that students consider are most important for the workplace, i.e. those most valuable for employers.**

1. Tell us the country in which you study

2. Tell us your gender

Select one answer

- Female
- Male

3. Tell us the kind of degree you are studying now*

Select one answer

- Bachelor
- Master/postgraduate studies
- Ph.D.
- Other

4. Tell us about your progress*

Select one answer

- I am in the first year of the degree

- I am in the second year of the degree
- I am in the third or further year of the degree
- Other...

5. Tell us the field of study of the degree you are taking

Examples: Mechanical Engineering, Communication, Economics, etc.

Skills can be defined as the **ability to apply knowledge and use know-how to complete tasks and solve problems**. Digital skills are those skills that are needed for a number of areas of competence. In the next question, we list areas of competence that serve to group skills, according to DigComp.

NOTE: DigComp is an European framework describing digital competencies that is used in the next question, you can find more information here: https://ec.europa.eu/jrc/en/digcomp

6. Which are the most important digital skills for finding a job and having a succesful career path?

Order answers by dragging them over to the right column. Please read them all first. We encourage you to consult DigComp if you are not familiar with it before responding to gain a better understanding of these groups of competences.

7. Give us some examples of key digital skills in jobs in your field of study*

Please list the most important examples of digital skills, being specific of your domain or business here is welcomed.

8. Do you have any other comments/suggestions?

9. Do you want to be informed of the results of the survey and other activities of the project?*

Select one answer

- Yes
- No

10. If so, please give us a contact email

Questionnaire for employers

1. Tell us the country of your organization*

2. Tell us the size of your organization*

Select one answer

- Micro-SME (1-9 employees)
- SME (10-50 employees)
- Medium organization (51-250 employees)
- Large organization (250+ employees)

3. Tell us the sector of activity of your organization*

Examples: Retail industry, automotive industry, education, health.

4. Tell us about the main job roles at your organization*

List the most frequent and core job roles or positions in your business, these are the ones that we ask you to consider in the rest of the survey.

5. Which is your position at your organization?*

Tell us about your position or role at your organization, specifying position and area, e.g. financial officer, technical support, HR director, etc.

Skills can be defined as the **ability to apply knowledge and use know-how to complete tasks and solve problems**. Digital skills are those skills that are needed for a number of areas of competence. In the next question, we list areas of competence that serve to group skills, according to DigComp.

NOTE: DigComp is an European framework describing digital competencies that is used in the next question, you can find more information here: https://ec.europa.eu/jrc/en/digcomp

6. Which are the most important digital skills for your organization?

Order answers by dragging them over to the right column. Please read them all first. We encourage you to consult DigComp if you are not familiar with it before responding to gain a better understanding of these groups of competences.

7. Give us some examples of key digital skills in your organization*

Please list the most important examples of digital skills, being specific of your domain

or business here is welcomed.

8. Do you have any other comments/suggestions?

9. Do you think students are properly trained with the key digital skills needed for the workplace?* [1-10]

10. Do you want to be informed of the results of the survey and other activities of the project?*

Select one answer

- Yes
- No

11. If so, please give us a contact email

Questionnaire for HE staff

1. Tell us the country of your organization*

2. Tell us the number of students of your organization*

Select one answer

- 100-1000
- 1000-10000
- 10000+

3. Tell us the kind of educational organization you work for*

Select one answer

- State-owned University
- Private University
- Business School
- Vocational training organization

4. Which is your position at your organization?*

Tell us about your position or role at your organization, specifying position and area, e.g. financial officer, technical support, HR director, etc.

5. Which discipline or area of study you teach/research/are responsible for?*

Skills can be defined as the **ability to apply knowledge and use know-how to complete tasks and solve problems**. Digital skills are those skills that are needed for a number of areas of competence. In the next question, we list areas of competence that serve to group skills, according to DigComp.

NOTE: DigComp is an European framework describing digital competencies that is used in the next question, you can find more information here: https://ec.europa.eu/jrc/en/digcomp

6. Which are the most important digital skills that your students would need when joining the workforce?

Order answers by dragging them over to the right column. Please read them all first. We encourage you to consult DigComp if you are not familiar with it before responding to gain a better understanding of these groups of competences.

