DATALIT

DESK RESEARCH REPORT

WP1

August 2020

This report is prepared by Susana Martins Marques, UNL

This report is revised by Dr. Pedro Cabral, UNL

Project reference no. 612561-EPP-1-2019-1-IT-EPPKA2-KA

Table of Contents

1. Introduction

This report is produced in the framework of the Erasmus+ Knowledge Alliance, KA2: Cooperation for innovation and the exchange of good practices. This joint research project DATALIT - "Data Literacy at the interface of higher education and business" - is coordinated by the "*Istituto per le Tecnologie Didattiche*" of the Italian National Research Council. The consortium has 14 partners, from 6 European countries, and it is envisaged to last for 3 years, with a total budget of € 595.290,00.

The project DATALIT aims at:

- Offering university students across different Faculties the opportunity to reach a suitable level of data knowledge that they can use and apply appropriately and diversely throughout their personal and professional lives;
- Narrowing the gap between business and academia and putting EU enterprises in direct contact with potential future employees or business partners properly trained to exploit data effectively.

The overall objectives of the project derive from the challenges and needs identified during the preliminary need analysis, and are the following:

- Defining a common understanding of what a data literate person is supposed to know and is able to do, not only as worker but also as an active citizen.
- Designing and developing innovative didactic frameworks related to data literacy that reflect the views and needs of academia and job market.
- Fostering a culture of data literacy among European citizens.
- Making graduate students acquire the data skills they need to success in the job market and to actively take part in the civil society.

This desk research was conducted by all partners of the consortium, for 18 European countries and Tunisia, which aimed to analyse the state of data literacy in each country, by answering some pertinent questions: How is data literacy (DL) perceived? Who are the stakeholders? How is it integrated in Higher Education Institutions (HEI) or

enterprises? What are the most important competences for a literate person? And other relevant questions, whose answers are summarized in this report. The multidisciplinary approach used in this research allows us to obtain the best representative data about DL in the target countries, how it is known by the general public, the Universities (students, staff, and professors), and in the enterprises/private companies.

This report provides results for **Work Package 1** - Developing a comparative needs analysis on Data Literacy - for the project deliverable **1.2** Needs analysis tools.

2. Desk Research from countries analysis

2.1. Albania and Kosovo

2.1.1. Scope

The desk research for Albania and Kosovo was developed by the consortium partner European University of Tirana (UET), from Albania. The focus of UET was to describe how DL is perceived in these countries, how it is covered by Universities courses, how DL is in the enterprise domain, and, finally, what are DL related competences and validation.

2.1.2. Desk Research Interpretation

In Albania, the concept of DL is quite sparse, it is difficult to have a specific definition. Normally, the most common definition regarding literacy fields are *health literacy, audit literacy, information literacy, big data, data modelling,* and *open data*, not specifically DL.

There are different potential stakeholders related to DL, that can be classified in 5 groups of interest [1]:

1) **Individuals, professionals**. Albania and Kosovo are two developing countries. In the context of EU integration, most of general data in country level should become open access and order to discuss about them in different level, in comparison with other EU candidate countries. DL in Albania and Kosovo in this manner will become a necessary skill for all individuals who pretend to participate in these public discussions. This skill will make the difference between an expert and a layman.

2) **Business**. All Albanian and Kosovar companies (especially big ones) that pretend to operate at a international level will not be able to make their business strategies based on their traditional data bases. They need to use DL in order to interpret their data bases, to understand them and to use them as strong arguments during their strategic planes.

3) **Universities (lecturers, students).** DL is a strong skill for all students and researchers who work with data. Indexed journals in national and international level request articles and publications that interprets data and, in most cases, reject the others who make general description of these data. Students and researchers are one of the most important stakeholders of DL in Albania and Kosovo.

4) **Government.** DL is a strong skill for government representatives who need to argue their decisions to all citizens. Data sharing has no meaning at all for most of citizens, but if this data is argued and is used to explain public policies of all levels, then it can have a positive impact to the audience.

5) **Media** and especially those one who are focused on investigative journalism are potential users of DL in Albania and Kosovo. There are a lot of tv media, newspapers, weekly journals etc., who transmit information to the audience but only few of them are able to create this information, to interpret them and open a public discussion for the wide audience.

There are different statistics about these stakeholders, but these statistics are mostly related with their core activity such as business, teaching, information, policy-making etc. There is no statistics according DL for these stakeholders in Albania and Kosovo.

There are a few organizations who deliver DL courses in Albania and Kosovo. In addition to universities/colleges, who are the main providers of DL courses in Albania and Kosovo, other delivers of DL courses are public and private training institutes, professional centres, public agencies (e.g. AIDA, INSTAT) etc. On job training is also a common way to improve DL skills for all employees who work with big data and large volume of information.

Learning technologies are used to deliver DL. These technologies are usually used by universities and/or colleges. Private universities use these programs to provide all university courses, including DL ones. Business actors use different programs to analyse and interpret data such as Microsoft excel, SPSS etc.

There is no direct fund for the validation of DL competences in Albania and Kosovo. Nevertheless, organizations that offer DL courses are the same that in most cases make the validation of these competences by issuing a certificate to all successful participants in their trainings, professional courses, qualification courses etc.

In Albania and Kosovo, one way of classification of DL competences in enterprises, companies, private and public employers, is called *Databilities* [2]. This is a DL competency framework, developed as a tool to measure and develop core DL skills and competencies. DL in itself it is composed by three pillars: reading; writing and comprehension. Each pillar has its own competences, which starts from the lowest level (1st level) to highest level (6th level) (Table 1).

Table 1. Databilities

DATA LITERACY		
READING	**WRITING**	**COMPREHENSION**
Data Discovery	Data Collection	Data Analysis
Evaluating and Ensuring Quality of Data	Data Management and Organisation	Data Interpretation (Understanding Data)
	Data Manipulation	Identifying Problems Using Data
	Data Curation and Reuse	Data Visualisation
	Metadata Creation and Use	Presenting Data (Verbally)
	Data Conversion (Format to Format)	Data Driven Decision Making
		Evaluating Decisions / Conclusions Based on Data

Source: https://docs.wixstatic.com/ugd/1ff4ae_14805e0c8ef14b54bdafd38e44d5de23.pdf

This is used by private and public institutions that usually, include some or most of DL competences listed above such as data collection, data management, data analysis, data interpretation etc, in their hearing announcements for job vacancies.

a. Data Literacy in Universities

In a quantitative perspective, it is in HEI institutions' autonomy to decide the number of modules for each academic year. From the other hand, seen from the qualitative perspective (course content), public and private HEIs follow more or less the same logic and strategy to organize course syllabus. The main courses that cover topics related to DL are Research Methods in bachelor's degree and Advanced Research Methods in master's degree. There are usually semesterly courses. Other courses that cover topics related to

DL are, Statistics (in bachelor's degree), Econometrics, Data Analysis, Data mining (in master's degree) etc. The faculties and departments that offer these courses are mainly informatics, engineering, and finance. DL in the courses that they offer is not part of the whole course but is integral part of the main topics they produce.

Networks with other foreign institutes function through International Relations offices, for international projects and partnerships; exchange programs; guest lecturers from partner institutions etc. Dual degrees are a good example how courses can offer from more than one institution and in this case, more topics related to DL usually are offered from that institution that is more experienced in this field.

The third parties attempt to include training of DL related competences in HE is obvious during the recruitment processes. During the open discussions with Labour market representatives, they usually mentioned the competences they need to see at students of the last year, and some of these competences related to DL, such as data collection, data analysis, data interpretation etc.[3], are usually mentioned from them.

There are collaborations between the business sector and HE regarding DL, especially through guest lecture experts, workshops, trainings, internships etc. In Albania, for example, at European University of Tirana, exists a formal collaboration with the business through a "Board of job market" formed by business representatives and that is part of each department of the university. They have regular meetings where they discuss how closely related are the subject offered by the university with the skill needed by the business, including DL related skills and competences. Whereas in Kosovo in beginning of 2020, the AAB College has created the "Industrial Board" which will play the same role as the "EUT Board of Job market".

Business actors normally have trainings that include DL skills during the internship's programs for the students. These are usually on-job-training and not part of any specific course. The only course that bachelor students can directly participate in training organized from the third parties (such as business partners, public agencies, NGOs, private training institutions etc.) is Practice and Career Development in bachelor's degree.

b. Data Literacy in the Enterprise domain

In job announcements, DL is not specifically mentioned, there are other competences required that commonly more emphasized like teamwork, work under pressure, work independently, self-organisation, communicativeness, etc. For technical positions, where data manipulation and analysis are required, the most common requirement is the MS Excel skills either intermediate or advanced. During the last years, the labour market has entered a dynamic area of continuous changes affecting the workforce and the organizations. In terms of human capital trends in Albania and Kosovo, Learning & Development is classified as both the most important and most urgent trend affecting the Albanian and Kosovo businesses environment. This trend aims to improve group and individual performance by increasing and honing skills and knowledge, therefore directly affecting how tasks and duties are executed. Improving Employee Experience will translate into higher employee engagement, higher retention rate, reduction of recruitment costs, preservation of business know-how and expertise and as a consequence, higher human capital productivity. Upskilling and Updating Leaders' capabilities ensures adequate preparation for leaders to face with new changes in technology, to design work as well as to better manage employee expectations (Deloitte Albania Human Capital report 2019).

UET in Albania, has established the Labour Market Boards per each Department which are composed of highly qualified professionals from the governmental sector, private enterprises, and businesses; CSOs, HEIs etc. The purpose of the board is to provide feedback and insights in regard to the needs/demands of the labour market so as UET can link education, research, and study programmes with the labour market and needs of the society. In addition, they serve as a network for job opportunities for students. In addition, the UET Alumni Association and the Student Services work towards the link between education and the job market. The Alumni Association tracks the alumni in their progress in the job market, up to 5 years after graduation.

Whereas AAB College in Kosovo has established the Industrial Board within the college composed of highly qualified professionals or leaders such as CSOs, HEIs. from the governmental sector, private enterprises, and businesses. The purpose of the Industrial

Board is to review the relevant academic programs within AAB and its literacy, provide feedback and other related insights in relation with the specific professional qualification and competence needs of the industrial market in Kosovo so the AAB College can sustainably link directly its provided education study programs or researches with the relevant needs of the industrial market. Parallel with that AAB Alumni and the student' Service have been working towards establishing the links between AAB specific programs or faculties with the job market by tracking the progress of the alumni students in the job market up to 5 years after graduation at AAB College.

The enterprises in Albania in general, do not offer DL courses to the general public. They have formal or informal training programs for their internal staff. Whereas in Kosovo there are some credible enterprises that do offer provision of specific DL courses such as Kosovo Management Institute, ULearn Systems etc. In addition, in Albania and Kosovo, many businesses have their internships programs where the big companies sometimes offer formal trainings to the trainees. These courses are not focused on DL. There are companies and institutes that offer courses to the general public, but they are not on the DL domain. It seems that there is not a strong market for paid DL courses in Albania, whereas Kosovo stands slightly better than Albania in this regard.

The universities serve as the main source of trained employee for the job market. The best students are the ones who gets hired first. Many of them start as internship programs, where they get on job training, then latter they get fully employed by the businesses. With the close collaboration of the universities with the businesses, sometimes business requires training of their existing staff from the universities through different means, either paid or not paid. Most the trainings required by business are for topics like leadership, marketing, management, human resources, etc., but not on DL. This type of training in general is offered from their internal qualified staff, as on job training in formal or informal settings.

c. Data literacy related competences and validation

DL, as a very specific and limited term, is not widely recognized in Albania and Kosovo and as consequence not documented in organizations documents like strategies, training

plans, etc. Instead, there are related competences, with partial inclusion on DL, like advanced excel skills, database skills, etc. In the national report of 2017 "Skills needs in Albania, 2017", prepared in the support of National Employment Services (NES), and in the report of "Labour Market and Skills Needs Analyses in Kosovo, 2019", prepared by ALLED II – "Aligning Education and Training with Labour Market Needs" Programme, funded by the European Union (EU) and the Austrian Development Cooperation (ADC) there is no identified DL skill or competence.

A methodological guide for piloting implementation of the 'Recognition of Prior Learning mechanisms' was approved in 2013 by the government, with the textile sector selected to undertake the first pilot on drafting the occupational standards 52 and preparation of the assessment tools. Pursuant to the VET Law, a DCM on the Recognition of Prior Learning (RPL) System was drafted in 2018 and submitted for approval. A guideline on occupational standards is prepared and is in use by the working group members, and a set of assessment tools developed and applied on a pilot basis in 2014 for assessing the competencies of textile industry production technicians occupation, with a group of ten assessors trained in how to conduct recognition and certification of competences acquired in non-formal and informal learning.

The Instruction of the Minister of Finance and Economy no. 24, dated 30/07/2018, regulates the procedures for qualifications at levels 2–5 in terms of recognition and certification of vocational qualifications certified abroad by VET providers or other institutions authorized by the country's legal framework. Recognition of foreign qualifications aims at guaranteeing the right of persons to progress in VET, higher education or entering the labour market in Albania.

National Employment Services (NES), an autonomous public entity, is the main actor in Albania focused on employee skills required by the job market in Albania. The largest share of employment is engaged in manufacturing, followed by wholesale and retail trade. Nearly all (97%) of employees work full-time, confirming a very slight interest of companies in part-time employees (PTEs).

The Vocational and Education Training (VET) System in Albania is undergoing a comprehensive reform and is focused on its access, quality, and linkages with the labour market. National Agency of Vocational Education, Training and Qualifications (NAVETQ) has produced a National Employment and Skills Strategy (NESS) 2014 – 2020. Harmonising the skills offered by the VET system and labour market needs, as well as motivating the private sector to become close partners, are considered the biggest and most difficult challenges. The tables (Figure1) below some result for this national strategy for objective D2 and D2.1.

D2. Developing and implementing the Albanian Qualification Framework

No.	Sub-objective	Actions	Status of completion
D2	Developing and implementing the Albanian Qualification Framework	D2.1 Review of the work undertaken on vocational qualifications of the AQF	HP
		D2.2 Establishment and operationalisation of sector committees	IP
		D2.3 Revision and linking of curricula to the AQF	SC
		D2.4 Selecting bodies and putting in place procedures for the validation of qualifications, skills assessments, certification and the validation and recognition of prior learning	HP

D2.1. Review of the work undertaken on vocational qualifications of the AQF

Outputs	Status of completion				
	NS	IP	HP	C	SC
Legal framework for AQF reviewed			X		
Legal package (e.g., financial, administrative regulations) prepared			X		
Review undertaken by NAVETQ on work done so far on qualifications, under various donor projects, and on qualifications offered by public and private VET providers and by universities					X
Research into different models for implementation of the credit system in VET undertaken	X				
Albanian credit system model conceptualised	X				
Overall status	2.6 = HP				

Law no. 23/2018 of 10.05.2018 ‘On some amendments and addenda to Law 10247 of 4.3.2010 ‘On the Albanian Qualifications Framework (AQF)’’ was adopted by the Albanian Parliament. Meanwhile, the AQF Task Force, led by NAVETQ, has established three technical working groups to prepare draft DCMs for implementation of the amendments introduced by Law no. 23/2018. A draft DCM on detailed level descriptors has been prepared and consulted with relevant stakeholders. The AQF Task Force has consulted with relevant stakeholders the initial drafts of the DCMs on inclusion of LLL qualifications in the AQF and on establishing sector committees. Three draft DCMs were

awaiting adoption at the end of December 2018. Apart from working with the legislation, the Task Force has prepared information documents on the AQF in order to increase general understanding and awareness among the public of the AQF and the List of National Qualifications with regard to demand in the labor market. It has also started the process of referencing national qualifications with the EQF. NAVETQ, in cooperation with the business sector, developed a revised National List of Occupations, which was adopted by DCM no. 514, dated 20.09.2017. The classification is a valuable source of information for development or revision of vocational qualifications and their descriptions and standards. These in turn will be included in the National Register (Catalogue) of Vocational Qualifications, compiled by NAVETQ and which will contain all vocational qualifications at AQF levels 2, 3 and 4. The National Catalogue is prepared in collaboration with the main stakeholders, including social partners, VET professionals and qualification experts.

In general, there is no IT based validation system used for employee competences in Albania. Some Albanian universities, including EUT, and some universities from Kosovo has been using an IT Validation tools called “LEVEL5” for competences validation, but only for the students as part of some Erasmus+ Capacity Building funded projects.

The main institutions that carry out studies on Validation of Informal and Non-Formal Learning in these countries are:

a) INSTAT (Statistical Institute),
b) ILO (International Labor Organization),
c) ETF (European Training Foundation),
d) Ministry of Social Welfare and Youth (MSWY),
e) National Agency of Vocational Education, Training and Qualifications (NAVETQ)
f) HDPC (Human Development Promotion Center),
g) Other relevant NGOs that are hired by different national and international donors.

2.2. Austria

2.2.1. Scope

The desk research for Austria was developed by the consortium partner University of Duisburg-Essen (UDE). The focus of UDE was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the business sector, and, finally, what are DL related competences and validation.

2.2.2. Desk Research Interpretation

"Data Literacy" straight translates to "*Datenkompetenz*" which translates literally back to "data competence". Literacy translates to *Alphabetisierung*, which translates back to alphabetization: this connotation can be described as somewhat harsh. This may be one reason why the term ‘data literacy’ is in very limited use in German speaking countries. The focus of public discussion has moved to the terms "Big Data", "KI" (artificial intelligence AI), "machine learning" and "*Digitalisierung*" as a general all-purpose but vague term. In education and science, the term ‘data science’ is used.

If you follow Conway [4], the related competences are hacking, statistics & math and substantive expertise. More precisely programming and thinking in algorithms combined with advanced knowledge in mathematics and statistics embedded in general knowledge how to generate hypothesis, run tests, and program software, and how to evaluate science.

This is the exact definition of a technical, unsexy, and difficult STEM career and maybe the best approach to scare away young people from the field – only desperate nerds will be interested in these fields. The result of work in the field of data science are usually described in the media with negative feel for society, but positive for companies that use these tools - to breach into privacy of their customers, maximize profit and manipulate society. ‘Big Data’ is an even more negative term, weaponizing data technology against society for profit, but with a fascist appeal of collecting every available data set and classify everything and everybody.

DL can also be described as society friendly approach opposed to big data, enabling ordinary people to understand the enterprise big data” strategy, with a less technical and scientific style. Additionally, the term ‘Digital Literacy’ is confused with the other terms,

describing the ability to use computer systems – this is how *"Digitalisierung*" is commonly used by media and politics.

"*Digitalisierung*" is a big thing in Germany and Austria but covers much more: from physical networks (bandwidth) over hardware and software to complete big data solutions. There is a public discussion over different aspects of big data usage, and an interest by many companies to use software that is capable of delivering actual results with this approach. The terms 'Data Science' and DL are not used by the general public – expect that no one without academic background will be able to tell what these mean but will have an opinion on big data.

In terms of stakeholders, for DL, the biggest interest group are academic entities like universities and research organizations. Some small organizations use this term also. On the broader "big data" approach, many companies and governmental organizations are willing to adopt solutions for large amounts of data. Some courses are offered, by companies and community colleges.

There has been some research for Austria: "Big Data in Austria - *Österreichische Potenziale und Best Practice für Big Data*" [5]. It has been published by the governmental office for statistics. Full text is available at FFG [6].

The main providers for courses are (applied) universities. Some NGOs, spin-offs and companies offer courses. As these courses unlikely will yield short term economic results, these offers had limited interest, some already are discontinued. There are offers for trainings at specific products in this field.

Learning Management Systems (LMS) are used for distribution of courses to students. The software platform used depends on the organizations. Moodle, Mahara and proprietary tools are in use.

There are several funding offers for companies in the entire range of computer usage – these cover big data topics as well. These programs have different restrictions and main goals – i.e. members only in Vienna [7] or the research organisation offers a specialized agency for SME [8], or courses at WIFI [9]. There is a special ministry for

"*Digitalisierung*", and the business location Austria called BMDW, which offers funding [10] as well.