7. Does your organization provide courses or modules specific for training digital skills?*

Select one answer

- Yes, as separate courses, modules or tracks.
- Yes, but digital skills are introduced together with content in regular courses.
- Not specifically.
- Other

8. Give us some examples of key digital skills in which your students are trained explicitly*

Please list the most important examples of digital skills, being specific of your domain or field of study here is welcomed. You can list titles of specific courses if any

9. Please give us your opinion of digital skill training at your institution*

- Assign **10** points
- **Students are properly trained in digital skills required for the workplace.**
- **Students are to some extent trained in digital skills required for the workplace.**
- **Digital skill training is not provided in the degrees or courses.**

10. Which on your opinion are good/best practices in providing digital skills training?*

Tell us your opinion on educational methods, pedagogical innovations, tools or practices that are effective in digital skill training. These may or may not be used at your institution. Please be as specific as possible.

11. Do you have any other comments/suggestions?

12. Do you want to be informed of the results of the survey and other activities of the project?*

Select one answer

- Yes
- No

13. If so, please give us a contact email

Questionnaire for civic organizations

1. Tell us the country of your organization*

2. Tell us the number of members of your organization*

Select one answer

- 0-100
- 100-1000
- 1000-10000
- 10000+

3. Tell us the kind of organization you work for*

Select one answer

- State-owned organization
- Non-Governmental Organization

- Non-Profit association
- Other...

4. Which is your position at your organization?*

Tell us about your position or role at your organization, specifying position and area, e.g. volunteer, communication, technical support, director, etc.

5. Which sector/area are you responsible for?*

e.g. social inclusion, education, human rights, etc.

Skills can be defined as the **ability to apply knowledge and use know-how to complete tasks and solve problems**. Digital skills are those skills that are needed for a number of areas of competence. In the next question, we list areas of competence that serve to group skills, according to DigComp.

NOTE: DigComp is an European framework describing digital competencies that is used in the next question, you can find more information here: https://ec.europa.eu/jrc/en/digcomp

6. Which are the most important digital skills that young people (with a special focus on students at university level) would need to become active citizens?

Order answers by dragging them over to the right column. Please read them all first. We encourage you to consult DigComp if you are not familiar with it before responding to gain a better understanding of these groups of competences.

7. Does your organization provide courses or modules specific for training digital skills?*

Select one answer

- Yes, as separate courses, modules or tracks.
- Yes, but digital skills are introduced together with content in regular courses.
- Not specifically.
- Other...

8. Give us some examples of key digital skills in which you provide training*

Please list the most important examples of digital skills, being specific of your domain or field of study here is welcomed. You can list titles of specific courses if any

9. Please give us your opinion of digital skill training at your organisation*

- Assign **10** points
- **Students are properly trained in digital skills required for the workplace.**
- **Students are to some extent trained in digital skills required for the workplace.**
- **Digital skill training is not provided in the degrees or courses.**

10. Which on your opinion are good/best practices in providing digital skills training?*

Tell us your opinion on educational methods, pedagogical innovations, tools or practices that are effective in digital skill training. These may or may not be used at your institution. Please be as specific as possible.

11. Do you have any other comments/suggestions?

12. Do you want to be informed of the results of the survey and other activities of the project?*

Select one answer

- Yes
- No

13. If so, please give us a contact email

ANNEX III. REPORTS FROM FOCUS GROUPS

Target	Focus group – educational experts (senior instructors)
Participant	UAH
Duration	2 h, 12 min.
Participant profile	6 senior instructors (>5 years teaching experience). Teaching background (main area of study): 1 Law, 2 Computer Science, 1 Economics, 1 statistics, 1 marketing.
Main findings	***Are digital skills perceived as important for entering the job market?*** Overall perception is that they are (perceived as less important by CS instructors), but it is hard to show qualifications in the area, so that recruiting processes are often not considering them explicitly.
	Do you think the University is providing sufficient digital skills training? Overall perception is that the offering is sufficient in the volume of credits, but it does not cover all the important areas equally.
	How is your organization providing such training? The University provides a program of "transferable training" that has specific courses on this area. However, the perception on that courses is that the offering is not systematic, and there are overlaps and gaps. Also, the elective nature of the courses does not

	Do you think there are training methods that could improve the provision of digital skills? The emphasis is on a systematic and integrated approach, rather than individual courses of modules. Instructional design methods discussed were Problem-Based Learning (PBL) and learning theories situated cognition (i.e. learning by doing in a situated context).

Target	Focus group - professionals (senior instructors)
Participant	UAH
Duration	2 h,27 min.
Participant profile	1 IT recruiting professional; 2 IT industry professionals; 1 Business School admission and internship manager; 3 non-IT industry professionals.
Main findings	• Are digital skills perceived as important for the daily work activities in your organization? The overall conclusion is that they are a requirement that is sometimes taken from granted, and if lacking, produces problems in performance that are only manifested with time and difficult to discover.
	• Which are the key skills that are most critical for a typical employee in your company? The overall appreciation is that the most important are those related to information search and assessment of the quality of information, as these are enablers for performance.
	• Is the Higher Education system providing the needed digital skills to students? If this is to be understood as use of tools, in general, yes. But the efficacy of individuals in autonomous tasks of searching

	information, and especially, distinguishing quality information is questionable. A problem is that job offerings do not make explicit these requirements but assume them, and it is not clear from the course listing of the candidates if they have acquired them.
	▪ Which are the most important digital skill gaps that you find in students coming from the University? The main problem seems to be in the intensity and focus of training. There is not a systematic addressing of those competences and thus new employees do not understand that they are expected from them in some cases. This creates a problems of gap in expectation from managers and responsible staff that should be addressed by an explicit account of digital skills as something employers need.

Target Focus Group	**Entrepreneurs - Enterprise & Network Agencies Representatives**
Participant	**MMS**
Duration	**1 h, 30 min**
Participant profile	**6 Directors.** Petty Bird x 1 (E-commerce) Moran McNamara x 2 (Tax Advisors/Accountants) Blakes Always Organic x 1 (Organic Food Company) Tremolo x 2 (Music Technology & Computer Science)
Focus Group Questions	1. *Are digital skills perceived as important for the daily work activities in your organization?* 2. *Which are the key skills that are most critical for a typical employee in your company?* 3. *Is the Higher Education system providing the needed digital skills to students?*

	4. *Which are the most important digital skill gaps that you find in students coming from the University?*
Main findings	**1. Are digital skills perceived as important for the daily work activities in your organisation?** • Having the right digital skills for the job in the current climate can be very lucrative to the company making the company and employees more efficient, work smarter and better at their job overall. • Bringing new innovative ideas and ways to do things is often critical to the survival and advancement of a company; the idea that 'you don't know that you don't know' stands the same as 'you don't know how you can improve or how you can do business better' unless you bring in staff that can do their job with the technical expertise to advance the company. • Digital skills allow the company to work with a leaner workforce having the right employees with the right digital skills means they can drive the technology that can look after the mundane predictable tasks and leave the more cryptic and complicated human based tasks to employees. This is particularly important in SMEs • The more digital skill an employee have the better it means they can fill most roles in the organization. This is particularly for companies who have a mid to high-tech requirements as most companies use some form of software, technology and of course Microsoft Office Applications. • Some of the companies prefer to manage their own social media and websites. Having the technology and social media skills spread across the company makes this effort more efficient. Everyone taking part on a collective platform such as Hootsuite makes it easier and consistent. Only one person is needed then to check those outputs before distribution. • Even in sectors that you may not directly associate with having digital skills includes customer service, marketing, retail, managing, writing and selling all have some digital requirement as essential to carrying out the job. • Being able to bridge the digital skills gap in our company would definitely mean we could enjoy a competitive edge over those who don't. It is always a catch up situation and juggle between resources to try and achieve bridging this gap.

	2. Which are the key skills that are most critical for a typical employee in your company? • **Tremelo:** Music Technology and Computer Science (Media Technology) teleconferencing, legalities around music, digital audio workstations, MIDI synthesizers, script writing, production of videos, delopment of digital creative content, artistic digital skills (e.g. multimedia, apps), editing, recording, mixing. • **Pretty Bird**; Online Sales; web development, website design/functionality/, design, content marketing, data analysis, email promotion, testing and information collection, advertising, search engine optimization • **Moran McNamara**; Tax Advisors Accountants, digital intelligence, Sage software, even Excel is important, business intelligence software, data analytics • **Blakes Always Organic**; Organic Food Producers, develop and improve communications and co-ordination of activities across functional areas, corporate governance, regulatory requirements, sustainable planning and development, supply chain management, financial commercial acumen
	3. Is the Higher Education system providing the needed digital skills to students? • Graduates seem to have a general understanding when they come to the work place but they are never specific enough. Most of the time we have to invest our own time, resources and money so they can be on par with their colleagues on the required digital skills. This can hamper resources and widen the gap. • They are not working with entrepreneurs in specific sectors, they are missing out on aligning the unique needs of specific sectors giving graduates an equal level playing field to other candidates who do have these specific skills. • There is a need and willingness for entrepreneurs to collaboratively work with educational systems to deliver the required digital skills in their sectors. This would positively impact course subject and entrepreneurs were willing to even come in and deliver a presentation based

	on what they require so students can gear themselves in the right direction for their preferred digital skills role. • The skills aren't advancing and keeping up with current trends. Not acquiring new and improved digital skills.
	4. Which are the most important digital skill gaps that you find in students coming from the University? • The main hard digital skills across all respondents in most demand are cybersecurity, data management and cloud computing. Particularly with recent Facebook revelations. • Other skills mentioned that are important but graduates may be lacking; customer centricity, data drive decision making, analytics, web development, mobile application design and development, big data, master data management, innovative strategy, user interface design.