"*Digitalisierung*" and "Big Data" have been in the centre of discussion several times, tied to the future of work, economic health, and data privacy issues. Companies use these terms to show their striving for future success but promise to respect the privacy of customers. The fitness for upcoming changes in the economy should appeal to the shareholders.

a. Data Literacy in Universities

Austrian universities offer courses about several aspects of DL. These courses are integral part of some studies, offered as addendum to bachelor and master levels of other studies, and specific "Data Science Studies" [11] mainly in applied science universities. These specific courses reach master level. They are offered sometimes as "*Duales Studium*", which means they are combined with a job at a company sponsoring the education [12], or they are offered as enhancement studies for people [13] with full-time jobs. Depending on goal and certification level the duration is from a few hours over one semester to several years full time. Faculties handling these courses are IT, mathematics, and statistics.

We found no specific partnerships linked to this topic alone. Partnerships are mostly used at a project or course level or as a general cooperation framework.

As the universities are mainly funded with taxes, the government does not offer additional courses for the same audience. Within the courses commercial products are used, so software companies will offer cooperation to enhance their market share. There are several cooperation's, most notably "*Duales Studium*" which combines a job and higher education, and similar approaches by governmental institutes.

Some examples of cooperation between universities and other entities, regarding DL and similar topics, are in the following links:

- Open Data movement and public sector information (PSI)

- https://www.data.gv.at/ is the main governmental platform. It offers data itself and a list of publishing institutions. Software applications for analysis are listed as well. A huge subset of data is published on a dedicated website:
- https://offenerhaushalt.at/is the platform to access public finance information of a all Austrian (governmental) communities. The platform allows visualisation, download and comparison of public finance data sets on the local level.
- https://www.opendataportal.at/was a central platform. The site is now mainly defunct.
- https://schoolofdata.wordpress.com/was founded by one person in Vienna with some support from public funds. They offered courses from 2013-2016. The site is now partly defunct.
- http://www.informationskompetenz.or.at/ a commission of libraries.
- http://european-big-data-value-forum.eu/ and http://www.learn2analyze.eu/ EU programme, some Austrian sites guide to them.
- https://thedataliteracyproject.org/learn is a site by the company Qlik, which is strongly promoted in Austria.
- NobleProg is a company offering commercial courses.
- IT Learning solutions offers several courses on specific products.
- Controller Institut offers courses.
- Economics Ministry about big data, with a detailed list of software products.

b. Data Literacy in the Enterprise Domain

There is little demand for DL topics. A search at *karriere.at* [14] gives 131 hits for big data, 4 for DL and 148 for data science. Python gives 264 hits and 967 for programmers - perhaps there is some overlap. Data science can be seen as enhancement for programming, or as an integral part of it if the companies search for programmers in the programming language they run their big data applications in.

As mentioned before, the "*Duales Studium*" integrates job and course to such an extent it can be seen as enhanced "training on the job". The influence of business to the courses therefore is huge. Business tracks from commercial institutes focus on the demand. There

are a few explicit DL courses, corresponding with minimal demand, as the term is rarely used. Courses for big data are available by several actors. Some are on specific products, so demand for these courses is driven and limited by the amount of sold licenses. Some are general audience offers, with the idea of enhancing the success of companies – these courses have to focus on the specific benefit they will provide. Another variant are free rider versions of these general audience tracks – these receive marketing as big data courses, but actually they focus on better software usage and some easy applied statistics. Data science is used at universities mainly. In bigger organizations the management sees the big data field as something important, but still developing, as there are only a few experienced applications with provable output. The fear of missing out drives some demand for courses to prepare staff for tasks in this field, so the enterprise won't be surprised by the development. The time schedule for trainings is tight, as working hours are quite expensive – one week, whole day, is the typical length for tracks.

c. Data Literacy related competences and validation

The related competences are hacking, statistics & math, and substantive expertise. These are of course certifiable on different levels and are sometimes part of the educational track - the curriculum at universities for most studies includes statistics and math. Applied informatics and general expertise in science are not so common.

For some computer or programming skills there are certifications: at the universities these are within the track certification system the institute uses, for enterprises there are commercial providers for specific products (Microsoft [15] runs a big portal), for the general public (like LPIC [16]), and by community colleges. For programming languages there are offers as well (i.e. Java [17]).

For some specific computer and programming skills certifications can be accessed without formal time requirements. For a bigger part experience and knowledge can't be verified, unless they are listed on a certificate of employment. In general, the focus in Austria is on formal certification. There is a national strategy [18] by the educational ministry called qualification register [19]. These projects attempt to upgrade the informal knowledge to level sufficient for formal recognition.

There is a central portal under the name *Nationaler Qualitätsrahmen* (NQR) [19]. We found no specific software for IT based validation in Austria. The ministry for education delivers the legal framework. *Volkshochschulen* (VHS) (community colleges), universities and commercial education companies also engage in projects for validation of informal learning. We found no combination of DL specific projects, that focus on such a knowledge validation.

2.3. Belgium

2.3.1. Scope

The desk research for Belgium was developed by the consortium partner INOVA+, from Portugal. The focus of INOVA+ was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.3.2. Desk Research Interpretation

From this research, it can be concluded that the term 'data literacy' in Belgium is mostly still not recognized nor translated. In other words, in Belgium, there has not been a clear definition of competences related to DL. The only recognized terms are journalism literacy, data science, data analytics, Big data, AI data, data management, and so on.

There are different potential stakeholders related to DL, they can be:

- Universities
- Private institutions/companies that offer courses related to DL
- Government bodies
- Employment institutes
- Public organizations/NGOs
- Research Institutes

There are several organizations, besides universities, that offer data-related courses. For example, Data Minded [20] is an engineering company that offers the capability, technology, and way of working for organizations to collect high-quality data and find actionable insights. Data Minded assist enterprises/companies in becoming more data-

minded and self-reliant to evolve from traditional reports to machine learning and intelligent applications. The company offers different services, manly consulting, platform management and also training in data engineering and data analytics/literacy for business intelligence (BI) professionals, data scientists and software engineers.

DigitYser [21] is the Digital Innovation Hub of Brussels where communities gather to boost digital skills, empower entrepreneurship, and facilitate digital transformation. This company is related to the Data Science Community in Belgium [22] and have a lot of events and activities in the field of training: (1) di-Academy [23] aims to upgrade the knowledge and the skill-set of students, job seekers, professionals, entrepreneurs, and anyone determined to shift their career towards tech or IT-related jobs; (2) the Data Science Bootcamp [24] is destinated to **young graduates** who want to be fully prepared for a data scientist role, to **job seekers** who are ready for a new challenge but needs first to acquire new skills, and also to **entrepreneurs** and everyone interested in data science. Besides the training activities, DigitYser hosts open job fairs [25] each year where companies can present their projects to a group of motivated data science professionals. It also allows data science bootcampers to present themselves.

No specific information was found on the platforms used to deliver DL courses, but platforms like Moodle are likely used to deliver DL courses as they are used to deliver other types of courses according to the methodology of each training provider.

In Belgium, there are several public-sector training providers, for example, in the French-speaking community:

- FOREM (Service public Walloon Employment and Vocational Training Service);
- *Bruxelles Formation* (Public sector training agency in the Brussels-Capital region);
- *Enseignement de Promotion Sociale* (Adult Education Provider – i.e. Wallonia and Brussels-Capital Regions);
- *Institut de Formation des Petites et Moyennes Entreprises* - IFAPME (Training Agency for the Self Employed and SMEs);

- *Service de Formation des petites et moyennes entreprises* - SFPME, (Training Service for Small and Medium-Sized Enterprises in Brussels).
- *Centre de Validation des Compétences* in Belgium

In the Belgian education system, validation strategies have been mainly developed in the higher education and the adult education sectors.

- **Higher education**: Validation of prior learning in higher education is defined by the Codex Higher Education (11 October 2013) [26]. This system is decentralized with each association in higher education elaborating their own rules of procedure. The procedure results in a proof of acquired competencies (*Bewijs van Bekwaamheid* [27]) which can then lead to the appropriate exemptions/shortened study duration and credit certificates and/or proof of qualification. Validation in this sector can be used to pursue education or for professional aims.
- **Adult education**: In the Flemish Decree of 15 June 2007 relating to (formal) adult education (*Decreet betreffende het volwassenenonderwijs* [28]), exemptions linked to the modular organization of educational programmes are defined. All programmes (i.e. modules) in the centers for adult education are developed based on course profiles approved by the Flemish Government.

The arrangements set up by the Department of Work [29] essentially aim at the recognition of non-formal and informal learning through the 'Certificate of Work Experience' (*Ervaringsbewijs* [30]) created by a decree approved on 30 April 2004 [31]. In short, people can receive a certificate of work experience if they demonstrate that they have acquired the skills needed to perform an occupation. Professional competence profiles are translated into standards by the Flanders' Social and Economic Committee (*Sociaal Economische Raad van Vlaanderen* – SERV [32]) and the social partners.

a. Data Literacy in Universities

The courses identified in the desk research both in public and private HEI are mostly disciplines that are part of a whole course – master and bachelor courses, or even continuous VET courses. Thus, the duration is generally short. There are several faculties

in Belgium that provide courses related, in some part, with DL competencies. Some examples are presented below.

French Universities:

- UC Louvain, Université catholique de Louvain
- ULB, Université Libre de Bruxelles
- U Liège, Université de Liège
- USL-B, Université Saint-Louis - Bruxelles

Dutch Universities:

- U Antwerpen, Université d'Anvers
- U Gent, Université de Gand
- U Hasselt, Université de Hasselt

Normally, DL is part of a course, and not the whole course. Some examples of courses including DL competences/topics are presented below:

- **Continuous Training/Courses** – "*Comprendre la structure des données et en résumer l'information - L'analyse de données* (data mining)" from ULB, *Université libre de Bruxelles*.
- **Part of course/discipline:**
  - Courses of Communication, Journalism, and Information (masters and bachelors) from *Université Catholique de Louvain*;
  - Master's in data science et Big Data from *Université libre de Bruxelles*;
  - Courses of Economics, Computer Science and English from *Université Saint-Louis – Bruxelles*;
  - Master of Computer Science: Data Science and Artificial Intelligence from U. Antwerpen;
  - Master of Science in Teaching in Social Sciences, Master of Laws in Laws, and Bachelor of Science in Dentistry from *Université de Gand* (University of Gent)
  - Courses of Data Science and Data Management from *Université of Hasselt*.

Some partnerships with other foreign institutes linked to DL, can be European projects and networks/global organizations.

- **European projects**

Erasmus+ initiatives are present in every country in the EU. There are a few numbers of projects related to DL which Belgium takes part. Searching in the Erasmus+ projects list, it is possible to see the one's which Belgium is involved with:

The **D3 project** (Developing Digital Data literacy [33]) recommended relating further actions to the European Framework for Digitally Competent Educational Organizations and supporting innovative approaches and digital technologies for teaching and learning in schools. The project is designed to promote a highly relevant educational approach, applying the framework of a digital citizenship educational paradigm, by providing innovative mechanisms (curricula and engagement structures) resulting in learning and engagement opportunities to integrate digital technologies and open data in schools. Belgium is currently a partner in this project.

ARIS (Artificial Intelligence skills for ICT professionals [34]) is a project coordinated by a Belgian partner, aimed to strengthen the key digital competences in VET provision for ICT professionals by offering an up-to-date curriculum and Open Educational Resources (OERs) in AI to address the existing occupational skills needs and mismatches. ARIS also intends to design a comprehensive and up-to-date training course in AI technologies and practical applications, to empower ICT professionals with initiative, entrepreneurship & updated digital skills required in the workplace.

DIGConsum (Training Path and OERs for Digitally Competent Consumers [35]) project's objective is to contribute to the empowerment of adult Europeans by providing them with digital competences in the field of digital consumption. Belgium is currently a partner in this project.

- **Networks/Global Organizations**

There are some networks and data communities in Belgium. Some are presented below:

The **AI & Data Science Community of Belgium** [22] is a network that aims to educate, inspire and empower scholars and professionals to apply data sciences to address humanity's grand challenges. It promotes the value of analytics and organizes events, hands-on sessions, and training to close the gap between academics and business.

The **Data Literacy Project** [36] is a global community dedicated to creating a data-literate world. Launched by the global data analytics leader Qlik, the Data Literacy Project includes founding partners Accenture, Cognizant, Experian, Pluralsight, the Chartered Institute of Marketing, and Data to the People – along with academic thought leaders. This project supports global educational institutions to place DL into the curriculum, and also encourage the world's leading organizations to provide DL training.

Qlik helps enterprises around the world move faster, work smarter, and lead the way forward with an end-to-end solution for getting value out of data. Qlik has also training programmes - Qlik Academic Program [37] – that provides qualified university professors, students, and researchers with free Qlik software and resources to help educate and train the next generation of experts leading with data.

Another interesting initiative in Belgium is **the individual competence portfolio online** (Cahier Individual de competences, CIC). That consists of a digital portfolio to facilitate the identification of acquired skills. The user can create and update the files and decides with whom they will be shared. Copies of certificates, references, and job profiles can be attached to the file. The aim is to use it as a common tool for the different validation systems existing in Belgium. It could be used by the certificate holders and also by PES and employers if the user wishes. The FOREM, IFAPME, the Validation Consortium, EPS and the French Community have developed the tool jointly[1].

There are some attempts to include training of DL competences in HE from third parties, like the following one's:

- Government of the French Community
- French-Speaking Government of the French Community
- Walloon and Brussels Regions

[1] http://crf.wallonie.be/cic/home/

b. Data Literacy in the Enterprise domain

The online search was made in different jobs' portals used in Belgium – Glassdoor, LinkedIn, StepStone and Indeed. According to the results, there is a significant number and variety of companies offering job positions that require DL competencies in data-related jobs. Examples of these positions are:

- Data Scientist
- Data Manager
- Clinical Data Assistant
- Data Analyst
- Data Protection Officer
- Data Engineer
- Data Analyst Marketing
- Data Quality Specialist
- Customer Success Manager
- Software Engineer Expert - Business & Data Intelligence

The hard skills that more seems to be related to these DL related jobs are knowledge of SAP, SQL Data Warehouse and QlickView; IT and legal aspects of data protection; knowledge of MS Office; knowledge in data modelling and Big Data technologies and concept; machine learning platforms. There are also a couple of ads with Research Grants for PhD related to data, and also Junior ads. Multinational enterprises like Nokia, Nike, Unilever, Toyota, GSK and EY presents a lot of internships related to DL jobs, for example:

- Unilever - Customer Development & Data Analytics Internship
- GSK - Internship Technology Stewart Belgium Operations: Data Science
- NOKIA – Internship: Digital ASIC/FPGA (hardware platforms)
- EY - Internship Data Analytics
- TOYOTA - Internship Powertrain Evaluation: Software tool development for data analysis and management

c. Data Literacy related competences and validation

Regarding the degree of recognition/validation of DL related competencies in Belgium, these competences are acknowledged differently according to the level of the qualification, but there are no specific frameworks or diplomas for this area. In HEI's, these competences are recognized through the ECTS applied to any other area. But also, in the field of VET and secondary education, these competencies are recognized.

Since 2011, the Department of Education and Training as well as the Department of Work and Social Economy and the Department of Culture, Youth and Media have been discussing the development of an integrated approach towards validation.

In Belgium there are two types of validation of non-formal and informal learning (VNFIL): (1) the **validation of competences** (VDC) in the continuous vocational education and training (CVET) sector, leading to the award of a recognized certificate; (2) the valorization of prior experience (VAE – *Valorization des Acquis de l'Expérience*) in adult education and higher education, leading to the validation of learning units or exemptions from certain parts of a study pathway [38].

2.4. Finland

2.4.1. Scope

The desk research for Finland was developed by the consortium partner Lithuanian Confederation of Industrialists (LPK), from Lithuania. The focus of LPK was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.4.2. Desk Research Interpretation

The term DL as the ability to read, work with, analyse, and argue with data in order to derive meaningful information and knowledge was not found in Finland as such. Instead, many other concepts (or rather skills and competences) directly linked or related to this term and/or its content, such as information literacy, media literacy, numeracy skills /data analytics, statistical literacy, science literacy, digital literacy, trans-literacy were

identified as forming so called "key information literacies", i.e. multiple literacies individuals may need to function effectively in the global information society.

Information literacy / information management skills / multi-literacy / numeracy / data analytics – since 2011 Finland participates in the OECD Survey of Adults Skills - (PIAAC). Respective definitions and statistics are available in the country in relation to that participation. The Survey is the largest ever study organised by the OECD on the level and use of basic skills of the adult population (16 to 65-year-olds in 33 countries) and provides a significant source of information for developing education and working life. The Survey provides a picture of adults' proficiency in three key information-processing skills [39]:

1) literacy – the ability to understand and respond appropriately to written texts;
2) numeracy – the ability to use numerical and mathematical concepts; and
3) problem solving in technology-rich environments – the capacity to access, interpret and analyse information found, transformed, and communicated in digital environments.

Average literacy and numeracy skills among Finnish adults were excellent. Finnish adults were also among the best in the survey in their ability to solve problems in technology-rich environments [40].

Media literacy – according to the "National Media Education Policy" (2019)– a strategic governmental document on media literacy in Finland, "the definition of media literacy has been discussed extensively and it has been researched, but a widely accepted definition has not yet been proposed. Other terms, such as media education, media skills or multi-literacy, are also used in addition to media literacy" [41]. In this policy document, media literacy refers to all skills related to using and consuming media as well as understanding of media and skills related to creating media content. "Media literacy is more than simply acquiring means of understanding and creating content for media. Media literacy is strongly connected to matters of personal growth, creativity, critical thinking, being literate and part of society and cultures."

Statistical literacy – according to the National Statistical office Statistics Finland, there is a growing need for better statistical literacy in Finland and in Europe. The statistical literacy of decision-makers and ordinary citizens alike needs improving [42], [43] . To an ordinary citizen, statistical literacy is important in two ways: 1) it is a necessity for understanding everyday life, a prerequisite for making rational personal decisions and a mean for implementing democratic control in public administration; 2) on the other hand, the globalisation of the economy and the advancements in technology demand from employees ever improving statistical literacy, capability to read statistics and mastery of statistical reasoning as the labour markets offer numerous opportunities for those capable of statistical reasoning. In public administration, statistical literacy is particularly necessary for those in management positions. Decentralization of administrative decision-making and management by results require the development of efficient planning and monitoring systems supported by advanced statistical information systems. It is especially important for statistical literacy skills to be improved among teachers, journalists, and library officials, who constitute the main intermediary spreaders of statistical information

Statistical literacy was defined by the W.M. Keck (Statistical Literacy Project) as: (1) critical thinking about numbers, about statistics used as evidence in arguments; (2) the ability to read and interpret numbers in statements, surveys, tables and graphs; and (3) the study of how statistical associations are used as evidence of causal connections.

Several attempts have been made to measure statistical literacy. A very complex study by Watson and Callingham (2003) assumed that statistical literacy is a hierarchical construct and suggested six levels of understanding: (1) idiosyncratic engagement with context, tautological use of terminology and basic skills associated with one-to-one counting and reading cell values and tables; (2) informal engagement with context often reflecting intuitive non-statistical beliefs, single elements of complex terminology and settings, and basic one-step straightforward table, graph, and chance calculations; (3) inconsistent engagement with context, appropriate recognition of conclusions but without justification, and qualitative rather than quantitative use of statistical ideas; (4) consistent non-critical engagement with context, multiple aspects of terminology usage, appreciation of variation in chance settings only, and statistical skills associated with the

mean, simple probabilities, and graph characteristics; (5) critical, questioning engagement in familiar and unfamiliar contexts that do not involve proportional reasoning, but which do involve appropriate use of terminology, qualitative interpretation of chance, and appreciation of variation; and (6) critical mathematical engagement with context, using proportional reasoning particularly in chance contexts, showing appreciation of the need for uncertainty in making predictions, and interpreting subtle aspects of language.