Target	Focus group – Lifelong Learning VET Students
Participant	Momentum Marketing Services
Duration	1 h
Participant profile	VET Students
Main findings	***Are digital skills perceived as important for entering the job market?*** • Having the right digital skills for the right area e.g. cyber security there is a short fall in industry and suitable skills are hard to find. • Practical, highly functional systems are the core of a lot of businesses but are neglected in college. Being able to meet the needs of core systems is something worth while having on your CV. • Having diversity, accessibility is important when considering digital skills especially for those with disabilities.

	• Knowing the different types of technology so you can be at least aware of it and how to use it at a basic level. You are expected to at least know a basic level in the most used technologies when leaving college • Languages are important it would be good to know different ways to integrate language in systems e.g. how to translate a website, how to use and integrate botchats, what to consider when building a website and how to create the content particularly videos, 3d videos and imagery • Basic functions would be great to know and is often avoided or missed in college e.g. how to do a basic internet search properly, what to look out for and what to avoid particularly when considering reputable security • Would be great to know more marketing software that would save time and resources and make us more employable and efficient employees e.g. email campaigns with Mail Chimp, Surveys with Survey Monkey, How to do a Blog Page or build a website online
	Do you think the University is providing sufficient digital skills training? • A lot of core practical business required digital skills are neglected, particularly specialist programs such as CRM and security. • There is not enough on the ground learning, plenty of theory which is often out of date which is poor approach for education, little interaction with entrepreneurs and what to expect when you enter the workforce, what happens is you study something really well in college and end up with it either out of date or not applicable. Colleges need to be more in touch with industry needs • Not made aware of what is coming around the corner and future trends with relevant resources to learn if required when we leave the college

	How is your organization providing such training? • Very basic training which is highly theory focused and little technical or practical application • I learn most of the practical up to date information myself online by researching what the companies I would like to work for are using • The information seems to be largely out of date but there is a lot of good practical work just at a basic level, it would be good to go further into an area which I would like to specialise in depending on the job I would like to go for e.g. excel for finance, mail chimp for marketing • Social media and apps are areas that are such a large part of many corporations yet using them is limited, I would like to have a good grasp of these subject areas when leaving college • Even recruitment digital skills would be great, we don't know what digital skills tests recruitment agencies perform and are not sure if we could carry out these tests sufficiently
	Do you think there are training methods that could improve the provision of digital skills? • It would be great to do more on the ground work such as work placements with enterprises, even to shadow or take part in their training programs if available before we leave college (when we have a job lined up) so we are equipped and trained when starting the job • Be more up to date and enterprise relevant • Have more flexible courses e.g. if I am going to work in marketing to have my digital skills focus on marketing skills required • To ask students areas they would like to work on or focus on and

	have project work on case studies that complement so that we have an overall knowledge and understanding with a realistic story behind it • Have enterprises come in and talk about their company's digital requirements (from different industries) so at least we are prepared to know what to expect and if we don't learn in college we can learn another way such as online or private training

Target	Focus group – Civic Institutions
Participant	Momentum Marketing Services
Duration	2 h
Participant profile	Civic Institutions
Size of Org **Kind of Org** **Types of Org**	0-100 State-owned Park Organisation, Libraries, Community Groups, Charitable Organisations, Community Based Learning
Positions	Library Managers x 3, Community Based Learning Tutor x 1, Charitable Organisation Managers x 2, Community Group Leaders x 2
Main findings	***Which are the most important digital skills that young people (with a special focus on students at university level) would need to become active citizens?***

	1. Protecting data and digital identities 2. Engaging in online citizenship 3. Managing digital identity 4. Sharing information and content 5. Storing and retrieving information 6. Netiquette 7. Copyright and licences 8. Evaluating information 9. Collaborating through digital channels 10. Browsing searching and filtering information 11. Developing Content 12. Protecting Devices 13. Interacting through technologies 14. Protecting the environment 15. Solving technical problems
	Does your organization provide courses or modules specific for training digital skills?* *yes* ***Give us some examples of key digital skills in which you provide training (see below)*** • Library Managers x 3 – Public Library System Sierra, How to use the different technical equipment • Community Based Learning Tutor x 1, Digital Marketing Course, General Information Technology • Charitable Organisation Managers x 2 Digital Marketing Foundations, • Community Group Leaders x 2, CRM Management, Finance Software
	Students are properly trained in digital skills required for the

	workplace. They usually do not know about our programs when they come to work with us, we make sure they are properly trained in our individual software and digital systems when they start working with us because it is vital for them to carry out their job ***Students are to some extent trained in digital skills required for the workplace.*** Somewhat in IT systems, General IT Applications and some are trained to intermediate level but a lot don't know the different systems such as CRM, Financial and how to use Excel for example reporting ***Digital skill training is not provided in the degrees or courses.*** It is provided but not on a practical level that can be applied to the real world. They do not understand what our businesses do and what technical/digital requirements we have or why certain skills are important so we provide training to deal with this shortfall. Most people who start working with us are more social media savvy to us which is good but we need to teach them how to use it from a professional point of view, the dos/don't, copyright laws, licences, sharing of information, confidentiality and privacy acts which they are often not aware of. These areas are priority to us.
	Which on your opinion are good/best practices in providing digital skills *training?** • In a realistic setting with real life scenarios with a mix of the general day to day to the more trick to the complex or at least learn what to do in those situations. If they do not know to know who to go to and to not react if you do not have the

	digital skills and knowledge to do so • It would be good if students were educated in different digital cultural types in different organisations as we would be very different to a private enterprise or marketing organisation. Privacy and preservation of citizen rights is priority to us • That students were made aware of the possible negative outcomes that can occur of their actions. That they are taught that they must be 100% confident in their actions before progressing • Auditing digital skills, we are all audited every year and a lot of this is done from digital documents, if students were made aware of auditing requirements when auditing documents e.g. the date/name/version/purpose formatting
Target	Focus group – civic institutions
Participant	ZUT
Duration	2 h, 12 min.
Participant profile	The meeting with Civic Organizations representatives took place on July 3, 2018 in the Regional Centre for Innovation and Technology Transfer (RCITT) building. Regional Centre for Innovation and Technology Transfer operates within the West Pomeranian University of Technology in Szczecin. The Centre was established in 2008 on the basis of International Programmes Office functioning since 1999. RCIiTT conducts counseling and training services for companies, researches, students and university graduates in the field of technology transfer, funding researches and development and supporting academic entrepreneurship. Some of our services are free thanks to funding from the European Commission and the Ministry of Science and Higher

	Education. https://innowacje.zut.edu.pl/ (HB) Hubert Dyba (expert on ICT, MEDICINE, ENERGY AND GAS) from Regional Centre for Innovation & Technology Transfer in Szczecin (TL) Tomasz Łyżwiński (expert on ELECTRIC INDUSTRY, MARINE, AUTOMATION) from Regional Centre for Innovation & Technology Transfer in Szczecin
Main findings	***Are digital skills perceived as important for entering the job market?*** HB: They are important. Nowadays, they are taught from primary school. In Poland passing the Matura exam requires preparation of the presentation about given subject. The presentation project requires a lot of searching, analysing and involved complex content creation process. TL: It's hard to check who possessed digital skills or not. That's why in our organization recruitment process is always associated with intellectual task to do. This task requires various digital skills.
	Do you think the University is providing sufficient digital skills training? TL: According to my observations, graduates of technical faculties have a higher level of digital skills. However, it is often very focused, related to the skills associated with their future work and studies program. HD: The acquisition of soft digital skills is supported by various universities initiatives. For example, I run courses related to content creation and management at Samsung Lab.

ANNEX IV. REGIONAL EMPLOYER NEEDS AND DIGITAL SKILLS

This annex reports part of the results of the Intellectual Output 1 (IO1) of the Digital Skills Accelerator (DSA) project, describing concretely activities undergone to identify regional needs and best educational practices as related to training in digital skills.

The research conducted combined surveys targeted to the different stakeholder groups with focus groups. The results are intended to inform the contents, design and instructional approach of the training materials that are part of other Intellectual Outputs of the project.

Here we understand regional in the sense of socio-economic regions, and we have identified the following regions as related to the partnership in the project:

- Southern Europe, including Spain as the country of reference and Belgium[5].
- Northern Europe, including UK and Ireland.
- Central Europe, including Poland.