Digital literacy – new opportunities to enhance students' digital literacy in Finland were provided with the new Finnish national core curriculum (from pre-school to the ninth grade) beginning in the school year 2016–2017. This was among the first steps when the Finnish government's "Predict 2030" report presented an ambitious educational goal: "by 2030, Finland will have the best education system in the world" in 2012. Since then Finland plans to conduct curriculum reforms under the guidance of the National Board of Education every 10 years. The Finnish National Board of Education pointed out that the world in which the schools are located is complex and interconnected, rapid and unstable, and increasingly digital. Therefore, the education system needs to conduct a comprehensive self-analysis, and the "Future of learning 2030 Barometer" collects multiple perspectives. With the support of the "2030 Barometer", the new curriculum is geared towards 2030, based on an analysis of the capabilities that children and young people need in their learning, everyday life, and workplace in the near future. The most essential aspect in the curriculum reform is the shift from focusing on learning objectives related to single subjects to an emphasis on broader competences crossing all learning in schools. The seven competence areas are as follows:

1) Thinking and learning to learn
2) Cultural competence, interaction, and self-expression
3) Taking care of oneself and others; managing daily life
4) Multi-literacies
5) Working life competence and entrepreneurship
6) Competence in information and communication technology (ICT)
7) Participation, involvement, and building a sustainable future

In one way or another, digital literacies are embedded into all competence areas, but most explicitly into the areas of multi-literacies and ICT.

The world's first global standard for digital literacy was announced at Dubai's Global Education and Skills Forum for the first time in 2019 (Finland participates in the process too). This is outlined in the DQ Global Standards Report, which establishes a framework for digital literacy, skills, and preparation. The framework aims to build a global digital intelligence framework called DQ which includes common definitions of digital literacy, skills, readiness, language, and understanding. Digital literacy in this report is defined as Digital Intelligence (DQ) and is "a comprehensive set of technical, cognitive, meta-cognitive, and socio-emotional competencies grounded in universal moral values that enable individuals to face the challenges of digital life and adapt to its demands. Thus, individuals equipped with DQ become wise, competent, and future-ready digital citizens who successfully use, control, and create technology to enhance humanity" [44] .

Multi-literacy - the concept of "multi-literacy" is based on a broad understanding of "texts" as entities expressed through verbal, visual, auditory, numeric, and kinaesthetic symbol systems, and their combinations"[45], [46]. "Multi-literacy does not refer to content and separate goals but is a goal in itself: a unit comprising information, competences, values, attitudes, and motives that the modern citizen should possess." The renewed national core curriculum in Finland (in 2015) identify seven cross-curricular competence areas for basic education and six for upper secondary education. In both cases, multi-literacy is included as one of the transversal cross-curricular competencies [45], [46].

Because the content of the digital literacy in the new Finish national core curriculum is in line with the Common Framework for Digital Literacy, Skills and Readiness (DQ, Global Standards Report, 2019), it can be assumed that the meaning of 'Data Literacy' in Finland is similar to one embedded in this Report: "Data literacy and AI is the ability to generate, process, analyse, present meaningful information from data and develop, use, and apply artificial intelligence (AI) and related algorithmic tools and strategies in order to guide informed, optimised, and contextually relevant decision-making processes"[44].

There is a wide range of stakeholders related to DL skills, knowledge and competences in Finland such as education providers (starting from pre-school and compulsory education, continuing through VET and higher education and the initiatives of life-long learning), private enterprises, public authorities (e.g. Ministry of Education and Culture, Ministry of Economic Affairs and Employment, National Statistics Office (Statistics Finland), Finnish National Board of Education etc.), educational institutions, scientist community, individuals etc. The significance of collaboration of various stakeholders is highlighted in each strategic document on future skills.

Besides universities, DL and related courses are delivered by wide range of different institutions in Finland, e.g. public authorities (for instance, Statistics Finland delivers paid and free-of-charge online and face-to-face courses and modules around statistical and DL [47]), national networks (e.g. The Finnish network of libraries), communities of practice (e.g. The National Network of public libraries), private enterprises (e.g. Talent Base: https://www.talentbase.com), IT academies [48] offer courses on various DL topics.

Various learning technologies (Moodle, Mahara, Doodle and other) are used to deliver DL courses in Finland

It seems that DL related competences are important for enterprises, companies, private and public employers in Finland.

a. Data Literacy in Universities

Analysis of study programmes across many Higher Education Institutions in Finland showed that they both - widely integrate DL courses (Undergraduate level studies) to their curricula and/or offer separate study programmes on DL (Master's level studies).

30 out of 36 universities in Finland offer full-time Data Science Masters (120 ECTS). These are the main universities [49]:

- **University of Helsinki** (Data Science; Life Science Informatics, computer Science, Economics – MSc; Atmospheric Sciences - MSc (Agriculture and Forestry); Urban Studies & Planning - MSc/MSSc/MA; Linguistic Diversity in the Digital Age – MA; Big Data Analytics);

- **Aalto University** (Data Science, Autonomous Systems (AUS), Cloud and Network Infrastructures (CNI), Visual Computing and Communication (VCC));
- **University of Turku** (MDP in Physical and Chemical Sciences: Theoretical Physics; MDP in Biosciences: Evolutionary Biology; MDP in Future Health and Technology; Digital Manufacturing (DM); MDP in Physical and Chemical Sciences: Astronomy and Space Physics; MDP in Information and Communication Technology: Digital Health; MDP in Human Neuroscience; MDP in Biosciences: Molecular Systems Biology; MDP in Nordic Cultural and Social Resilience; MDP in Inequalities, Interventions and New Welfare State; MDP in Gender Studies; Software Engineering; Governance of Digitalization);
- **University of Eastern Finland** (International MDP in Information Technology; European Master's Degrees in Colour Science; MDP in Linguistic Data Sciences);
- **University of Oulu** (Computer Science and Engineering – MSc; Biochemistry – MSc; Financial and Management Accounting – MSc);
- **Tampere University** (Computer Sciences – Data Science; Computer Sciences – Statistical Data Analytics);

Some universities offer undergraduate programmes in Data Sciences [50]:

- **Aalto University** (Computer, Communication, and Information Sciences; Computer, Communication, and Information Sciences - Machine Learning, Data Science and Artificial Intelligence; Computer, Communication, and Information Sciences; Science and Technology - Data Science; ICT Innovation (EIT Digital Master School) - Data Science);
- **University of Helsinki** (Data Science).
- **Arcada University of Applied Sciences** (Big Data Analytics);

Brief description of Data Science & Big Data studies says that “Data Science degrees teach students to use scientific techniques to extract insights from data. Big Data studies prepare specialists who work with large collected databases, by showing students how data mining, programming, and data visualisation work, and how to make predictions.

Big Data courses approach business adaptability and sustainability and help you understand markets and customer behaviour" [50].

Related disciplines include the following subjects: Informatics & Information Sciences; Geographical Information Systems (GIS); Business Information Systems; Video Games & Multimedia; Computer Sciences; Data Science & Big Data; Health Informatics; Human Computer Interaction; IT Security; Web; Technologies & Cloud Computing; Cyber Security; Software Engineering; Artificial Intelligence; Machine Learning.

Only one example was found, for attempts to include training of DL related competences in HE from third parties – the training that is delivered by the National Statistics Office – Statistics Finland [47].

It seems that there is close collaboration between all stakeholders involved, including the business sector and HE, although explicit examples were found for this kind of collaborations.

b. Data literacy in the Enterprise domain

After the Job announcement research in Finland, it can be concluded, that DL competences are requested by enterprises for higher position and salary jobs.

DL courses are provided by different economic units: libraries, education institutions, public centers financed by budget and waste number of enterprises etc.

Libraries manage large amounts and flows of information, provide access to these sources, and carry out educational activities. They regularly organize seminars, discussions, and political debates. The National Library is the methodological center of the country's libraries and contributes to the development of citizens' media and information literacy competencies.

c. Data literacy related competences and validation

As described in **Eurydice database/Finland 8.2 Developments and Current Policy Priorities**, the Vocational Qualifications Act enacted in 1994 created a new system of competence-based qualifications, where people may acquire vocational qualifications by demonstrating their vocational skills in competence tests irrespective of how they have

acquired their skills. At the same time, a uniform quality assurance system was created for vocational adult education and training [51].

Eurydice database/Finland **6.4 Organisation of Vocational and Technical Upper Secondary Education** also mentions, that one of the purposes for changing the law base of the vocational upper secondary education and training in 2014 was to strengthen the learning-outcome approach of vocational qualification requirements and the modular structure of qualifications which supports the building of flexible and individual learning paths and promotes the validation of prior learning. Upper secondary VET students are for example required to have completed the basic education syllabus or an equivalent previous syllabus. In addition, VET providers may ignore the order of scores in student admission for individual student-related reasons ('flexible selection'): applicants deemed by the provider to have sufficient capabilities to complete education and training may also be admitted as students. VET applicants include young people and adults from different educational and working backgrounds, whose prior competencies must be recognised as part of their vocational qualifications. It is also possible for general upper secondary school graduates to apply for vocational education and training and complete vocational qualifications.

As pointed out in Eurydice database/Finland **8.5 Validation of Non-formal and informal learning**, validation of non-formal and informal learning has relatively long and established roots in Finland and the legislation and policies are well developed and detailed. However, there is no one single law regarding validation of non-formal and informal learning, but rather laws and regulations for each field of education define validation separately. These fields include general upper secondary education, vocational education, and training (including adult VET), and higher education. The core message of the legislation is that validation of non-formal and informal learning is a subjective right of the individual and the competences of an individual should be validated regardless of when and where they have been acquired.

According "**2016 update to the European inventory on validation of non-formal and informal learning: Country report Finland**", the strengths of the Finnish validation

arrangements are in the strong co-operation between all stakeholders. For example, social partners including employers are strongly involved in all aspects from designing the content of qualification requirements to individual validation procedures. Transparency and co-operation promote trust and high market value of the system, i.e. employers see qualifications gained through validation as equally valuable or trustworthy as the qualifications gained through school-based learning [51]. Validation is embedded in the formal qualification system.

2.5. France

2.5.1. Scope

The desk research for France was developed by the consortium partner Dataninja, from Italy. The focus of Dataninja was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.5.2. Desk Research Interpretation

In France, DL seems to be central in the public discussion about the relation between digital skills and access to democracy. The country hosted the International Data Literacy Conference in 2016 [52], 2017 [53] and 2018 [54], which goal is to foster a "data culture finally accessible to non-specialists". The conferences are organized by the Fing Foundation and include a long list of private and public partners, demonstrating an institutional high interest on the topic.

Different stakeholders have been involved in the promotion of DL skills in France in the past years. In 2013, the French Chapter of the Open Knowledge Foundation was involved in the French translation of the international School of Data, "a set of comprehensive courses designed with no pre-requisite knowledge as well as data expeditions to reuse the available data on a specific topic and helps train civil society actors in the handling of data." [55]. The curriculum includes online courses on finding data, critical thinking applied to data and statistics, the use of spreadsheets, data cleaning data exploration, data visualization and storytelling.

The *Association Fréquence écoles* is dedicated to digital skills and media practices for all audiences. It runs workshops and training events and gas produced free educational material. A whole section is devoted to activities to encourage DL, with resources targeted at teachers and educators who can then replicate the suggested activities for their students. Their offer follows the Pix Digital Skills Framework (see section on competences and validation) and the educational goals of their data literacy activities are as follows [56]:

- Learn how to read, produce, analyse, and interpret data.
- Develop a critical view on the use of data.
- Learn to represent data, that is to say to datvisualize.
- Understand the role of data and personal data in the digital economy.
- Understand how algorithms, search engines and more generally suggestions work in the display of content.

France is also home to a network of InfoLabs, promoted by the Fing Foundation. InfoLabs are described as labs for sharing practices, learning skills, and working together on projects related to information, data, and digital skills. They seek to include different audiences, like individuals who want to learn data skills and receive assistance in developing data projects; organizations who want to receive training and discover their data; researchers and journalists who need help to find specific dataset or to develop skills to communicate the data; and all other kinds of amateurs and professionals who want to work together on data projects. Other than the physical labs, the website has a rich resource section with tutorials, "recipes" to solve specific data tasks, and articles related to the promotion of data literacy skills [57][58].

a. Data Literacy in Universities

The University programs considered, that is those that came up in the first pages of Google Search, seem to suggest that DL is considered interdisciplinary across different fields. While predominantly found in Data Science or more technical degrees, but DL courses are also taught to students in the Humanities and Social Sciences.

According to a small survey of 177 High Education courses (Table 2) related to data offered in the following Institutions, it has emerged that the majority of courses refer to high-level data skills, like databases or data analysis & statistics (Figure 3). Only a very small part of the courses was dedicated to the critical assessment of data sources, to communication/visualization of data or basic data skills. This could be explained by the fact that courses focused on advanced data topics also do cover more low-level DL skills, like assessment of the data sources, without making it explicit. It seems however that it is uncommon to find University courses dedicated solely to the most basic skills of DL, that is the ability to evaluate and criticizes the data. Skills that, on the other hand, are predominant in the work of the DL associations mentioned above.

Table 2: Data Literacy High Education courses analysed, by institution. A link to the whole dataset is provided in the Bibliography & References section of this paper.

Institution	Location	Courses analysed	Type of Institution
Conservatoire national des arts et métiers (CNAM)	Paris	82	Public
SciencesPo	Paris	42	Public
Université Paris 1 Panthéon-Sorbonne	Paris	33	Public
Kedge Business School	Bordeaux, Marseille, Paris, Toulon	14	Private
Aix Marseille School of Journalism and Communication	Marseille, Aix-en-Provence	5	Public
Continuing Professional Training Center - Béziers - Agde - Pézénas	Béziers, Agde	1	Private
Total		**177**	

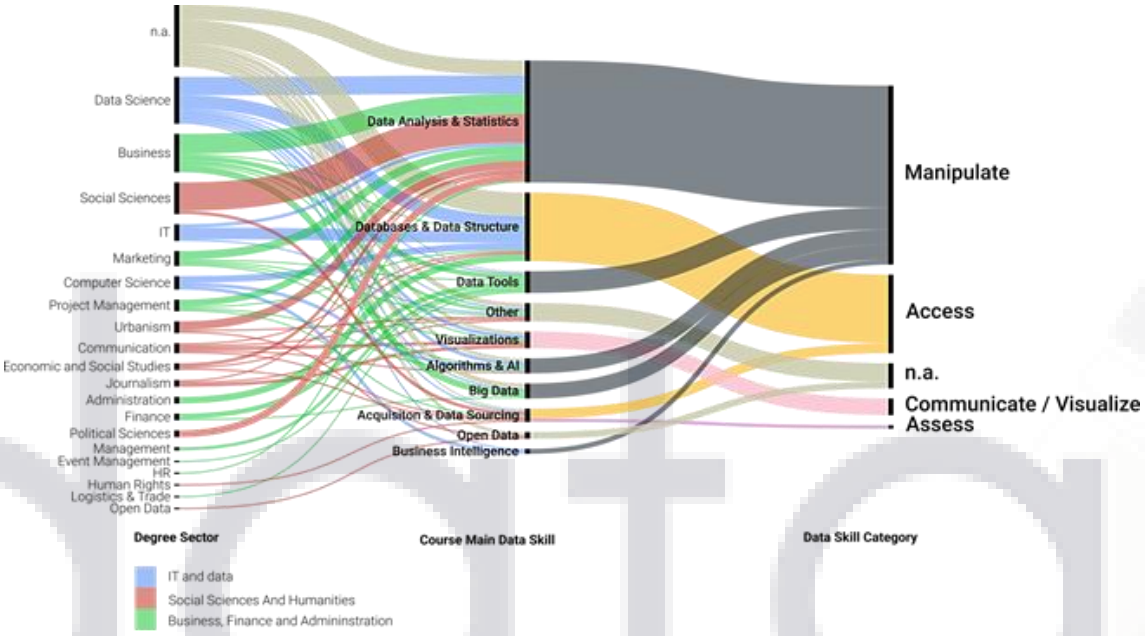


Figure 2: Categorization of Data Literacy Abilities in the French High Education Curricula analysed, by topic of courses and of degree.

In this section, it is interesting to mention that one of the institutions analysed, the *Conservatoire national des arts et métiers* (CNAM), has published a research paper titled "Data Literacy & Social Human Sciences", whose goal is to "to analyse the skills required along the data value chain and to question them in epistemological and methodological ways to include them in a data analysts diploma" [59],[60]. The paper is particularly targeted at the application of such skills in Social Sciences and Humanities. The research specifies 5 sets of skills associated with DL. Below there is a summary.

1) **Collection and preparation of data**, including quality assessment of production methods, knowledge of data structures and models (from CSV to databases) and data cleaning.

2) **Data Analysis and statistical methods**, including techniques with software programs like Excel, statistical programs or programming languages, exploratory data visualization with tools like Tableau, data mining, spatial and temporal analysis.

3) **Managing data quality before and after the processing**, including critical and ethical analysis of the data, compliance with GDPR and other applicable legislation, integration of metadata and data dictionaries.

4) **Management of data projects within an organization**, including evaluation of existing company data, alignment of projects with the company's data strategy, communication of data, delivery of suggestions based on data insights to optimize the organization strategies.

5) **Design of data services specific to an organization and its activity**, including devising data strategies and development of dashboards.

Finally, regardless of the course, all French Universities are obliged to offer trainings to their students for the Ci2 certifications, the national certification on IT skills which also includes DL skills [61].

b. Data Literacy in the Enterprise Domain

According to a 2017 survey, "Only one in ten employees in France can precisely understand and analyse the data to which they have access in order to argue. [...] 43% of employees say they have not received adequate training [in DL]" [62].

There seems to be several companies and initiatives involved in fostering DL skills in the enterprise domain. Such actors can be synthetically divided into two distinct categories. On one hand, there are DL courses and trainings targeted ad current or aspiring employees. On the other, there are courses and services targeted at organizations needing to understand the potential of integrating a "data culture" in their strategies.

At the center stage of all this, there is the international company **Qlik** [63], the company behind the famous BI software and partner of the Data Literacy Project [36]. Qlik in the past years has been involved in several French events promoting a data culture among enterprises [64]. Other than events and trainings, Qlik also offers DL consultancies to companies [65]; a DL program in several languages, including French [66]; and a DL certification aimed at the enterprise domain [67].

In terms of employment demand for DL skills, there is a convenient job search portal dedicated to jobs that require data skills: DataRecrutement.fr [68]. Although most of the listings in the portal are for jobs properly in the data or IT domain, there are a few also for those in other departments, like design, marketing, sales, support, accountant, etc.

The government itself is also directly sustaining digital skills trainings for the job market, with the *Grande École du Numérique* [69], a network of 750+ courses aimed at job seekers, in launched in 2015. While not specifically targeted at general DL, the School offers several training opportunities for aspiring employers interested in data, especially those without a MA. While most of the data trainings are targeted at those wishing to pursue data analyst / scientist careers within enterprises working in the data domain, there are also several exceptions. For example, Simple.co offers trainings for "data artisans" [70].

c. Data Literacy related competences and validation

The insights below refer to two national competence frameworks:

- **C2i**: is the national certification on IT skills, with different levels. While not focused on DL, some of the digital skills mentioned refer to it [61].
- **Pix**: a non-profit public service with a focus on democratizing access to digital skills. They have developed a specific set of digital skills that they assess, many of which related to DL [71].

The C2i Skills Framework

The C2i certifies the possession of digital skills and is usually issued by French higher education institutions to their students. It is comprised of a general level 1, for License students, and a series of different level 2 certificates, targeted at specific professions, for Master students. The framework covers digital literacy in general and therefore, for the purpose of this research, we have selected only the skills related to data literacy.

What emerges from the analysis is that general DL skills are disseminated in the framework, but there are no dedicated sections to address the topic in a structured way.

In particular, Level 1 certification only addresses DL specifically in terms of being able to use a spreadsheet for calculations and graphical representations.

The Pix Skills Framework

The Pix framework identifies 3 core areas for Information and Data Skills: Information Research and Monitoring; Data management; Data processing. An additional area, Content Creation Skills, also includes some advanced themes linked to DL, for example "Representation and coding of information" and "Collection and exploitation of massive data".

This framework seems to follow closely the structure and themes of the DigiComp [72].

What is evident is that this framework excludes DL aspects related to the communication of data. There is mention of "graphic representation", but only in the context of data analysis, not as a mean to communicate data insights to an external audience.

On the other hand, the framework emphasizes skills related to the critical evaluation of data and the ability to read and write datasets

2.6. Germany

2.6.1. Scope

The desk research for Germany was developed by the collaboration between the consortium partners Q21, Blinc, and University of Duisburg-Essen (UDE), from Germany. The focus of these partners was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.6.2. Desk Research Interpretation

The term 'data literacy' is rather rare and almost unknown in German and is instead defined by the term "*Datenkompetenz*" (which would be called "Data Competence" if translated directly into English)[1].

[1] The linguistic subtleties and at the same time difficulties become even more apparent in relation to "literacy" when translated into German, which is to be found as "*Alphabetisierung*" or "*Lesefähigkeit*", which in turn can be expressed in the literal translation back as "alphabetisation" and "reading ability". A direct translation automatically excludes itself, which in turn makes the term "data competence" easily justifiable

Much more decisive, however, are the terms and emphases that are summarised under DL. Especially in the public discussion, "Big Data", "AI" (artificial intelligence), "machine learning" can be subsumed under this term, which in turn are also combined as "digitisation". In research and science, the term ‘data science’ is clearly distinguished from this.

DL can also be described as a society-friendly approach, as opposed to big data, which allows the general public to understand the corporate strategy of big data with a less technical and scientific style.

Furthermore, the term ‘digitization’ is used in politics and media, in an inadequate context, and is described as the ability to use computer systems.

The scope and significance of "digitization" is a big issue in Germany and Austria and is now playing a major role. In addition to the terms already mentioned, it covers also other areas such as physical networks (bandwidth), hardware and software, and even complete big data solutions. The public interest in this area is great and can be found increasingly in large political, economic, and social discussions. Especially the different aspects of using large amounts of data and the interest of many companies to use software that can actually deliver results in this area are in the focus of this field of interest.

On the other hand, the terms ‘data science’ and ‘data literacy’ are not or hardly used by the general public. To put it bluntly, "no one without an academic background is expected to be able to actually describe or even explain the terms DL and ‘data science’ in more detail. However, one should always have an opinion regarding big data.

The use and application of the actual term DL and its specific environment are mainly localised in academic institutions such as universities and research organisations, thus representing the largest and most important stakeholder group. Nevertheless, some small organisations also use the term in the same context, but their number is much smaller and, as things stand at the moment, cannot be covered with much impact.

The term ‘Big Data’, i.e. the handling and processing of large amounts of data, plays a much greater role. Companies in particular, but also governmental organisations, are showing a particular interest in solutions and structures in this area.

The main providers for courses are universities. There are also (online) courses available from **Qlik** [73] and other international platforms like Coursera, Udemy, etc.

You can also find courses on DL related competences from private course providers, but they will typically be promoted under the labels “data science” and/or “big data”. (for example:

- https://www.neuefische.de/
- https://www.statworx.com/de/academy/data-science-offene-kurse/

Learning Management Systems are used for distribution of courses to students. The software platform used depends on the organisations. ILIAS, Moodle, Mahara and proprietary tools are in use.

We did not find any information on support programmes directly connected to DL for enterprises, but there are a number of support programmes for “digitization” in general for enterprises [74].

“*Digitalisierung*" and “Big Data” have been in the centre of discussion several times, tied to the future of work, economic health, and data privacy issues. Companies use these terms to show their striving for future success but promise to respect the privacy of customers. The fitness for upcoming changes in the economy should appeal to the shareholders.

a. Data Literacy in Universities

If you search on the platform https://hochschulkompass.de (with support from the German Rectors‘ Conference [75]) for bachelor or master degree study programmes using the key word ‘data literacy’ you will only get 2 results, one for a Data Science master

degree study programme, one for a Web Development bachelor degree study programme. Doing the same with the key word ‘data science’ you will get 99 results.

So, while data science is getting more and more established over the years, DL seems to get into the focus only in the last two or three years.

In the last years the *Hochschulforum Digitalisierung* published some documents and articles on DL including a competence framework for DL education on universities [76].

There have been two support programmes for DL Education on universities in the last two years by the *Stifterverband* [77].

The winners of those programmes are:

- *Georg-August-Universität Göttingen* (University of Göttingen)
  - http://www.uni-goettingen.de/en/592287.html (General information about the project “Learning Reading Data”)
  - https://github.com/Daten-Lesen-Lernen/daten-lesen-lernen-lecture (course materials (exercises and case studies))
- *Hochschule Mannheim*
  - https://www.modal.hs-mannheim.de/ueber-modal/ziele-aufbau.html (DL Education Model “modal”)
  - They are also offering courses for SME (https://www.uni-mannheim.de/newsroom/presse/pressemitteilungen/2019/juli/data-science-fuer-den-mittelstand)
- *Leuphana Universität Lüneburg* (Leuphana University Lüneburg)
  - https://www.leuphana.de/news/meldungen-studium/ansicht/datum/2018/09/28/leuphana-erfolgreich-im-stifterverband-wettbewerb-data-literacy-education.html
- *Rheinisch-Westfälische TH Aachen* (RWTH Aachen University) (no information found about the project/programme)
- *Fachhochschule Bielefeld* (FH Bielefeld University of applied science)

- https://www.fh-bielefeld.de/presse/pressemitteilungen/datenkompetenzen-fuer-studierende-aller-faecher (general information about start of the project DataLiteracySkills@OWL in cooperation with the universities Bielefeld and Paderborn)

- *Universität Bielefeld* (University Bielefeld)
  - https://50jahre.uni-bielefeld.de/2019/11/19/datenkompetenzen-fuer-studierende-aller-faecher/ (general information about start of the project DataLiteracySkills@OWL in cooperation with the university of applied science Bielefeld and university Paderborn)
- *Ruhr-Universität Bochum*
  - https://news.rub.de/hochschulpolitik/2019-11-18-stifterverband-digitale-kompetenzen-im-studium-vermitteln
  - https://news.rub.de/presseinformationen/hochschulpolitik/2018-07-20-digitalisierung-neue-konzepte-fuers-lernen-und-lehren (general information about the project Data.Literacy@RUB)
- *Hochschule Bonn-Rhein-Sieg* (University of applied science Bonn-Rhein-Sieg)
  - https://www.hs-niederrhein.de/weiterbildung/data-strategist/
  - https://www.hs-niederrhein.de/weiterbildung/data-strategist/data-literacy/ (information about Certificate of Advanced Studies "Data Strategist" and certificate course DL (in cooperation with *Hochschule Niederrhein*))
- *Technische Universität Dortmund* (TU Dortmund University)
  - https://www.tu-dortmund.de/suche/detail/detail/tu-dortmund-gewinnt-im-wettbewerb-data-literacy-educationnrw/ (information about the project Data Competence Network (DaCONet))
- University of Duisburg-Essen
  - https://www.uni-due.de/2019-11-18-datacampus-wird-gefoerdert (general information about the project "DataCampus")

- https://www.uni-due.de/dataedu (start page of the online course "Data Education an der UDE")

- *Technische Hochschule Köln* (TH Cologne – University of Applied Science)
  - https://www.th-koeln.de/hochschule/300000-euro-foerderung-fuer-lehrkonzept-zur-datenkompetenz_71410.php
  - https://kisd.de/en/news/datenkompetenz-in-der-lehre-verankern-data-literacy-initiative-der-th-koeln-vom-stifterverband-ausgezeichnet/ (information about the Data Literacy Initiative (DALI))
- *Hochschule Niederrhein* (Hochschule Niederrhein University of Applied Science)
  - https://www.hs-niederrhein.de/weiterbildung/data-strategist/
  - https://www.hs-niederrhein.de/weiterbildung/data-strategist/data-literacy/ (information about Certificate of Advanced Studies "Data Strategist" and certificate course DL (in cooperation with Hochschule Bonn-Rhein-Sieg))
- *Universität Paderborn* (Paderborn University)
  - https://www.uni-paderborn.de/en/nachricht/91877/ (general information about start of the project DataLiteracySkills@OWL in cooperation with the university Bielefeld and university of applied science Bielefeld)

Another example is the "Advanced Data and Information Literacy Track" of the University Konstanz (https://www.uni-konstanz.de/en/teaching/adilt/)

All these programs are typically designed as interdisciplinary events. Faculties involved are most often from the economics, the computer science or statistics field, but there are also me from the sociological, psychological, medical, and natural science area.

There are several cooperation's, most notably *Duales Studium* which combines a job and higher education.

There is also some cooperation on the DL projects mentioned in above. For example, at the *Hochschule Mannheim* [78] and the TH Cologne – University of Applied Science.

b. Data Literacy in the Enterprise Domain

There is little demand explicitly for DL, but there is a demand for data science. A search at karriere.de gives 493 hits for "big data", 2 for "*Datenkompetenz*",12 hits for "literacy" (5 of those for DL (two of them for jobs at universities connected to developing DL courses) and 6 for computer literacy or digital literacy) and 3447 for "Data Science". Python gives 995 hits and 4189 for programmers - perhaps there is some overlap.

As mentioned before, the *Duales Studium* integrates job and course to such an extent it can be seen as enhanced "training on the job". The influence of business to the courses therefore is huge.

In bigger organisations the management sees the Big Data field as something important, but still developing, as there are only a few experienced applications with provable output. The fear of missing out drives some demand for courses to prepare staff for tasks in this field, so the enterprise won't be surprised by the development. The time schedule for trainings is tight, as working hours are quite expensive – one week whole day is the typical length for tracks.

c. Data Literacy related competences and validation

Besides formal education, DL competences are not recognised and validated by a standardised approach.

For some computer or programming skills there are certifications: at the universities these are within the track certification system the institute uses, for enterprises there are commercial providers for specific products (Microsoft runs a big portal [15]), for the general public (like LPIC [16]), and by community colleges. For programming languages there are offers as well (i.e. Java [17], php [79]).

For some specific computer and programming skills certifications can be accessed without formal time requirements (like some of the certifications for programming languages or specific products of commercial providers).

In general, the focus in Germany is on formal certification, but in the last years some tools have been developed for the validation of informal skills like the ProfilPASS [80] or

MYSKILLS [81] and of course we have our LEVEL5 [82] validation system developed by **blinc eG** in cooperation with **Q21 GmbH** and **BUPNET GmbH**.

MYSKILLS is computer based tool. It is currently available for 30 professions. It is connected to learning outcomes described in the training plans of the respective profession.

LEVEL5 can either be used as an IT based tool or on paper. It is connected to reference systems described in 5 levels on three dimensions (Knowledge, Skills and Attitudes).

The **ProfilPASS** was developed in a project of the *Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung*. The coordination and service centre for the accompanying counselling and the qualification of counsellors is located at the by the DIE (German Institute for adult education). **MYSKILLS** was developed by the *Bundesagentur für Arbeit* (German Federal Employment Agency) and the *Bertelsmann Stiftung*. **LEVEL5** has been developed by blinc eG in cooperation with BUPNET GmbH and Q21 GmbH. It has been used in a number of European projects.

2.7. Ireland

2.7.1. Scope

The desk research for Ireland was developed by the consortium partner Blinc, from Germany. The focus of this partner was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.7.2. Desk Research Interpretation

‘Data literacy’ is a rarely used term in Ireland. The public discussion centres on "Big Data", as Ireland is legal home of many U.S. tech giants who operate branches in the country for tax reduction reasons. The “Open Data” movement for public access to data collections, especially as open government data, is present in the public discussion. “Data Science” and “Artificial Intelligence” are used in the science community. There are offers for enhancing digital literacy, i.e. the “All Aboard” online course national project [83].

The mainstream perception of emerging computer technologies is nowadays on big data, with an implicit demand for digital literacy and access possibilities. The Irish Government's Action Plan for Jobs 2013 identified Big Data as a priority, as Ireland has distinct advantages for this sector. The corresponding **Innovation Partnership programme** still offers funding and support [84]. The term DL may not be in common usage but is well understood.

On the specific term the biggest interest group are academic entities like universities and research organisations. Private companies and NGO organisations focus on Big Data and Open Data [85]. As Ireland is the base for European operations to many U.S. enterprises, there is some influence from these on political issues like the GDPR. This applies to non-EU countries as well, as Ireland is the last country within the EU that speaks the English language. This attracts enterprises from India and the former Soviet Union especially.

The official source for statistics is a central office [86], there is a board [87] as well. We found no detailed information about stakeholder distribution by percentage or similar.

The providers for courses are universities and a lot of private companies and some NGOs. Commercial courses focus on trainings with specific goal and suitable software products. Universities do not use the term DL for courses but use the terms 'data science' and 'big data', and offer all course levels bachelor, master and postgraduate.

Learning Management Systems are offered by most stakeholders. The software varies from different stakeholders. Moodle, Mahara and proprietary tools are in use. A commercial example is CMIT [88] using Moodle.

There is a National Learners Database [89]. This database allows citizens to find most courses for different target groups. There are some funding programmes as mentioned above.

Many of the big companies branching in Ireland actually use the data mining techniques and require DL for their employees. As foreign companies fuel the demand for personnel, the job market rewards digital literacy. Google, Facebook, Activision, Blizzard, and similar big players have staff in their offices in Ireland.

a. Data Literacy in Universities

Universities in Dublin, Cork, Limerick and Maynooth offer courses as mentioned above in data science. These tracks range from postgraduate to master. Faculties handling these courses are IT, mathematics, and statistics. The duration varies on the certification desired, starting from a few hours for one semester to a master's in data analytics or data science.

Partnerships are mostly used at a project or course level or as a general cooperation framework, but we found a specific cooperation for data science [90]. There are platforms located in India that offer assistance in migration to Ireland with courses in Data Science and Data Analytics [91] – Ireland seems to be a perfect fit because of the language, membership in the EU and the U.S. companies branched in the country.

The government does offer courses via the programmes mentioned above and supports the universities. Universities offer commercial courses as well [92]. The programmes of the government are designed to improve the job market and enhance business in general, so these can be considered cooperation. The **Science Foundation Ireland** is an example for commercial influence on higher education [90].

b. Data Literacy in the Enterprise Domain

There is unspecific demand for DL in a wide array of jobs. A search at ie.indeed.com or irishjobs.ie shows more matches with data science or data analyst. "Python" and "developer" give again more hits with some overlap. The "Data" searches show a lot of recruitment agencies offering positions, so there may be some demand by enterprises that don't search openly for staff. As mentioned above, there are collaborations between all sectors, so business involvement in course design can be expected.

There are a no explicit DL courses. Courses for Big Data and Data analytics/science are available by universities and private companies for non-students on a pay-per-study basis. Even online tracks are available for a fee. As major players operate the EMEA markets from Ireland, the Big Data field is essential in their global strategy. With collaborations enterprises hope to acquire well prepared staff.

c. Data Literacy related competences and validation

DL and related competences are seen as very important by all actors – Ireland is a bridge to the U.S., exports knowledge to world through foreign students and is a base for most IT giants. IT is seen as emerging market, with a huge potential of available jobs in the field. There are several ways to receive validation; one of them is the **Analytics Institute**, which is part of the European data science framework [93].

There is an independent state agency for education and training which maintains the **qualification framework** [94], [95]. For some computer and programming skills there are certifications by universities, enterprises and by community colleges.

For some computer and programming skills certifications there are no formal requirements, so everybody can apply for a test of skills and certification. CEDEFOP offers a full report on validation [96].

The National Qualification Framework (NQF) and the QQI are the main sources for validation. The QQI does not specify the kind of IT based validation tools used.

2.8. Italy

2.8.1. Scope

The desk research for Italy was developed by the collaboration between the consortium partners CNR-ITD, SmartRevolution, Evodevo, and Dataninja, from Italy. The focus of these partners was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.8.2. Desk Research Interpretation

In Italy, the interest in DL seems to be rising in the public debate due to several factors. On one hand, the Open Data movement that since early 2010 promotes the release of public data under open licenses, on the other hand for the increasing interest of newspapers and public institutions regarding the use of data in covering news and monitoring public decisions. During the COVID-19 emergency, data has become a

central topic due to the official reports on the pandemic diffusion announced day by day on television, as well as regarding topics like privacy discussed in the mainstream television talk show.

As for public events, DL still presses as a side argument. In fact, there are no public conferences fully focused on this topic, while the topic is likewise included among the most important in sectoral events for schools, professionals, digital marketers, journalists.

Among stakeholders of the job market, there are freelance and professionals with competence in the fields of journalism, communication, and marketing, mainly oriented to leverage the power of utilising data for both internal and external communications.

In the secondary school sectors, there have been a few initiatives such as *A Scuola di OpenCoesione*, an online educational program to bring data and journalism competencies among students.

Likewise, the Ministry of Education has launched a program of funding called ***PON Cittadinanza Digitale***, to help schools improve their educational systems, and also assists with topics such as Open Data and Data Journalism.

Italian civil society organizations are increasingly promoting Open Data as an instrument of transparency, instead of DL itself as a competence domain.

Regional and hyperlocal public administrations are providing their employees with learning opportunities focused on Open Data and basic data-related competencies. They are also promoting courses for citizens.

Different kinds of private educational players are promoting courses both online and offline focused on DL.

The most effort in spreading data related competence seems to be in Higher Education, with dozens of courses (degrees and masters) but strictly focused on Data Science instead of DL itself.

a. Data Literacy in Universities

In Italy, there are several universities offering courses in which concepts related to DL are taught. However, most of the courses are specifically related to the technical competences required to extract, elaborate, analyse, and visualize data.

The duration of the courses varied depending on the department and the specialization. ICT departments have activated entire master or undergraduate degrees in subjects related to DL. The analysis of degrees in humanities, social science and journalism have also highlighted the presence of DL related courses in these faculties.

The following are examples of master's degrees in DL related competences:

- *Università Bocconi Ricerca, organizzazione e analisi quantitativa dei dati. Corso di formazione manageriale* (https://www.sdabocconi.it/it/formazione-manageriale/ricerca-organizzazione-e-analisi-quantitativa-dei-dati-ii-edizione)
- *Università Bocconi*, Data science and business analytics *magistrale* (https://www.unibocconi.eu/wps/wcm/connect/Bocconi/SitoPubblico_EN/Navigation+Tree/Home/Programs/Master+of+Science/Data+Science+and+Business+Analytics/)
- *Università di Milano-Bicocca*, Data science *magistrale* (https://www.unimib.it/ugov/degree/4055)
- *Università di Pisa*, Data science and business informatics *magistrale (*https://www.unipi.it/index.php/lauree/corso/11134)
- *Università di Roma-La Sapienza*, Big Data *Metodi Statistici per la Società della Conoscenza master II livello* (https://www.dss.uniroma1.it/it/master-bigdata)
- *Università di Roma-La Sapienza*, Data Science master's degree in data science
- *Università di Roma-Tor Vergata*, Customer Experience & Social Media Analytics master II livello (http://www.master-cesma.it/)

The following are examples of undergraduate courses in DL related competences:

- Bologna Business School, Data science, *master I livello* (https://www.bbs.unibo.it/hp/master-fulltime/data-science/)

- *Università Cattolica - Milano*, Data Science for Management, *master I* livello (https://offertaformativa.unicatt.it/master-data-science-for-management)
- *Università di Milano-Bicocca*, Master in business intelligence and data analytics, *master I livello* (https://www.unimib.it/didattica/master-universitari/master-attivati-aa201819/business-intelligence-e-big-data-analytics)
- *Università Niccolò Cusano*, Data analyst, *master I livello* (https://www.unicusano.it/master/data-analyst)

While examples of semestral and specialization courses have been listed below:

- *Università dell'Insubria*, Machine learning and big data analysis, Global entrepreneurship economics and management *magistrale* (https://www.uninsubria.it/ugov/degreecourse/131058#0)
- *Università Carlo Cattaneo* - LIUC, Information literacy *per ingegneri Ingegneria Gestionale triennale* (http://my.liuc.it/corsi/syllabus.asp?ID=5612)
- *Università di Bergamo*, Data analytics *Scienze della comunicazione triennale* (https://www.unibg.it/ugov/degreecourse/40872)
- *Università di Milano-Bicocca, Analisi multivariata dei dati Psicologia clinica e neuropsicologia nel ciclo di vita magistrale* (https://www.unimib.it/ugov/degreecourse/217692)
- *Università di Milano-Bicocca, Statistica Sociologia triennale* (https://www.unimib.it/ugov/degreecourse/267039)
- *Università di Parma*, Information literacy *Servizio sociale triennale* (https://www.unipr.it/ugov/degreecourse/162585)

In the list reported above, both private and public universities are represented. The faculties most represented are in the economic, computer science and statistical fields, but there are also examples in which the DL related competencies are taught in Sociology, Psychology and Communication science, even though in this case there is not a specific degree but only a semestral course.