While the definitions of those regions are not strict and varies according to the source, it served as a framework for the attempt of finding differences. Concretely, Poland is often considered as part of a differentiated Baltic region, and the British Isles also as a different region. In any case, these differences are only used as a tool for analysis of insights and not as a separation of concerns. The overall differences in digital skills according to the latest data from the Digital Agenda Scoreboard of the EC6 however give a different picture, with Spain, Ireland and Poland in more comparable status when looking at the average of EU countries than UK. However, these differences are not so large. For example, in the indicator for persons using computers at work for 2017, UK ranks high in the group of partner countries with a 57%, and Poland with a 40%, but Spain and Ireland are in a 51%. The detail of the different areas in the scoreboard are provided in the following Table.

[5] EUCEN carries out its main activity in Spain, so that no additional regions have been included.

[6] Available at https://digital-agenda-data.eu 2018 data not complete at the time of this writing. It should be noted that interesting data series as perception of preparedness related to digital skills for work are only available for 2011, so we have not used them as a source of information.

Indicator	Poland	Spain	Ireland	UK
Have written a computer program	3%	6%	5%	10%
Basic or above basic Digital Skills - Information domain	94%	92%	94%	92%
Basic or above basic Digital Skills - Communication domain	89%	91%	95%	97%
Basic or above basic Digital Skills - Problem solving domain	83%	84%	87%	94%
Basic or above basic Digital Skills - Software for content manipulation	64%	68%	61%	77%

It is noticeable that the differences are small in the "Information Domain", while there are wider differences in some others, if we consider the two groups of countries mentioned above. However, the differences may be attributable to different factors other than regional differentiated needs. While they do not correlate with macroeconomic variables as GDP per capita, it can be hypothesized that they do roughly with percentages of internet users. As it can be appreciated when looking at the available data, it is difficult to find regional differences that can be attributable to differentiated needs, and hypothesizing those may require a detailed breakdown of digital tool use across sectors in national economies, for which data could not be found at the European level.

Consistently with the analysis just provided, the survey and focus group research conducted as part of DSA activities did not reveal significant insights of the need of a specialized digital skill training when accounting for the nationality of the survey respondents or the participants in focus groups. Also, no previous studies on differentiated regional needs for digital skills were found during desk research. In consequence, we approached the research on that particular element by direct interview in an attempt to identify potential regional differences that may set future directions for inquiry. The interviews conducted were structured, aimed at the stakeholder group of employers only, and the items are provided in the following Table.

Issue	Questions
Control question	Do you think there is a gap in the digital skills of HE students when they confront the workplace? Which are those that require more attention?
Regional specificities	Do you think there are some digital skills of special specific importance in your country or region? Can you name some?
Regional differences	Which do you think are the main differences of your country with other in the EU about the need of digital skills?
Lifelong learning	Do you think there is a gap in the training of digital skills for lifelong learning in your region?
Entrepreneurship	Do you think there is a gap in the training of digital skills for entrepreneurs in your region?
Citizenship	Do you think there is a gap in the training of digital skills for entrepreneurs in your region?
Context	Can you describe some situations in which a digital skill gap is creating problems or inefficiencies?
Best practices in teaching digital skills	Do you know of some best practice in digital skills training in your region?

The protocol of the interview was as follows:

- Providing the participant with some basic context information: digital skills and categories and examples of digital skills according to DigiComp framework.
- Following the questions in the above table and taking notes of the relevant comments.
- Final reflection and opportunities to discuss ideas or issues not covered in the questions, according to the opinion of the interviewed expert.

If we consider more specific geographical areas, taking into account the surrounding areas of the specific locations of partner's offices, we can get a more detailed picture of potential differences that affect the job market. What follows is an analysis of those main characteristics, focused on the particular countries of the partners, followed by the findings of the questionnaire interview, in an attempt to fill the gap in statistical data with some qualitative insights. In the case of best practices in training digital skills, the studies did not result in any example of good practice. While many courses and offerings from HE regarding digital skill training, no study with a scientific or at least evidence-based evaluation of the initiative was found. As a consequence, the examples collected could not be classified or sorted on the basis of any sound evidence, thus no good practice was found for which a reliable basis could be taken as criteria.

Madrid and countryside of Henares in Spain

The major industries that drive the economy of Spain are the tourism, manufacturing, agriculture, and energy industries. During the last four decades Spain's foreign tourist industry has grown into the second-biggest in the world, and the tourism industry is considered as one of the world's most competitive.