The main partnerships activated at University are with technological partners (represented by enterprises working with data). We have not detected specific collaboration with foreign Universities or in conjunction with European initiatives or projects.

Not all the universities are implementing initiatives to integrate traditional training with internships or third parties to develop DL competencies.

An interesting initiative to report is the Data Science Industrial Liaison Program (ILP), implemented by the University *La Sapienza* (Roma) Master degree in Data Science, aimed at creating and strengthening relationships between the Universities and companies, public administration, industrial and public research institutes.

The Customer Experience & Social Media Analytics promoted by the *Università di Roma-Tor Vergata* has activated relationships with enterprises such as Accenture, Altran, SaS to increase the employment opportunities of the students.

b. Data literacy in the Enterprise domain

We looked at job announcements held by the specialized website Indeed (https://it.indeed.com/). We found that there is a definite request of DL competencies in data related jobs and some degree of request in more general jobs.

In particular, we select the most asked **hard** and **soft skills**:

HARD SKILLS

- Relational Databases
- SQL Language
- Data models
- Business Intelligence platforms such as Tableau, Qlik, Business Intelligence, Cognos, PowerBI
- Excel
- Office tools: Excel, Word, Powerpoint
- Data visualisation / Dashboarding
- Data warehouse
- Data Programming languages such as R, Python, SAS, Scala

SOFT SKILLS

- Attention to details
- Communication skills
- Problem-solving capabilities to discover, address and resolve issues
- Independent worker
- Team worker
- Ability to translate technical concepts to many different organizational departments
- An open mind and innovation orientation
- English fluency

- Big Data (Hadoop, Spark, Elastic Search)
- No-SQL (Mongo DB, Cassandra, HBase)
- Social oriented tools such as Google analytics
- ETL Tools such as Talend, Datastage, Informatica
- Data engineering / streaming technologies like Kafka, Spark, Flink, AWS EMR, AWS Lambda
- Artificial intelligence
- Data Mining / Machine learning / Deep learning
- Machine learning platforms
- SCRUM methodology
- Source versioning tools such as GIT
- Statistical DB
- Ability to quickly understand business requirements and transform them into data models
- Enjoy working with internal and external customers

These competences are sometimes/often asked for non-data specialist positions, such as secretary or accountant. In particular, knowledge of Excel and basic reporting capabilities are the most asked general hard skills while attention to detail and ability to understand business requirements are the most asked soft skills.

We have not found evidence of interactions of enterprises with universities. However, there are private universities that design their courses using the interaction with steering committee that include enterprise representative. This is the case of LUISS University [97], that is an extension of ConfIndustria [98], the main association representing manufacturing and service companies in Italy, and *Bocconi* University [99] that makes the collaboration with enterprises one of its strengths.

Within Italy, there is a wide variety of online and in person courses, such as that of the DataNinja School [100] (DataNinja is a partner of Datalit), Adfor [101], Life Learning [102], E-magister [103] and others. E-magister is a platform hosting courses from

learning organisations; for example, "Digital Marketing and Big Data IED" held by Istituto *Europeo di Design*, an important Italian school at University level.

These courses are competing with international platforms such as Coursera, Udemy, edX, LinkedIn Learning, that are offering a lot of technical courses on data related analysis, mainly on the technical side. These platforms have the advantage of brand recognition, so they are more valuable in a CV. On the other hand, these courses are typically in English, so there is a large part of the possible market that is cut out from them: the language divide is in some way even worse than the digital one.

In fact, it is much easier to find advanced courses (machine learning, big data, data analytics) than basic data courses, i.e., DL for beginners.

An important free source is the DL online courses offered by Qlik [73], offered even through the Data Literacy Project [36]. Qlik is one of the leaders in data visualisation and it is interesting that is trying to raise the level of their users.

Evodevo (partner of Datalit) offered an introduction to data modeling and open data to the "*Sapienza*" for several years at the University of Rome, High School for archivists and librarians.

Almaviva [104], is one of the most important Italian IT companies, which offers courses for their former employees that includes data literacy (based on the tools Google Sheets)

There are several educational approaches put in place in the business sector concerning the DL competencies. The enterprises are trying to hire data scientists, data analyst, big data and/or data warehouse specialists and so on, but trained people are very difficult to be found. Presently, an approach is asking specialized consultancy companies to offer courses inside the enterprises, with customised curricula. This can be quite complicated given the staff turnover, especially in large corporations. Another important problem is that data competence is needed not only by data specialists but even by employees working in marketing, secretaries, warehouses. The current curricula of the standard courses are not particularly suited to these kinds of employees.

c. Data literacy related competences and validation

Outside formal education, DL competences are not recognised and validated through a standardised approach. Indeed, Italy still lacks a national operational approach for the identification, validation and certification of competences acquired in NFIL contexts.

The Recommendation of 20/12/2012 of the Commission of the European Parliament on Validation urged all EU Countries to set up a validation system for NFIL by 2018. The recommendation also states that key stakeholders, in particular enterprises, employers and formal education institutes should be actively involved in the definition of such a validation system.

In Italy, up to the end of 2012, there were only a few regional approaches to competence validation (*Campania, Friuli Venezia Giulia, Lazio, Liguria, Marche, Basilicata, Trento, Puglia*). Some of them have produced interesting results[1], however, they did not lead to a national systemised validation approach. In 2013, fostered by the European Recommendation, the Legislative Decree no. 13 of 13/01/2013 defined principles, tasks, and responsibilities to develop a national validation system based on the comparability of learning outputs and set up a National Technical Commission for its implementation. Moreover, in 2014 it started working to set the minimum standards for certification.

The work is proceeding extremely slowly and after 7 years from the Decree on competence validation and certification, there is still no national system to validate and certify competences acquired in NFIL settings. In January 2020, the National Technical Commission finally issued the "Guidelines for the interoperability of public entities within the national system for competence validation"[2]. The implementation of such systems requires two main elements:

- a national Register of titles and qualifications: a framework of standards for the certification of competences acquired in formal, informal, and non-formal contexts;
- Services for the identification, validation, and certification of competences on the whole national territory

[1] More information on regional approaches can be found at http://librettocompetenze.isfol.it
[2] http://www.bollettinoadapt.it/certificazione-delle-competenze-i-nodi-irrisolti-in-attesa-delle-linee-guida-per-lavvio-del-sistema-nazionale/

The first element has been partially implemented through the National Framework of Qualifications with its supporting online platform. However, the Register should be regularly updated, and public and private representatives of economic/professional sectors should be given the possibility to collaborate to its development through proper informatic means.

The second element, instead, presents several unclear obstacles that may impede its implementation. In particular, the Commission should better define: the professional profile of the "validators"; how and from which sources such services will be financed (will it have a cost for the beneficiaries?); and how validation and certification services will be applied to professions that are not organised in professional associations.

To conclude, several Italian institutions are particularly involved in the analysis and promotion of NFIL validation, such as ISFOL (*Istituto per lo Sviluppo della Formazione Professionale dei Lavoratori*) and *Tecnostruttura*. ISFOL is the Institute for the Development of Vocational Training of Workers. Under the supervision of the Italian Ministry of Labour, this agency has set up a working group on the recognition of non-formal and informal learning. Surveys presenting an overview of past and present data collection have monitored all schemes (regional, national, stakeholders) have been carried out, providing a systematic analysis of the status of NFIL validation in Italy. *Tecnostruttura* is a technical association that works for the regions, in particular, implementing VET policies and other ESF (European Social Fund)-funded projects. One of *Tecnostruttura's* working commissions is dedicated to employment and education policies. For more than ten years, *Tecnostruttura* has participated in building the 'foundations' of a national validation framework, providing technical assistance throughout the process.

2.9. Lithuania and Latvia

2.9.1. Scope

The desk research for Lithuania and Latvia was developed by the consortium partner Vilnius University. The focus of this partner was to describe how DL is perceived in these

countries, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.9.2. Desk Research Interpretation

In Lithuania and Latvia, DL is perceived as a broader term than just a mere computer/IT literacy. Yet, the latter is also an integral part of the DL concept. DL in its broadest term in these countries refers to ability to use digital technologies for information search and management, communication and problem solving. It includes interdisciplinary competences and enables to cope with the 4th industrial revolution challenges. To a large extent, DL in Lithuania and Latvia refers to information literacy – ability to comprehend data (i.e., media) outlets, assess them critically and communicate them later on [105].

There is a wide variety of the stakeholders related to DL: individuals, private enterprises, public entities [106], educational institutions, scientist community, etc. DL is also widely encouraged and promoted among different age groups: from primary school students to elderly [107], [108]. Therefore, the importance of DL competence in Lithuania and Latvia is perceived to be horizontal; it does not depend on the age group, income, or urbanization level.

Regarding the statistics about these stakeholders, the information is vast and various. The Lithuanian Department of Statistics provides information regarding DL among individuals, private enterprises, and public entities. For individuals, there is statistics about data security, e-commerce, internet usage. For private enterprises, there is statistics about e-commerce, web advertisement, data clouds, internet usage. For public entities, statistics exists regarding e-service provision, employees' data literacy (mostly IT) course participation, their email usage [109].

DL courses are delivered by a variety of different institutions, beside universities. Various communities, private enterprises, NGOs, IT academies hold courses for different DL theme subjects. In Latvia, as a part of international network, a Data School is established. It aims to promote DL in local society and trains people DL competences. Also, EU funds are used to promote DL (for instance, in regional libraries across Lithuania) [110], [111], [108], [112], [113].

Learning technologies (mostly – Moodle) are used to deliver DL courses both in Lithuania and Latvia (for instance, data science courses [114]).

DL related competences received an increasing importance for businesses in Lithuania and Latvia. Therefore, there is a strong support to increase their acquisition. Mostly, businesses and public institutions communicate their DL competence needs via surveys, press releases, articles, reviews, social networking, various initiatives (such as hackathons, open data conferences and co-creation events) [115],[116],[117],[118],[119],[120].

a. Data Literacy in Universities

Analysis of study programs across many Higher Education institutions in Lithuania and Latvia showed that they widely integrate DL to its curricula. 23 (of 28) of Lithuania and 5 (of 13) HE Institutions of Latvia executes study programmes closely related to DL or which curriculum includes subjects, closely related to DL (data analysis, database creature and management, data visualization etc).

The analysis of descriptors of study fields, approved by Ministry of Education and Science of the Republic of Lithuania (as the main regulations for study programme licensing and legitimacy), was performed as well and it helped us to structure and summarize the findings [121]:

- there are some differences for requirements for DL in study fields but not differences related the status of HE (public or private);
- HE institutions which are related to IT, engineering and technology sciences (e.g.*Vilnius Gediminas* Technical University; *Vilnius kolegija* / University of Applied Sciences; *Vytautas Magnus* University etc) executes study programmes directly dedicated to creating and management of data bases (e.g. Systems of Business information; Information systems; Data analysis technology; Data analysis and modelling, etc) and study programmes which include such courses like data visualization; security of data; data analysis, etc.

- HE institutions which are related to sciences in fields of medicine and health; natural; humanitarian sciences and arts do not have courses in DL, or these courses are very specific;
- HE institutions which are related to social sciences are mostly related to DL (e.g. Vilnius University; University of Management and Economics (ISM); *Kaunas* University of Technology (KTU); *Klaipėda* University (KU); *Mykolas Romeris* University (MRU), etc etc) because of several reasons: a) programs related to business management (especially linked to innovations) include data literacy to a larger extent, as it is one of the core necessities for technological part of business administration; b) study programs of finances, accounting and business management tend to include general DL courses more than others in coherence with the descriptors of these study fields; c) rather frequent aspect of DL in social sciences is information literacy. This competence, according to study descriptions, prepares students to understand and exercise complex business-related data, use information management tools and select reliable sources of information; d) course of research methods is mandatory for all study programmes in social sciences field.

HE Institutions of Latvia executes study programmes which curriculum includes subjects, closely related to DL (subjects: Databases; Data protection; Data Processing Systems; Privacy and Data Protection; Data Analysis; Analytics & Storytelling with Data; Big Data; Statistics and data interpretation; Information and Business Processes; Advanced Data Technologies; Introduction to Big Data). Almost all programmes which curriculum include subjects related with DL also includes subjects related to research methods.

Academic staff in HE institutions are encouraged and supported for inviting business or public sector representatives. Case of the Faculty of Economics and Busines Administration of Vilnius University could be considered as appropriate example for analysis in this field. The list of topics, which were offered by invited guests includes more than 200 topics, 10 percent of them are related to DL (e.g. Data safety; GDPR and personal data safety; Data based decision making; Data Analysts, Data Scientists,

Business Analysts; Types of data, methods of data collection, storage and processing, basic tools for working with data, etc.).

HE institutions provides services and trainings for business and public sectors in some extent (approximately 50 percent HE institutions in Lithuania and 30 percent in Latvia) but topics related DL where identified only in two institutions:

- Vilnius University, Faculty of Philosophy (Qualitative benchmarking training with fsQCA2.0 and TOSMANA software; Consultations on methodological issues of quantitative observation research, training to work with the analysis program Noldus Observer XT);
- Stockholm School of Economics in Riga (SSE Riga) (Automatization of data processing and efficient reporting principles; Interactive data visualization with MS Power BI; Effective work with MS Excel and basics of data analysis).

In Lithuania students of social sciences studies are encouraged to collect data for their bachelor thesis during their internship.

Internships models in Latvia's HE institutions are not clearly standardized: our research showed that there are several models used (3-4 weeks duration internships every semester; one semester internship in the end of studies; 6 ECTS internship one semester plus 20 ECTS internship in the company last semester), there is no possibility to identify relations with DL.

List of **Lithuania' HE institutions**, which study programmes descriptions were analysed:

- *Šiauliai* State College: https://www.svako.lt/en
- Northern Lithuanian College: http://www.slk.lt/en
- University of Applied Social Sciences: https://www.smk.lt/en/
- Utena University of Applied Sciences: https://www.utenos-kolegija.lt/en
- *Graičiūnas* School of Management: http://www.avm.lt
- Lithuanian Business University of Applied Sciences: https://www.ltvk.lt/en/

- Vilnius College of Technology and Design: https://en.vtdko.lt/
- Vilnius *kolegija* / University of Applied Sciences: https://en.viko.lt/
- University of Management and Economics (ISM): https://www.ism.lt/en
- *Vytautas Magnus* University: https://www.vdu.lt/en/
- *Vilnius Gediminas* Technical University (VGTU): https://www.vgtu.lt/index.php?lang=2
- Vilnius University (VU): https://www.vu.lt/en/
- *Alytaus kolegija*/ University of Applied Sciences: https://alytauskolegija.lt/en/
- *Kauno kolegija* / University of Applied Sciences: https://www.kaunokolegija.lt/en/
- *Kaunas* University of Technology (KTU): https://en.ktu.edu/
- *Klaipėda* University (KU): https://www.ku.lt/en/
- *Mykolas Romeris* University (MRU): https://www.mruni.eu/en/
- *Šiauliai* University (ŠU): http://www.su.lt/index.php?lang=en
- *Kauno technikos kolegija*/ University of Applied Sciences: http://www.ktk.lt/home-en/
- *Kazimieras Simonavičius* University: https://ksu.lt/en/
- *Klaipeda* State University of Applied Sciences (KVK): https://www.kvk.lt/en/
- *Kolping* University of Applied Sciences: https://www.kolpingokolegija.lt/en/
- LCC International University: https://lcc.lt/about-lcc
- *Marijampolės kolegija*/ University of Applied Sciences: http://www.marko.lt/#
- St. Ignatius of Loyola University of Applied Sciences: https://www.ilk.lt/en/home/
- International School of Law and Business (ISLB): https://www.ttvam.lt/
- *Vilniaus kooperacijos kolegija*: (https://vkk.lt/lt/)
- Vilnius Business College: http://www.kolegija.lt/en/

List of **Latvia' HE institutions**, which study programs descriptions were analysed:

- *Jāzepa Vītola Latvijas Mūzikas akadēmija*: https://www.jvlma.lv/en

- *Rēzeknes Tehnoloģiju akadēmija*: https://www.rta.lv/en/
- Riga Graduate School of Law (RGSL): https://www.rgsl.edu.lv/
- Stockholm School of Economics in Riga, SSE Ryga): https://www.sseriga.edu/
- Baltic International Academy: http://bsa.edu.lv/lang/eng/applicants.html
- *Ventspils* University of Applied Sciences (VUAS): https://venta.lv/en/
- University of Latvia: https://www.lu.lv/en/
- Art Academy of Latvia: https://www.lma.lv/en
- *Daugavpils* University: https://du.lv/en/
- Latvia University of Life Sciences and Technologies: https://www.llu.lv/en/
- *Liepaja* University: https://www.liepu.lv/en
- *Rīga Stradiņš* University (RSU): https://www.rsu.lv/en
- Riga Technical University (RTU): https://www.rtu.lv/en

b. Data literacy in the Enterprise domain

After the Job announcement research in Lithuania and Latvia, we can conclude, that DL competences are requested by enterprises, but not very often and also the need of this competence very much depends on the position: for secretary or administrator position DL competences were requested in 30% announcements, for accountant - 13% (only for chief accountants), for media and public relations services 54%, for Human Resources management 27%. But for customer service (0% of 165 job announcements), Security & Rescue Services (0% of 29), medicine there is no such requirement at all.

In Lithuania according to regulation every study program in university has to have a Program committee, which is composed of academy and at least one student representative and one social partner from business or public institution. Also, it is common that some programs have more than one partner. The purpose of the Program committee is to ensure the relevance of the study program objectives, their accessibility, the competitiveness of the program, by combining the views of stakeholders, their needs, and good practices. The main responsibility of Program committee is to update program structure/design in order to better fulfil society, business and economy needs and

expectation. According to this regulation business has direct impact on study programs. Also, there are programs that have institutional affiliation with business, especially it is pertinent to technological programs. In both cases the enterprises are involved in the design of Program structure and courses in universities.

Every bachelor program in university has an internship which lasts about 1 semester (16 weeks). The tripartite internship agreement between university, internship institution and student are signed for every student. According to tripartite internship agreement the company assigns the student internship supervisor who organizes and monitors the student internship. According to this system, the business/internship organization plays important role in student education.

DL courses are provided by different economic units: libraries, education institutions, public centers financed by budget, enterprises, NGO, media organizations, etc. The leading role is taken by public and educational institutions. Enterprises working in IT and the data domain usually are partners with them when organizing digital literacy (computer) courses.

Libraries manage large amounts and flows of information, provide access to these sources, and carry out educational activities. They regularly organize seminars, discussions, and political debates. The National Library is the methodological center of the country's libraries and contributes to the development of citizens' media and information literacy competencies.

As a result, various media, and information literacy (especially Digital Literacy) training and seminars are currently very popular in Lithuania as well as in Latvia. It is relevant not only to beginners, but also to those who know and manage them quite well. Most popular topics: "Electronic services", "Information resources and search", "Social networks", "Creative use of new media", “Copyright Basics”, “Internet Security and Internet Ethics”.

Most popular methods for non-formal media and information literacy education for children and adults used in Lithuania are: consultations on computer-based writing, civic

discussions, role-plays, training how to use public e-services, verification of facts and sources, search for alternative sources of information, recognition of surreptitious advertising and propaganda, identification of traditional technics of manipulations, development of critical thinking.

In Lithuania Media and DL competences development starts in gymnasium, is developed in HEI, later in work and ends in third century universities for senior people. School programs have special subjects on DL, in HEI are either specific DL subjects or DL competencies are included in other subjects of the program. Also, there are seminars about to DL organized by academy or the library of the institution. Therefore, the enterprises include DL requirement in job description or business specific data literacy needs are thought within that institution (e.g. banks, statistics offices). Publicly run courses are more focused on senior generation. E.g. in Lithuania, the "Media and Information Literacy Program" workshops aim to increase the ability of older people to use different media, to better understand and critically evaluate media content, and to develop the ability to make connections in the context of various media.

In Latvia, the situation is very similar to Lithuania. DL competences development starts in gymnasium, is developed through all stages of life by different institutions, but public institutions play more important role comparing with private ones.

c. Data literacy related competences and validation

Validation of computer literacy and other DL related competences is an integral part of the lifelong learning system in Lithuania and Latvia.

Regarding computer literacy, Public institution Information Technologies Institute (ITI) started with ECDL (European Computer Driving License) Programme implementation in Lithuania since year 2000, while the holder of the ECDL license in Latvia is the Latvian Information and Communication Technology Association (LIKTA). In both countries people of various occupations can be tested for particular subsets of computer literacy skills depending on test taker occupation.

ECDL tests can be taken using automated testing systems, which are installed on servers www.ecdl.lt and www.ecdl.lv. In Lithuania, it is possible in test centres to take these modules: Computer Essentials, Online Essentials, Word Processing, Spreadsheets, Presentation, Using Databases, Online Collaboration, e-Citizen, e-Guardian v.1 for IT specialists and e-Guardian v.2 for teachers. The modules: ECDL basis, ECDL advanced (incl. Advanced Word Processing, Advanced Spreadsheets, Advanced Database and Advanced Presentation) and e-Citizen are available in test centres in Latvia.

In 2017 the Ministry of Education and Science issued general principles for validation of nonformal and informal learning in Lithuania [122]. Persons willing to formalise learning outcomes relevant to qualifications at EQF level VI-VIII can apply to an appropriate HE provider. HE institutions have internal procedures for recognising candidate's non-formal and informal learning. If the applicant seeks to acquire a HE qualification, the non-formal and informal learning is recognised as a part of a relevant study programme and the person is awarded a diploma of HE after successful completion of this study programme.

In Latvia, the validation of qualification in tertiary levels (EQF levels V-VII) is regulated by Procedure of Validating the Learning Outcomes Achieved through Learning Outcomes Acquired in Non-Formal Education or Professional Experience [123]. This regulation defines both criteria and procedure. The decision regarding the recognition of learning outcomes is taken by the Commission of Learning Outcomes Recognition established in the relevant higher education institution or college. The basis for the assessment of professional competence are the professional competences as defined by the Occupational Standards [124].

In vocational education in Lithuania, the procedure for competences assessment [125] defines that a person wishing to formalise learning outcomes relevant to qualifications at EQF level I-V shall apply to an appropriate VET provider. The VET provider assesses the skills and knowledge of the applicant based on VET standards and relevant formal VET programmes. Individuals who successfully pass the exam are awarded a formal qualification certificate (from 2015 – VET diploma).

In Latvia, professional competences in VET (EQF levels II-IV) are assessed according to the Procedure of Vocational Qualification Examination in Accredited Vocational Education Programmes [126]. The regulation prescribes the procedure for the validation of the professional competence acquired outside the formal education system, which conforms to the professional competence of the first, second or third level vocational qualification.

Law on employment [127] introduced the validation of non-formal and informal learning as one of the measures supporting learning in Lithuania. The unemployed person is free to choose a validation service provider. According to the procedure for the implementation of employment support measures [128] the Public Employment Service should organise validation of non-formal and informal learning if it is necessary for the unemployed person to fill in the vacancy or start their own business.

In Latvia, employers may choose to ensure the upgrading of qualifications and assessment of competences of the employees in the official way (through Vocational Education Competence Centre) or informally within the company. In the first case validation will be recognised in formal education, in the second further validation will be needed. A new tendency is to disregard official diplomas should the candidate be able to prove needed competences (e.g. through company tests during the recruitment procedure). Such an approach is increasingly popular e.g. in the IT area.

Tests available electronically are widely used by HE and VET as an assessment tool of informally acquired competences in Lithuania and Latvia.

The institutes, organizations, involved in working on Validation of Informal and Non-Formal Learning (VINFL) in Lithuania and Latvia are:

- **Lithuania:** Ministry of Education and Science, Ministry of Economy and Innovation, Qualifications and Vocational Education and Training Development Centre, Public Employment Service (before October 2018 – Lithuanian Labour Exchange), HE institutions, VET institutions and stakeholders

- **Latvia:** Ministry of Education and Science, National Centre for Education, State Education Development Agency, State Education Quality Service, Vocational Education Competence Centre, Sectoral Expert Council, State Employment Agency, National Tripartite Sub-council for Cooperation in VET and Employment, HE institutions, VET institutions and stakeholders.

2.10. Portugal

2.10.1. Scope

The desk research for Portugal was developed by the collaboration between the consortium partners *Universidade Nova de Lisboa* (UNL - Nova IMS) and INOVA+, from Portugal. The focus of these partners was to describe how DL is perceived in the country, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.10.2. Desk Research Interpretation

According to the Digital Competence Framework 2.0 for citizens, from the European Commission, information and DL are abilities that allow people to articulate information needs, to locate and retrieve digital data, information, and content. Also, to judge the relevance of the source and its content, to store, manage, and organize digital data, information, and content [129], [72]. But in Portugal, the most known concept is of digital literacy, not exactly DL, FCT (*Fundação para a Ciência e a Tecnologia*) created the National Initiative for Digital Skills e.2030, Portugal INCoDe.2030, which is an integrated public policy to enhance and foster digital competences [130].

“The Portugal INCoDe.2030” initiative addresses the concept of digital competences in a broad manner. It includes the notion of digital literacy (i.e. the ability to access digital media and ICT, to understand and critically assess contents, and to communicate effectively), as well as the production of new knowledge through research. The concept of digital competences is also linked to the use of digital technologies to design new solutions for different types of problems, the integration of interdisciplinary knowledge and data analysis, the intensive use of artificial intelligence, as well as of advanced

instrumentation and communication networks and mobile systems, and the development and programming of cyber-physical systems. This involves hardware and software and extends the concept of ICT to electronics, automation and robotics"[130].

There are many potential stakeholders related to DL like HEI, that offer various curricula related with data, data science, data analytics, statistics, big data, deep learning, AI, business intelligence, among others (some examples are presented in Table 3 and Table 4 below).

Other stakeholders are private institutions/companies that offer courses related to DL, for example, Rumos has over 650 courses related to data, IT, and so on, that are offered to the general public, but most of these courses are directed to people who have already some background related to data and IT. These courses aim to increase the literacy of the people being trained or redirect them to other fields of knowledge [131]. The company SAS has a training academy for the general public who want to learn more about the SAS software, and want to become more familiar with topics like machine learning, data science, programming, business intelligence and analytics, among others [132].

Public organizations are also import stakeholders, for example the *Agência da Modernização Administrativa* (AMA) is responsible for the digital transformation of the various aspects of the public administration [133]. The Institute for Employment and Vocational Training (IEFP) is the governmental organization for employment in Portugal, they also offer various courses to those that are unemployed or want to change careers [134].

Other stakeholders can be organizations that offer research about different areas of Portugal, like *Fundação Francisco Manuel dos Santos*, responsible for various data portals like PORDATA, a Portuguese database with open access to the public, or INE (Instituto Nacional de Estatística), the Portuguese statistics portal, also with open access to the public[135],[136], [137].

In September 2018, ANACOM (*Autoridade Nacional de Comunicações*, http://www.anacom.pt) presented an infographic (Figure 4) to show the behaviour of digital literacy in Portugal for the year 2017, for the International Literacy Day. This infographic was done based on Eurostat information [138].

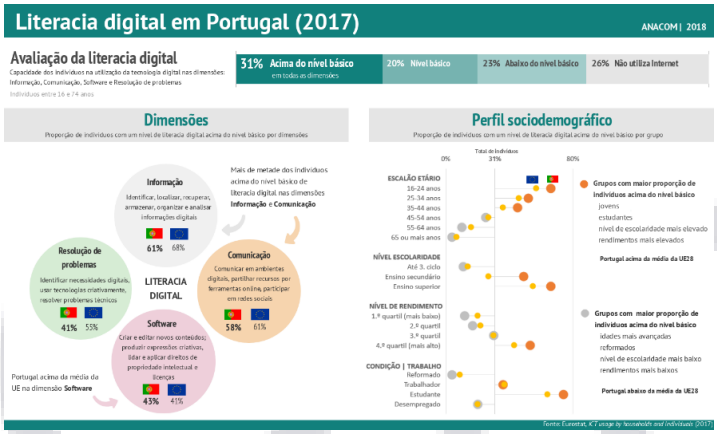
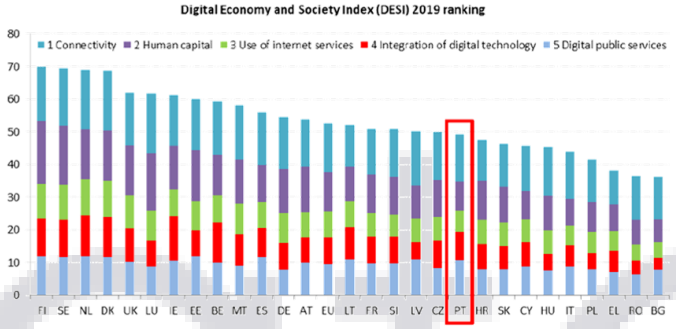


Figure 3. ANACOM data literacy infographic (2018) (ctrl+click on image to see it larger)

In this infographic we can see that a 31% of individuals have a digital literacy above the basic level at all dimensions (information, communication, problem solving, and software). More than 50% of individuals are above the basic literacy in terms of Information and Communication, and around 40% are above the basic level of digital literacy in terms of Problem Solving and Software. Portugal has, therefore, around 20% of its population bellow the basic level of digital literacy.

In the Digital Economy and Society Index Portugal report, for 2019, Portugal ranks 19th out of the 28 EU Member States. “Compared with the previous edition of DESI, the country scored slightly better overall as well as in four of the five dimensions considered, but it did not improve its ranking (Figure 5). The largest improvement corresponds to the Digital public services dimension (Portugal's best performance), driven by a sizeable increase in the share of e-government users. Progress was also observed in the Connectivity dimension, thanks to an improvement in take-up rates for both fixed and mobile ultrafast broadband services. The country performs weakly in both the Human capital and Use of internet services dimensions, which is partly explained by the relatively large number of people who do not use the internet on a regular basis” [139].

	Portugal		EU
	rank	score	score
DESI 2019	**19**	**49.2**	**52.5**
DESI 2018	19	46.8	49.8
DESI 2017	17	44.6	46.9



There are several organizations, besides universities, that offer data related courses, not exactly DL courses, but most of these organizations have beginner's level data courses for stakeholders with no/little background in data related fields. For example, the company Rumos, has a postgraduate course in data science, that has just a few pre-requisites to participate in the course (see course description) [140]. This course aims to train people in managing data science teams, extracting, pre-processing, and exploring data, descriptive/predictive models and, also, Python. Other organizations, like Lisbon Data Science Academy, deliver starters course about data science for stakeholders who want to become entry-level data scientists. It has a duration of 31 weeks, and it is aimed at developing software skills, Python, mathematics, and so on [141]. There are organizations that offer a lesser number of courses, but in a more intensive learning format, called bootcamp, that focus on a specific theme. One example is the course Data Analytics offered by Ironhack, that has only three courses available, but offers an intensive leaning path during 9 weeks (for the Data analytics course) aimed at developing software engineering skills, Python, and Machine Learning [142]. All the mentioned organizations have different learning levels; some offer courses for those who have little digital knowledge, while others offer more advanced courses for those who have an intermediate to advance knowledge in data related fields.

Learning technologies are widely used is various courses in Portugal, including DL related courses. Some examples are provided in table 3 below.

Table 3. Examples of Higher Education Institutions that use learning technologies

Institution	Web Site	Location	Type of institution	LMS/e-portfolio used
UNL - Nova IMS	https://www.novaims.unl.pt/	Lisbon	Public	LMS - Moodle
Universidade da Beira Interior	https://www.ubi.pt/	Covilhã	Public	LMS - Moodle
Universidade de Lisboa (UL)	https://www.ulisboa.pt/	Lisbon	Public	LMS - Moodle
Universidade Católica Portuguesa	https://www.clsbe.lisboa.ucp.pt/pt-pt	Lisbon	Private	LMS - Moodle
UL - Instituto Superior Técnico	https://tecnico.ulisboa.pt/en/	Lisbon	Public	LMS - Fenix

In 2018, IEFP (*Instituto do Emprego e Formação Profissional*) and 14 Portuguese Polytechnic Institutes signed training agreements on digital skills for unemployed higher education graduates. This partnership between IEFP and CCISP (*Conselho Coordenador dos Institutos Superiores Politécnicos*) is included in the project *Parceria Competências Digitais +*, a project directed to unemployed HE graduates, who will receive training in IT, and the project will have the participation of private companies in the digital sector [143].

a. Data Literacy in Universities

In Portugal there are various HEI that deliver courses with DL related competences. The programs analysed are part of four HEI (Table 4) in different parts of the country, 2 from Lisbon, 1 from Minho and 1 from Coimbra. The courses analysed have different levels of knowledge, from undergraduate to PhD and, also, some executive courses or intensive trainings.

Although, data/digital competences are mainly observed in courses related with Information Technologies, Data Science, Artificial Intelligence, and so on, it is possible

to see more and more courses from other fields of expertise adopting data/digital related competences, like Tourism, Design or Marketing. For example, the bachelor's degree in Design and Multimedia offered by *Universidade de Coimbra* uses introductory course units to programming, web, artificial intelligence, among others, to provide a broader level of digital skills to their students, proving that DL is becoming more and more an interdisciplinary field for different areas of knowledge.

Table 4. Higher Education Institutions analysed

Institution	Department/School	Location	Type of institution	Courses analysed
Universidade Nova de Lisboa	Nova IMS	Lisbon	Public	6
ISCTE - Instituto Universitário de Lisboa	ISTA – School of Technology and Architecture	Lisbon	Public	4
Universidade do Minho	School of Engineering	Guimarães	Public	2
Universidade de Coimbra	Faculty of Sciences and Technology	Coimbra	Public	2
Total	-	-	-	14

Erasmus + initiatives are present in every country in EU. There are a few number of projects related to DL, some related with economic aspects, others with ICT skills in adults, and others still, with raising the digital competences in youth work force. Searching in the Erasmus+ projects list, it is possible to see various projects related with DL. Portugal is involved in the following ones:

- "Developing Financial Competencies for EU Citizens Utilizing Online Learning and Digital Literacy" (2014) - eFinLit (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2014-1-PT01-KA204-001056) - Portugal was the coordinator of this project, through the Polytechnic Institute of Porto, and the general goals of this project were to identify and address specific needs of EU citizens in financial literacy, utilize ICT tools and digital literacy to improve EU citizens' competencies in dealing with financial issues, to develop a partnership model of a wide range of expert organizations in the fields of training,

online learning and literacies, address the challenges of financial management generated by the current economic transformations taking place in EU, and meet the basic objectives of EU 2020 strategy such as social cohesion through digital literacy.

- "Digital Natives: Advancing Digital Youth Work" (2019) (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2019-2-HR01-KA105-061066) - Portugal is currently a partner in this project, through a social enterprise named Teatro Metaphora - Associação de Amigos das Artes. The overall goal is to promote the understanding of the importance of digitalization of society; learn about planning, designing, and evaluating digital youth work; learn about information and data literacy; understand digital communication, safety, and creativity.
- "Level Up - Digital Skills for Adults with Blue-collar Occupations" (2018) (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2018-1-TR01-KA204-058746) - Portugal participates as a partner, through Instituto de Soldadura e Qualidade, a private company. The main goal of this project is to define digital skills for blue collar workers, create a training content to teach them and have an online tool so that they can keep up with the digitization and have a sustainable work life in the digital age.

These are just three examples of the many projects involving DL subjects between Portugal and other countries, where is possible to see the different levels of DL necessities, from HE institutions, to private companies, or cultural institutions. Digital competences are becoming even more necessary at all levels, there are a several projects involving teachers and students from lower educational degrees (like high school or below), that seem to have an innovative view on how to give a more digital class to the students and also to help students obtain important digital skills ("How To Make STEAM Literacy A Reality For All Students"(2019) (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2019-1-UK01-KA229-061376); "MATH-ICT Europe" (2017) (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2017-1-TR01-KA219-046336)).

There are several collaborations between the business sector and HE, regarding DL and related areas. Nova IMS, from *Universidade Nova de Lisboa* has a few courses that have private institutions partnerships. An example is the Master Degree Program in Data Science and Advance Analytics, with a Major in Business Analytics, has this in their course presentation: "The best students of the 1st year of the Master in Data Science and Advanced Analytics will be invited for a 6 month paid internship, to be held during the 2nd year, in one of the program's partner institutions (Accenture, *Grupo Ageas Portugal*, SAS, Millennium BCP, Rebis Consulting, NOVA IMS and *Tranquilidade*)" [144].

The Postgraduate program in Geospatial Intelligence (GEOINT), from Nova IMS also has a partnership, with external institutions, namely Portuguese governmental institutions like the Military Academy and the Army's Geospatial Data Centre, and the United States Geospatial Intelligence Foundation (USGIF), responsible for the accreditation of this course [145].

Another example of similar partnerships is the Master program in Telecommunications and Computer Engineering from ISCTE (already mentioned above, in table 4) also in collaboration with external institutions to enhance employment chances for their students. They state the following about the employability in the course presentation: "The integration of students into companies frequently begins with professional internships in collaboration with IAESTE (International Association for the Exchange of Students for Technical Experience) or through participation in exchange programmes that take students to companies like BT Exact (UK), SIEMENS (Germany) or research centers such as CERN (Switzerland)" [146].

This kind of partnerships, collaborations or accreditations are not exclusive of these two HEI's, it is possible to see an increasing number of collaborations between HEI's and the business sector, especially related to data/digital competences courses.

b. Data Literacy in the Enterprise domain

According to the results of online search in the main job portals used in Portugal, there is a significant number and variety of companies offering job positions that require DL

competences. However, the vast majority of these job offers are for multinational companies (not Portuguese) and very concentrated in the Lisbon area.

A search in the widely used job portal *Expresso Emprego* (of the Portuguese newspaper *Expresso*) using the key word "DATA" shows results in the following careers and skills: data analyst, data analysis, data entry, data warehouse business intelligence. There are ads for Data Engineer, Master data specialist, data scientist, IT data center engineer, among others. Also, other jobs require data-related skills, e.g. Contract Administrator (for Siemens), Accountant (for PSA Bank), Iam integration developer, digital marketing manager, business analyst, even translator of Indian languages (for an IT company) and HR administrator. In LinkedIn jobs (search for jobs in Portugal) there is also a variety of job offers directly related to DL, e.g. Data analyst, data engineer, big data consultant, etc. and other apparently non related jobs requiring data-related skills, e.g. purchasing/office manager, quality assurance developer, product manager. In LinkedIn there are hundreds of job offers directly related to DL, again in the vast majority coming from multinational companies and strongly concentrated in the area of Lisbon. The companies requesting "data-professionals" are not only from the IT sector and include e.g. Adidas, banks, IKEA. There are also a couple of ads with Research Grants (*Bolsas de Investigação*) for PhD related to data.