The University of Alcalá is located 35 kilometers northeast of the country's capital, Madrid, at the town of Alcalá de Henares, that has its origins in the roman town called Complutum. It stands out for its rich archaeology and as a cultural place, as its historical center is one of UNESCO's World Heritage Sites. The author Miguel de Cervantes was born in Alcalá de Henares, and many important figures of the Spanish Golden Age are connected or studied at the University. But the surrounding area, known as countryside of Henares (the river) is also a highly industrialized area. This creates a combination of attraction for tourism, especially cultural tourism, and a residential area for one of the highest concentrations of industrial and technology enterprises in Spain.

Madrid is one of Europe's largest financial centers and the largest in Spain. The city has 17 universities and over 30 research centers distributed in the surrounding area. It is the third metropolis in the EU by population, and the fourth by gross internal product. In consequence, the area is a hub for employment in industrial and technology companies, with unemployment rates significantly and systematically lower than in the

rest of the country. Madrid is also considered one of the top European destinations concerning art museums and it is a destination for events or as a destination for visiting other parts of the country.

According to CEDEFOP in 2017[7], in the digital economy and society index (DESI), Spain is weak on the demand side, with low levels of digital skills and internet use; only 54% of Spaniards have basic digital skills. However, it is, strong in the use of digital technologies and in digital public services, the area where Spain performs best.

Considering the socio-economic needs of the country and particularly the area, there is a clear need for digital skills training, that can be connected with the major economic sectors in the country.

Structured interviews were conducted with three entrepreneurs, two from IT companies and one from a training company, and also with three managers representative of the tourism, energy and IT sectors. All of them considered that a gap exists in the skills of students, but in the case of IT, it was mostly related to high-end software engineering and technical skills, not basic transferable digital skills. Regarding the differences and specificities, all the participants showed a perception of the country labor force to be in general below the mean in the EU. However, no concrete gap in DigiComp competences areas was clearly pointed as a lack specific to the region. Similarly, there was no clear differential gap for entrepreneurship or lifelong learning, and only in the area of citizenship there was an opinion that more emphasis should be given to communication skills.

Szczecin and the West Pomeranian Voivodeship in Poland

The economy of Poland is the sixth-largest economy in the European Union, GDP per capita at purchasing power parity growing on average by 6% p.a. over the last two decades, the most impressive performance in Central Europe, which in effects doubling Polish GDP since 1990. The largest industries in Poland are the agriculture, manufacturing, energy, and tourism industries.

The West Pomeranian University of Technology, Szczecin (Polish: Zachodniopomorski Uniwersytet Technologiczny w Szczecinie, ZUT) is a technical university in Szczecin, Poland. The university was established on January 1. 2009 in Szczecin, from the merger of the Agricultural University in Szczecin and the Szczecin University of Technology.

[7] http://www.cedefop.europa.eu/en/news-and-press/news/spain-promoting-digital-skills-young-people

The University has 10 faculties with 47 fields of study. The university employs 2.3 thousand employees, and about 15 thousand students are taught at the University. The main goal of the University's activity is to educate and conduct scientific research in the field of technical, agricultural, economic, biological, chemical and mathematical sciences.

Szczecin is the capital and largest city of the West Pomeranian Voivodeship in Poland. Located near the Baltic Sea and the German border, it is a major seaport and Poland's seventh-largest city. The area of Szczecin is known as a vital place for the start-up and IT community, and also by its level of maritime and production sector. Besides the West Pomeranian University of Technology, Szczecin is the site of the University of Szczecin, Pomeranian Medical University, Maritime University, Szczecin Art Academy.

According to CEDEFOP in 2018[8], in the digital economy and society index (DESI), Poland is overall very weak (fourth from the end in EU) on the demand side, with low levels of digital skills in most cases. From this point of view, there are some urgent needs in terms of the development of digital skills.

Structured interviews were conducted with: dozen of entrepreneurs, from different industries - from production, through retail to IT. All representatives were on the top-management level but different in functions - managing, hiring, engineering. All agree upon key findings, that there is a room for improvement in an education process which should in effect deliver a better understanding of the digital skillset and its practical usage.

Northern Ireland part of the United Kingdom

The economy of the United Kingdom is highly developed and market-orientated. It is the sixth-largest national economy in the world. The service sector dominates, contributing around 80% of GDP; the financial services industry is particularly important, and London is the world's largest financial centre. Britain's aerospace industry is the second-largest national aerospace industry. Its pharmaceutical industry, the tenth-largest in the world, plays an important role in the economy.