The Data Science Portuguese Association (https://dspa.pt/) promotes specific job offers in the sector arriving from companies requiring human resources with DL related competences.

Public information on DL courses provided by enterprises that are not from that area or that are not training providers was not found. It should be noted that the vast majority of enterprises in Portugal don't have the size and probably the resources required to organize DL courses.

Still, connections with companies can be detected through some features of the training offer available (outside universities) in this field. As stated in Part 1. question 2, several private non-academic training providers offer courses in DL (for example: Rumos offers post-graduation in Data Science [140], other training providers have different offers:

EDIT[147], citeforma [148], Galileu, vantagem+ [149]). Trainers of the post-graduation of Rumos, for example, work in enterprises like Vodafone, Talkdesk, Hostel World.

Bright Concept Consulting, in its "AI Academy" has a more transversal offer addressing DL. Courses include: Leadership and data knowledge, data science and business, automation, and creativity [150].

The business sector does not refer to a structured approach towards DL competences. There are, however, some elements that illustrate how the input of enterprises is collected.

- A study conducted in 2015 among 47 companies, identified the 5 most required competences in Portugal: technological engineering, marketing & communication, economic sciences, operations and logistics, automation. It is likely that most of these areas involve DL skills.
- There is a significant representation of the business sector in DSPA: in DSPA's website, at least 100 of the most relevant companies acting in Portugal are listed as Associates, including Deloitte, Ageas, Altice, Brisa, EDP, CUF and several hospitals. Among the objectives of DSPA, there are: representing the data science sector, cooperation with higher education institutions.
- The Portuguese Agency for Qualifications (ANQEP), public body that regulates and certifies VET (Vocational Education and Training), created 16 Sectoral Councils for Qualifications, representing various sectors, to ensure the update of the national qualifications and training offer considering the participation of all economic and social actors. In these structures, companies have the opportunity to discuss with other actors and give input about the competences required for their workforce. This input is taken into consideration by ANQEP when reshaping the training and qualifications offer and when releasing information and forecasts on skills needs.

c. Data literacy related competences and validation

DL competences are acknowledged differently according to the qualifications level, but there are no specific frameworks or diplomas for this area.

In HEIs these competences are recognized through the ECTS applied to any other areas.

At non-academic level, ANQEP regulates the recognition of competences, including formal and informal validation systems, based on a National Catalogue of Qualifications. Among the qualifications in this catalogue, several are directly related to DL, e.g. Data organization and restructuring, Document database, Information analysis and display, Database marketing, Database management systems (DBMS), Analysis of information systems, Database administration, Data structures, Customer databases, digital literacy, Surveying and data recording. These qualifications are not only related to the IT sector but also to professions in the automotive sector, agriculture, libraries and archives, commerce, electronics, and automation, audio-visual and media, extracting industries and accounting.

Other recognition (and certification) mechanisms in this field are provided by multinational players like Microsoft, that offers an MCSE: Data Management and Analytics [151].

The assessment system for DL related skills at non-higher education level follows the requirements of the National Catalogue of Qualifications provided by ANQEP. There is a specific assessment system for the recognition, validation and certification of competences acquired.

At higher education level, the assessment systems follow the rules of the respective organisation/department.

At international level, a number of relevant initiatives can be highlighted: the Data Literacy Project has a Data Literacy Certification [36]. Also, the DC4WORK project (Erasmus+ programme) provides guidelines and training to support digital competence promoters in integrating and implementing learning processes in SMEs in a digital age [152].

In Portugal, there is a system for validation of informally acquired competences (RVCC in Portuguese) both for school and professional competences: RVCC processes for school competences are based in reference documents on Key-skills for Adult Education and

Training for basic and secondary level; RVCC processes for professional competences are based in reference documents on professional competences included in the National Catalogue of Qualifications.

Although this system exists already some years ago and has been important for many citizens to complete the compulsory education and follow further education, training, or professional paths, it is not highly acknowledged by enterprises and employers.

The only IT-Based tool identified was "*Passaporte Qualifica*", which is not exactly a validation tool, but a technological instrument to register qualifications and competences acquired or developed throughout life, and guidance for learning paths. The Passport prioritizes proposals of conclusion/increase of qualification of adults, also for the qualification in a double certification.

Validation of competences informally acquired is performed by the so-called "*Centros Qualifica*". There are hundreds of such centers all over the country. The institution managing these Centers and issuing the referential for certification is ANQEP.

2.11. Republic of Serbia, Bosnia-i-Herzegovina, and Croatia

2.11.1. Scope

The desk research for Republic of Serbia, Bosnia-i-Herzegovina and Croatia was developed by the consortium partners PanonIT and University of Novi Sad, from Serbia. The focus of these partners was to describe how DL is perceived in these countries, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.11.2. Desk Research Interpretation

From the desk research it can be concluded that term "data literacy" in Serbia is still not recognized nor translated [153]. In other word, in Serbia we still do not have competences related to DL. The only recognized terms are information literacy and data science. In Croatia it is translated as "*podatkovna pismenost*" and is recognized by the Higher Education institutions [154].

With this research, we can see that DL is not fully implemented within higher education institutions nor enterprise organizations outside of data science, computer science and business analytics fields. In general, there is no strong ability to identify, understand and use data. There is a common misconception that DL is mostly relevant to data science and data engineers. Understanding of DL is usually related to digital literacy which is commonly defined as the ability to use information and communication technologies to find, evaluate, create, and communicate information, requiring both cognitive and technical skills. Within the enterprise domain, data stays enclosed within IT departments while improvement of DL in companies is not aligned with business goals. Employees don't know how to properly use available data, there are misconceptions that one can only understand and use data through complex specialized tools and technologies. Conclusion is that training sessions on DL are necessary in order to help companies, universities, and the public to learn how to properly operate on data

Major stakeholders in Serbia are: Higher Education Institutions – University of Belgrade, University of Novi Sad, University of Nis, University of Kragujevac, University of Novi Pazar; Ministry of education, science and technological development of the Republic of Serbia; Ministry of Trade, Tourism and Telecommunications of the Republic of Serbia; Institute for Improvement of Education of the Republic of Serbia; Digital initiative Serbia. Generally speaking, the overall potential stakeholders are:

- Educational institutions
- Governments agencies and departments
- Businesses
- Online education providers
- Various non-profit organisations
- Individuals

There are statistics found on the subject of digital literacy and potential stakeholders done by the Statistical Office of the Republic of Serbia, but not on the subject of DL.

There are very few organizations delivering DL programs, meetups and promoting DL in general besides universities: Open Data Open Opportunities, Digital Serbia Initiative, IT

companies and organizations (i.e. Data Science Serbia, Startit Center, Microsoft Data Science, ECDL, VisualisingData).

a. Data Literacy in Universities

Research of the DL coverage by university courses shows that DL is mostly covered by study programs related to computer science, data science, digital technologies, and marketing but there are also various fields of science that offer data literacy related programs as part of courses.

Serbian universities:

1) **University of Belgrade**:
   a. Faculty of Organizational Sciences:
      i. Data analysis (Master 4.0, the one semester, DL is a whole course)
      ii. Database (Undergraduate, the summer semester, third year students from Information systems and technology, DL is a whole course)
      iii. Fundamentals of information and communication technologies (Undergraduate, the winter semester, first year students from Management, DL is a practical part of the course)
   b. School of Electrical Engineering:
      i. Machine Learning (Master, the winter semester, students from Signals and Systems, DL is a practical part of the course)
      ii. Database (Undergraduate, the one semester, students from Electrical and Computer Engineering, DL is a practical part of the course)
2) **University of Novi Sad**:
   a. Faculty of Technical Sciences:
      i. E-business course (Undergraduate, the summer semester, third year students from Engineering Management, DL is a practical part of the course)
      ii. Machine Learning (Undergraduate, the summer semester, fourth year students from Applied Computer Science and Information, DL is a practical part of the course)

iii. Database (Undergraduate, the summer semester, fourth year students from Applied Software Engineering, DL is a whole course)
iv. Geospatial data visualization (Master, the winter semester, students from Automation, Geomatics and Systems Management, DL is a practical part of the course)

b. Faculty of Philosophy:
i. Data analysis and processing (Undergraduate, the summer semester, fourth year students from Sociology, DL is a whole course)
ii. Introduction to statistics (Undergraduate, the winter semester, first year students from Psychology, DL is a practical part of the course)

3) **University of Nis**:
a. School of Mechanical Engineering:
i. Engineering statistics (Undergraduate, the winter semester, third year students from Mechanical Engineering, DL is a whole course)
ii. Business statistics (Undergraduate, the winter semester, first year students from Engineering management, DL is a whole course)

4) **University of *Kragujevac***:
a. Faculty of Engineering Sciences:
i. Algorithms and data structures (Undergraduate, the summer semester, third year students from Mechanical Engineering, DL is a whole course)
ii. Database (Undergraduate, the summer semester, third year students from Mechanical Engineering, DL is a whole course)

Croatian Universities

a. **University of Zagreb**:
a. Faculty of Organizational and Informatics:
i. Database (Master, the one semester, students from Data and knowledge base, DL is a whole course)
b. Faculty of Electrical Engineering and Computing:

i. Information processing (Undergraduate, the one semester, students from Electrical engineering and information technology, DL is a practical part of the course)

ii. Neural networks (Master, the one semester, students from Information Processing, DL is a practical part of the course)

iii. Advanced models and databases (Master, the one semester, students from Software Engineering and Information Systems, DL is a whole course)

b. **University of Split**:

a. Faculty of Electrical Engineering, Mechanical Engineering and Naval Architecture:

i. Introduction to Information Systems (Undergraduate, the one semester, students from Industrial Engineering, DL is a practical part of the course)

ii. Database (Undergraduate, the one semester, students from Electrical engineering and information technology, DL is a whole course)

iii. Programming for the Internet (Undergraduate, the one semester, students from Electrical engineering and information technology, DL is practical part of the course)

b. Faculty of Philosophy:

i. Qualitative methodology (Undergraduate, the one semester, students from Sociology, DL is a whole course)

ii. Internet research methods (Undergraduate, the one semester, students from Sociology, DL is a practical part of the course)

c. **University of *Rijeka***:

a. Faculty technical science:

i. Digital electronics (Undergraduate, the one semester, students from Electrical engineering, DL is a practical part of the course)

ii. Programming (Undergraduate, the one semester, students from Electrical engineering, DL is a practical part of the course)

d. **University of *Osijek***:

a. Mechanical Engineering Faculty in *Slavonski Brod*:

i. Fundamentals of Informatics (Undergraduate, the one semester, students from Manufacturing Mechanical Engineering, DL is a practical part of the course)

ii. Statistics (Undergraduate, the one semester, students from Management, DL is a practical part of the course

Major universities are part of Erasmus + programme which aims to support education, training, youth, and sport in Europe. It is managed by the European Commission (the EU's executive body), the Education, Audiovisual, and Culture Executive Agency (EACEA), a series of National Agencies in Programme countries, and a series of National Offices in some Partner countries.

University of Novi Sad, University of Nis and Ministry of Education, Science and Technological Development of the Republic of Serbia are a part of the Erasmus + MILETUS "*Student's Mobility Capacity Building in Higher Education in Ukraine and Serbia*". The partners on the project are *Aalborg* University from Denmark, *Politecnico di Milano* from Italy, and National University of *Kyiv – Mohyla* Academy, Mykolayiv National Agrarian University, Private Higher Educational Institution *Kharkiv* University, *Lesya Ukrainka* Eastern European National University and Ministry of Education and Science from Ukraine. Project coordinators are Hamburg University of Technology and Institute of Business Logistics and General Management (W-2) from Germany. They together provide course of Data gathering and analysis of the information (The whole course about DL) [155].

University of Zagreb is a part of Summer School provided by West University of Timisoara. At the course of "Taxation and Accounting in the Digital Era and Global Economy" students can learn how to use data in the digital era of global economy[156].

It is possible to say that there are some attempts to include training of DL related competences in HE from third parties, for example:

- Digital Serbia Initiative created Master 4.0 study program [157]. Also, the Digital Serbia Initiative cooperates with companies and organisations as well as higher education institutions.
- Employment and Social Policy: Strengthening competitiveness and skills through lifelong learning. Founded by European Union Strategic Agenda 2019-2024. Presidency of the Council of the European Union - Croatia [158].

b. Data literacy in the Enterprise domain

This desk research's conclusion is that DL skills requirements are mostly restricted to business analysis, data specialists and similar jobs related to data science. Following positions do have requirements in terms of data skills: data analyst, data analysis, data entry, machine learning engineers, business analysts. In addition to these, we were able to find job advertisements with digital literacy requirements in the fields of marketing, sales, human resources, project management, accountant services and public relation. To research job requirements, we used local job seeking websites

Digital Serbia Initiative Master 4.0 study program brings together higher education institutions and enterprises. List of major companies involved in Digital Serbia Initiativeare Microsoft, Nordeus, 3Lateral, Infostud, Vega IT Sourcing,Ringiel Axel Springer, DevTech, Biosense, Levi9, Saga,EY, Telekom Srbija, Schneider Electric,Startit, Vipmobile, and others.

A specific DL related course provided by an enterprise was found. The course from Microsoft "Microsoft Data Science"[159].

Through a search in companies' websites, news, LinkedIn network, etc., we concluded that companies encourage employee's education through participating in conferences. Internships and intern trainings on this subject are provided only within IT companies within data science, machine learning and business analytics departments for employees involved within these departments. Blackrock Academy is an excellent example of the educational resources available to its employees. If no course is available, the external vendor is providing training services.

c. Data literacy related competences and validation

DL competencies are not structurally validated/assessed outside of business analytics and data science fields in any of the countries analysed. There are no structured assessment systems or tools to assess DL competences. Various online platforms are available to the public in Serbia, Bosnia, and Croatia, offer DL certificates, and these are the available resources in terms of validation of the DL, also at the University level courses and ECDL certification [160]. Also, there are no institutes or organizations, involved in working on Validation of Informal and Non-Formal Learning (VINFL) in Serbia.

Some of the certificates that are present on the enterprise market of the 3 countries are presented below:

- Microsoft Digital Literacy (https://www.microsoft.com/en-us/digitalliteracy/home)
- Qlik Data Literacy Program (https://www.qlik.com/us/services/data-literacy-program)
- edx - Columbia University Business Analytics (https://www.edx.org/micromasters/business-analytics?source=aw&awc=6798_1587623302_a45630f935e603b96ec4c73d67e28a61&utm_source=aw&utm_medium=affiliate_partner&utm_content=text-link&utm_term=427859_Digital+Defynd)
- Coursera - Advanced Business Analytics Specialization (https://www.coursera.org/specializations/data-analytics-business?ranMID=40328&ranEAID=vedj0cWlu2Y&ranSiteID=vedj0cWlu2Y-hkSgfCjITicHQutfO0sV.g&siteID=vedj0cWlu2Y-hkSgfCjITicHQutfO0sV.g&utm_content=10&utm_medium=partners&utm_source=linkshare&utm_campaign=vedj0cWlu2Y)
- IC3 Digital Literacy Certification (https://certiport.pearsonvue.com/Certifications/IC3/Digital-Literacy-Certification/Overview.aspx)

2.12. Romania

2.12.1. Scope

The desk research for Romania was developed by the consortium partner CNR-ITD, from Italy. The focus of this partner was to describe how DL is perceived in this countries, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.12.2. Desk Research Interpretation

The desk research conducted online concerning the use of the term 'data literacy' in Romania revealed that DL is not a common and widely used concept. Therefore, this desk research has been focused on concepts strictly related to DL such as media literacy, information literacy and digital literacy since they have been introduced in the Romanian educational contexts in the last few years. The "National Strategy on Digital Agenda for Romania" (2014-2020) directly targets the ICT sector, and it affects the educational sphere. In fact, one of the four main fields of action identified by the Romanian government is focused on ICT in education. In this perspective, digital and information literacy have been mentioned as key competence for compulsory education in Romania ever since 2003 (as stated by the "Report on the Reform of Compulsory Education in Romania", Ministry of Education and Research, Bucharest, 2003).

Moreover, a report of literacy in different contexts in Romania [161] highlights that there is a national strategy to promote teaching paths in Information and Communications Technology (ICT) in schools. Students and teachers should use ICT in all subjects in class and also for complementary activities [162]. Therefore, ICT is integrated into the curriculum of secondary education [163].

In Romania, media literacy skills with a particular focus on critical thinking, information literacy, safer internet and ICT skills are promoted and developed by various NGOs, training centers for different target groups - children, parents, teenagers, retired people or living in socially disadvantaged areas etc. These organizations play a key role in developing the media education in Romania, and the National Audiovisual Council

(C.N.A.) - the national audiovisual regulator - is entitled by law to promote media education in the country. The Ministry of National Education in 2013 approved the MediaSIS training course aimed at teachers who want to improve their media and digital literacy. We can affirm that even though there is a particular interest towards digital, information and media literacy, there is not a specific reference to DL.

This desk research highlights that, in Romania, DL is not specifically developed, but both hard and soft skills that can be related to DL are covered at the university level by different departments. A certain interest of the enterprises, on DL competences, has been detected, and finally from the analysis of the assessment and validation tools the lack of a proper tool widely adopted at country level has emerged.

a. Data Literacy in Universities

The first notable thing to be reported, is that the label “data literacy” is not the most commonly used. Instead, “digital”, “information” and “statistical” literacy are the preferred expressions.

According to the Digital Economy and Society Index (2018), Romania occupies the last position in the field of basic digital skills. In a world that is constantly changing, “traditional” digital literacy is no longer sufficient for a skilled digital educator. Another EU report, entitled "The European Framework for Digital Competence of Educators” (DigCompEdu), highlights the idea that society has increasingly higher expectations from professors (regardless of the level at which they teach). Based from this premise, a small-scale study was conducted (156 Romanian university professors) within the Romanian higher education space to define professors’ needs regarding the use of new technology to design and digitally deliver courses, and to emphasize what concrete steps, actions, responsibilities and measures should be taken to drive a digital university vision [164].

Regarding specific programs and/or modules on the acquisition of DL related competences in Higher Education, at the postgraduate level, the Faculty of Letters, Department of Information and Documentation Sciences, of the University of Bucharest jointly with the Library of the Cluj Medicine and Pharmacy University, Cluj- Napoca has developed a national project for the implementation of information literacy course in

medical school modules. The modules are addressed to medical students as part of their PhD training. In 2017 a survey has been implemented regarding the information literacy activities developed by libraries for their users. The results of this survey highlighted the lack of structured and regularly running courses included in the curriculum of study programs and thus a need for a generalized decision-making on a national level about information literacy programs (Doctoral School Curriculum – A good starting point for implementing information literacy in Romanian Medical Universities. Madge, O., and Robu I. 2017).

Cimpoeru and Roman (2018) argued that a particular challenge in teaching statistical literacy in introductory courses is dealing with students who do not have a proper mathematical background. This is the case for the Introductory Statistics Course of the second-year students in the Applied Modern Language undergraduate program from the Bucharest University of Economic Studies [165].

A questionnaire was developed in order to evaluate the strengths and weaknesses of the students' current statistical literacy level and to provide significant insight regarding their attitude and beliefs towards statistics. The results prove that undergraduate students' basic statistical literacy skills like graph analysis or table reading are acceptable, while mathematical level is well below average, correlated with a high anxiety regarding mathematics and preconceptions about complexity of statistics.