Northern Ireland is a constituent country of the United Kingdom located in the north-east of the island of Ireland. It shares a border with the Republic of Ireland to the south and west and is bounded in the north by the Irish Sea and Atlantic Ocean. Northern Ireland consists of six counties. Although its R&D indicators are significantly below UK's average, Northern Ireland presents other strengths, such as a highly educated English-

[8] https://www.cedefop.europa.eu/en/country-data/poland

speaking workforce, one of the youngest populations in the European Union, a competitive cost structure and a pro-business environment.

Northern Ireland is a rather sparsely populated part of the UK. In 2017, it made up nearly 6% of the UK's landmass but had less than 3% of its population (1.87 million people; Eurostat, 2018). It has the smallest economy of all regions within the UK, with a Gross Domestic Product (GDP) of €51.1b, which corresponds to 2.1% of the 2016 UK total and was significantly lower than the GDP of 55.7b in 2015 (Eurostat, 2018).

Northern Ireland also underperforms economically as its GDP per capita (PPS) in 2016 was one of the lowest in the UK at €23,600 compared to the UK average of €31,400 (Eurostat, 2018) and the labour productivity in 2016 was 16.5% below the UK average (UK Office for National Statistics, 2017).

Despite its strengths in school and higher education, Northern Ireland has traditionally lacked the types of firms needed to retain its well-educated workforce. Data from the Labour Force Survey shows that in the first months of 2017 some 16% of the Northern Ireland working age population had no qualifications at all: this was almost eight percentage points higher than the United Kingdom average (8.3%).

Northern Ireland has a particularly poor record for R&D spending by businesses, innovation activity and patents. This shortcoming is becoming more important as developed economies are increasingly relying on commercial knowledge as their competitive advantage in global trade. Research economies, including Finland and Sweden, now have levels of BERD five to six times higher than Northern Ireland.

NI is home to two universities and a number of higher education colleges. Queens University Belfast is a research-intensive university; in the UK-wide 2014 research excellence framework (REF), Queen's had 14 subject areas ranked within the top 20 in the UK, six in the top 10 and two in the top five. The percentage of the population aged 30-34 with tertiary education level in Northern Ireland (35.5%) was below the 39.1% EU average and well below the 48.1% UK average after a sharp decline from the 41.6% just two years before.

In 2016, there were 23,100 people employed in the High Tech sector; in 2017, this number decreased remarkably and resulted in a total of only 20,700 people employed (Eurostat, 2018). In 2017, 35.3% of the population aged between 30-34 years had a degree in tertiary education, lower than the UK average of 48.3% (Eurostat, 2018).

The 2014 Framework for Smart Specialisation identifies five priority technologies: information and communication technologies, life and health sciences, advanced manufacturing and agri-food technologies.

According to CEDEFOP in 2017[9], in the digital economy and society index (DESI), in Human Capital, the United Kingdom performs very well but its recent progress has been rather limited. A large proportion of the UK population uses the internet regularly (93% - at least once a week); most people do so daily; and only 4% of the population has never used the internet. These figures are well above the averages for the European Union, 81% and 13%, respectively. Nevertheless, the UK faces some digital skills gaps. In terms of basic digital skills, the UK performs above average in the European Union: 71 % of the population had at least basic digital skills in 2017; the EU average was 57%. However, as such, almost 30% of the population does not have basic digital skills. The UK also suffers from a shortage of skilled ICT professionals. There is also a strong and growing gender divide with increasingly fewer women studying for and choosing ICT careers. Only 17% of Computer Science students in the UK are female (2016/17).

Structured interviews were conducted with three entrepreneurs, one from an IT company (web development) one from a Food Processing company and one from a training company, and also with three managers representative of the tourism, agriculture and IT sectors. All of them considered that a gap exists in the skills of students, but in the case of IT, it was mostly related to programming, coding and software engineering skills, not basic transferable digital skills.

Regarding the differences and specificities, all the participants were of the opinion that while the Northern Ireland labour force was above the mean of the EU average, it was felt that they were also below the mean of the United Kingdom labour force as a whole (this is in fact broadly inline with macro economic and skills assessments). However, when the DigComp framework was introduced and was used to guide the discussion, a general conclusion was that there were no specifics regional difficulties for particular digital skills, but rather that the Northern Ireland region would be in line with the United Kingdom as a whole.

[9] http://www.cedefop.europa.eu/en/news-and-press/news/spain-promoting-digital-skills-young-people