Some examples of degree courses in traditional DL fields are as follows:

- The Bucharest University of Economic Studies organized a 2-years European Master program in Applied Statistics and Data Science, https://ec.europa.eu/eurostat/cros/content/ro-bucharest-university-economic-studies-ase_en
- And a Summer School in Data Science with a focus on machine learning, text processing, data management and visualization and applications in finance and economics, https://datascience.ase.ro/
- A 2-years High Performance Computing and Big Data Analytics Master hosted by the University Babes-Bolyai aims at providing students with the appropriate

tools for further doctoral studies and professional activity, https://www.mastersportal.com/studies/234135/high-performance-computing-and-big-data-analytics.html

Below, some examples of events, workshops, and university programs at any levels aimed to develop soft skills related to DL:

- At bachelor level, the Department of Journalism within the Faculty of Political, Administrative and Communication Sciences of Babeș-Bolyai University, http://www.fjsc.unibuc.ro/anunturi/anunturi-de-interes-general/zileleculturiimedia2016?tmpl=%2Fsystem%2Fapp%2Ftemplates%2Fprint%2F&showPrintDialog=1
- Victor Babes University of Medicine and Pharmacy, Timișoara, http://www.umft.ro/evenimente-din-cadrul-universitatii-de-medicina-si-farmacie-victor-babes-din-timisoara_172/the-5th-edition-of-the-workshop-communication-skills-–-a-practical-approach-for-students_435
- Faculty of Sociology and Communication, Transilvania University of Brașov, https://www.unitbv.ro/en/faculties/faculty-of-sociology-and-communication.html

b. Data Literacy in the Enterprise domain

In this section, we aim to provide a great number of suggestions to show that DL competencies are required in numerous job areas in Romania. To achieve this we used two of the most popular job search sites of the Web: Glassdoor.com and Indeed.com.

The results we have collected are more concentrated for the city of Bucharest, due to the fact that as the capital of Romania, the greatest demand for work clearly comes from there. The terms we looked for in the job listings published on these sites were: “Computer Literacy”, “Data Literacy” and “Digital Literacy”. Indeed, we have to say that in many job listings the skills related to DL were requested without making it explicit in the job listing. In order to show the most relevant results, we have omitted all those where the skills of the Microsoft Office Package (Outlook, Excel, PowerPoint, Word)

were the only one's requested. These, although do not explicitly present the terms related to DL, could implicitly recall them. Instead, no relevant links were found between companies and university courses (or traineeships) for teaching DL topics.

In Table 5, below, we present only some of the results that were collected. We want to focus on some of them, to show how DL skills range between the various job figures, from the more technical to the less one, referring to the IT field. As a first example we can see how the receptionist job published by JLL asks in the candidate requisites section for DL skills. This makes us understand how important it is for an employer that his employee has a good knowledge of DL. As further results, the ability to analyse and visualize data, as well as the ability to obviously know how to handle it, is required in technical professional figures of the IT field.

Table 5. Some examples on job search in Romania

Company name	Job	Requested Competencies	Place	Source
Booking.com	Language Specialist	Strong computer skills, including familiarity with Computer Assisted Translations tools;	Bucarest	Glassdoor
Takeaway.com	HR Business Partner	You are proactive, data-driven and can prioritize your tasks independently;	Bucarest	Glassdoor
Tradeshift	Support Advocate with German or French	Highly data-driven mindset and passion for analytics	Bucarest	Glassdoor
HP Inc.	Pricing Analyst - Intern with English	Computer literacy, curious to work with various technical tools to gain efficiencies	Bucarest	Glassdoor
Oracle	Project Manager - IT Department	PC literacy in a Microsoft environment,Project Management skills, Numerate / data-driven, displaying financial	Bucarest	Indeed
JLL	Receptionist	Strong PC literacy and proven ability to manage daily activities using various systems.	Bucarest	Glassdoor

c. Data literacy related competences and validation

As already mentioned, the term DL is not widely used in the Romania context. When it comes to the validation of the competences related to DL it is possible to refer to the assessment of digital competences. In this context, the paper [166] presents a cross-sectional survey carried out among students of Faculty of Medicine, College of Dental

Technicians (University of Medicine and Pharmacy "Carol Davila", Bucharest) and Faculty of Chemistry. The findings of this study revealed that the first year Romanian undergraduates were well prepared and had a high level of computer literacy and computer skills. In order to improve problem-solving abilities of undergraduate students, authors suggested that the courses related to multimedia topics as well as those related to information ethics should be increased in number.

An interesting resource connected to the assessment of competence in educational context in Romania is the study named "OECD Review of Evaluation and Assessment in Education: Romania 2017". This study has been promoted by the National Government, UNICEF and the Organization for Economic Cooperation and Development (OECD) and it constitutes part of a larger initiative aimed at evaluating the Romanian education system. The Ministry of Education in Romania was the partner leading the review process.

As stated in this report, Romania is currently reforming its curriculum to focus on the development of competencies. The reform of the curriculum has led to the definition of new curricula based upon the EU's eight key competences for lifelong learning. These competencies include, amongst the others, competences related to learning to learn, entrepreneurship and digital literacy.

This also marks a significant shift in the assessment methodologies that will be put in place, as they will be more oriented to the assessment of competences. It is relevant to highlight that data literacy is not explicitly mentioned but it enters in this context through related domains such as digital literacy, critical thinking and also problem solving skills.

Concerning digital literacy skills, the Ministry of Education in Romania recognizes the IC3 certification (Internet Core Competency Certification) Digital Literacy certification as equivalent to the compulsory Digital Competence examination ("*Examen de competențe digital*") that is a part of the National Baccalaureate examination (taken by all high school students). In particular the two standards Global Standard 4 (GS4) and Global Standard 5 (GS5) are recognized to be equivalent to the objective domains of the Ministry's Digital Competence examination.

The IC3 certification Digital Literacy is widely used to measure and validate digital skills of students and employees, however, even though it can be applied to almost any school or career pathway, it is mainly focused on basic computer literacy by including operating systems, hardware, software, and networks.

2.13. Spain

2.13.1. Scope

The desk research for Spain was developed by the consortium partner *Universidade Nova de Lisboa* (UNL - Nova IMS). The focus of this partner was to describe how DL is perceived in these countries, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.13.2. Desk Research Interpretation

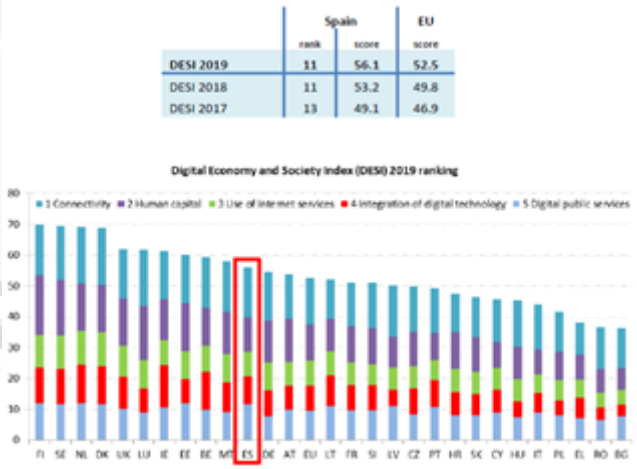
Spain perceives DL as digital skill that can be defined as the ability to access, analyse, interpret, and display data as information in a useful, relevant, and appropriate way for the purpose for which it will be presented [167]. A data literate person has the ability to [168]:

- Know when it is appropriate to use data for a specific purpose. For example, in customer segmentation.
- Know how to interpret data visualizations, such as graphs and tables. For example, understanding what a scatter plot means.
- Apply critical thinking to information derived from data analysis. For example, to assess when information we have received makes sense or not.
- Understand what analytical tools and methods exist, and when, how, and where they can be applied. For example, knowing what the affinity analysis is for.
- Recognize when the data has been manipulated or misinterpreted. For example, when the results of a company are communicated.
- Knowing how to communicate information regarding data to people without adequate capacities. What is often known as data storytelling.

There are many potential stakeholders related to DL like HE institutions, that offer various curricula related with data, data science, data analytics, statistics, big data, deep learning, AI, business intelligence, among others (there are a few example in Table 6, below).

Other stakeholders are private institutions/companies that offer courses related to DL, like Qlik, that is a private company that works in the data sector, and their learning center has a program for DL [73]. Public organizations are, also, important stakeholders, like SEPE (*Servicio Público de Empleo Estatal)*, that is governmental organization for employment in Spain [169].

In the Digital Economy and Society Index (DESI) Spain report, for 2019, Spain ranks 11th out of 28 EU Member States. The improvement is due to a better performance in some of the DESI dimensions measured, namely Connectivity and Digital Public Services. Spain performs well in connectivity, thanks to the wide availability of fast and ultrafast fixed and mobile broadband networks and to the increasing take-up. With regards to Human capital, Spain ranks at the same level as last year, and still scores below the EU average in this dimension.



	Spain		EU
	rank	score	score
DESI 2019	11	56.1	52.5
DESI 2018	11	53.2	49.8
DESI 2017	13	49.1	46.9

Figure 5. Spain ranking in DESI report, 2019

In particular, around one fifth of people in Spain are not yet online and close to half of them still lack basic digital skills. Despite growing demand on the labour market, the

supply of ICT specialists is still below the EU average. Most progress has been made with Connectivity. As regards the Integration of digital technologies, while more Spanish businesses use social media and big data than in previous years, but cloud and e-commerce stagnated compared with last year. Spain is doing best in the area of digital public services, having implemented its e-government strategy in good time. It ranks fourth in the EU in this area [170].

There are private organizations that offer courses in DL, one in particular, offers courses where the term 'data literacy' is the main focus, this company is Qlik [63]. Their online courses offer a Data Literacy Program, where a person can choose from 18 MOOC's (Massive Online Open Course), that range from understanding DL, passing through mathematics and statistics, ending in the advance analytics courses. This company also offer two data related certifications, the "Data Literacy Certification", and the "Data Analytics Certification".

The governmental organization for employment in Spain SEPE (*Servicio Público de Empleo Estatal*) also offers professional training in digital competences, mainly for those who are unemployed, they also have collaborations with private tech companies (AWS (Amazon Web Services), CISCO, Cloudera, Everis, Accenture, Fundación Telefónica, Google, Huawei, IBM, Linux, Oracle and SAP) [171].

According to a 2006 article from the newspaper EL PAÍS, about 1300 institutions and universities use Moodle as a complementary tool for the presential classes, and for e-learning platforms [172].

a. Data literacy in Universities

In Spain there are various Higher Education institutions that deliver courses with DL related competences. The programs analysed are part of three HEI (Table 6), situated in Madrid and in Barcelona. Most of the programs analysed are master programs and one is a bachelor's degree.

Although, data/digital competences are mainly observed in courses related with Information Technologies, Data Science, Artificial Intelligence, and so on, it is possible

to see more and more courses, from other fields of expertise, adopting data/digital related competences, like Space related fields, or biology related fields. Similarly, to other countries, it is possible to see how DL is becoming more and more an interdisciplinary field for different areas of knowledge.

Table 6. Higher Education Institutions analysed, Spain

Institution	Department/School	Location	Type of institution	Courses analysed
Universidad Carlos III de Madrid	Graduate School of Engineering and Basic Sciences	Madrid	Public	3
Universidad Autonoma de Madrid	Centro de Estudios de Posgrado - Ingeniería y Arquitectura	Madrid	Public	1
Universitat Politèccnica de Catalunya Barcelona Tech	Facultad de Informática de Barcelona (FIB)	Barcelona	Public	2
Total	-	-	-	6

Erasmus + initiatives are present in every country in EU. There are a few number of projects related to DL, some related with STEM, others with ICT skills and Literacy for undergraduate students, and others still, with raising the ICT skills and critically-computational skills (CCT) in adults. Searching in the Erasmus+ projects list, it is possible to see various projects related with DL, Spain is involved in the following one's:

- "Citizen Science at School" (2017) - CSS (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2017-1-ES01-KA219-038084) - Spain was the coordinator of this project, through the *Colegio Corazòn de Maria*, a school for the secondary level of the general education, and the general goals of this project was to increase the scientific vocations of the students towards the study of the subjects of STEM and creating partnerships with universities, research centers, national and international experts, etc.
- "Skills fOr Success" (2017) (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2015-1-UK01-KA219-013567)- Spain participated in this project with two partners, *Ies la Rabida* and *Institut Joan Sola*, two schools for the secondary level of the general education, and the

general goal of this project were to increase literacy and ICT skills, increasing digital competences in students, as a way to reduce the number of early school leavers without basic skills and accreditation in literacy.

- "New Adults' Competences for Skills Revolution" (2017) (https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2017-1-IT02-KA204-036729) - Spain participated in this project with two partners, *Ajuntament de Cunit*, an institute for adult education, and *Universidad de Zaragoza*, a higher education institutions. The general goals of this project were to create a common methodology to deliver critically-computational skills (CCT) and ICT skills to adults, to stimulate a digital culture in these adults, that lack these skills.

These are a few example where different institutions from foreign countries have created partnerships with Spanish institutions to create projects involving data/digital literacy competences at various levels, from a secondary level of education, to adult education.

There are some collaborations between the business sector and HE, regarding DL and related areas. For example, Barcelona Technology School (BTS) has several courses of data related subjects and has partnerships with several private companies to boost the professional experience of their students, during the master's programs. These companies support and mentor BTS, the students will have deep contact with the companies, not only to learn from their knowledge, but also to approach to the employment opportunities they will present you during the programs [173], [174].

b. Data literacy in the Enterprise domain

Searching in the well-known job site Indeed (http://ttps://www.indeed.es), using the keyword "Data" shows results in the following careers: data science, data analyst, data engineer, data modeler, among others. These offers are part of the IT sector, but there are other offers from other sectors that request some sort of data related skills, mainly IT skills at a basic level (Microsoft Office, databases, etc). When a new search is done in Indeed website, with no keyword attached, it is possible to see, for example, LIDL (https://www.indeed.es/jobs?q&l=Espa%C3%B1a&start=20&vjk=5f4ef5e872a77d81&

advn=8040479391618830) with a job offer for "*Administrativo/a Dpto. Ventas a 30 horas/semanales"*, where the tasks to perform are elaborate reports and presentations, maintain the database, perform cost analysis, and manage documentation, some skills requested are domain in Office and analytical skills. Other administrative offers request the same, which requires a data literate person, even in a basic level, to have a good performance in the workplace.

c. Data literacy related competences and validation

DL competences are acknowledged differently according to the qualifications level, but there are no specific frameworks or diplomas for this area. In HEI's, these competences are recognized through the ECTS applied to all areas.

In Spain there is a common framework of digital competence for teachers has been published by the Ministry of Education, available from January 2017. Developing digital competence in education requires integration of ICT in the classroom and teachers properly skilled in that competence. The Spanish framework (*Competencia Digital Docente*, CDD 2.0) is based on the European framework for digital competence for citizens (DigComp 2.0), which identifies the main elements of digital competence grouped in five areas: information and DL, communication and collaboration, digital content creation, safety, and problem solving [175]. CDD 2.0 proposes competence descriptors in three levels (A-basic, B-intermediate and C-advanced), subdivided into six levels (A1-C2) for each competence included in the five areas. It is complemented by an online tool for teachers where teachers can create a digital competence passport by continuously self-assessing, updating, and listing digital competences gained throughout their professional life until they reach higher standards [175].

According reports from TALIS (2009) (http://www.oecd.org/education/talis/) and the European survey of ICT schools in education (2013) (https://ec.europa.eu/digital-single-market/sites/digital-agenda/files/KK-31-13-401-EN-N.pdf), Spain was ranked first in ICT training hours per teacher. However, in relevant surveys, teachers assessed their training as insufficient to integrate all available technological means. This paradox suggested the need to rethink the efficacy of teacher ICT training and how best to apply

ICT in the classroom [175]. In this way, it seems important to validate the competences acquired in educational institutions and, also, in private institutions.

One example of a IT-based validation Tool is Portfolio (https://portfolio.intef.es/), that is a tool direct to assess the digital competences of Teachers.

Some examples of institutes, organisations, involved in working on Validation of Informal and Non-Formal Learning (VINFL) in Spain are presented in Table 7:

Table 7. Validation of Informal and Non-Formal Learning (VINFL) in Spain

Validation of Informal and Non-Formal Learning (VINFL)	Website
Catálogo Nacional de Cualificaciones Profesionales (National Catalogue Of Professional Qualifications)	https://incual.mecd.es/
Proyecto Reconoce (Recognize Project)	https://www.reconoce.org/proyecto-reconoce/que-es

2.14. Switzerland

2.14.1. Scope

The desk research for Switzerland was developed by the consortium partner SmartRevolution, from Italy. The focus of this partner was to describe how DL is perceived in these countries, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.14.2. Desk Research Interpretation

The Digital Switzerland Strategy[1] objective provides the guidelines for government action and indicates where and how authorities, academia, the private sector, civil society, and politics must work together to shape the transformation process to benefit Switzerland and make Switzerland a leading digital innovation hub.

Switzerland applies a successful model of openness and modernization in a digital future to support its strong industrial and export sector. The state actively facilitates the structural change associated with digitalisation and is considered a world leader in

[1] The digital Switzerland Strategy provides: The Principles and core objectives; Fields of action; Implementation; for the future of digitalisation of Switzerland

innovation, though recognises the competitiveness of a digital market. Switzerland has identified that automation is the largest future industrial change and will combat it with lifelong learning whilst maintaining flexibility and adaptability in its workforce in response to the digital age. This will ensure that the country sustains its talent to maintain high employment levels. Currently, there is a concern to upskill the population fast to ensure that it is not left behind in the labour market and in everyday life. The graph below, published by the Federal statistical office on the 17.10.2019, shows that data skills shall be improved for the majority of the population.

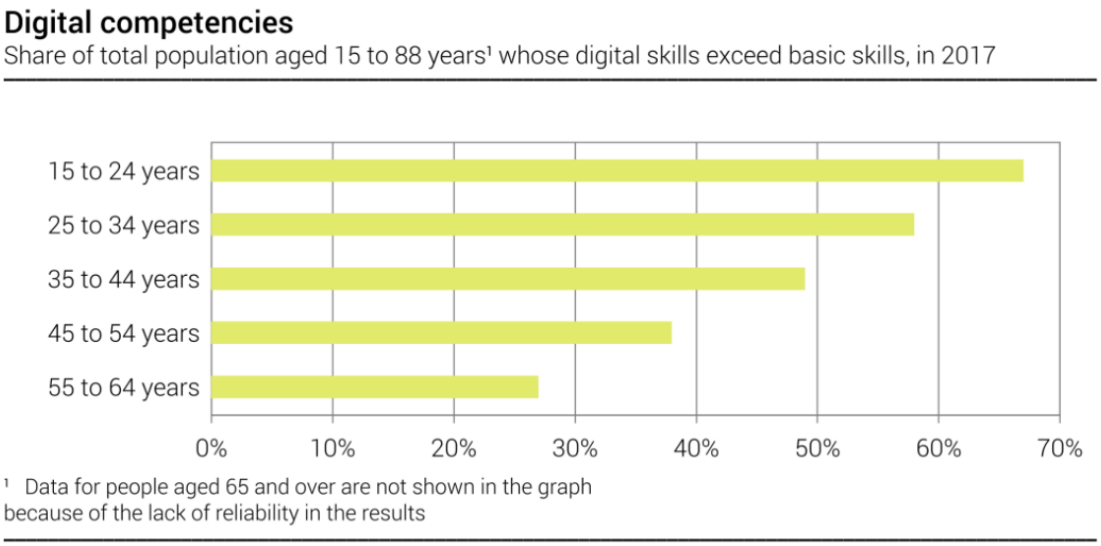


Figure 6. Federal statistical office graphic, with data skills for Switzerland population

In 2018, 93% of Swiss households had an internet connection, which puts the country five percentage points ahead of the European average. 91% of Swiss aged 16-74 surf the web at least once a week (of which 73% from a mobile device).

Small and medium-sized enterprises (SME) account for 99% of companies on the Swiss economy and provide two-thirds of jobs in the country. Small companies tend to offer upskilling practice through external providers rather than in-house structures. In Switzerland, 74% of companies offer outside learning opportunities compared to 58% with their programmes.

Within the private and no-profit sector, there are a host of companies supporting the swiss movement into the digital age:

- Open Knowledge network founded in 2011, is registered under OpenData CH. The Foundation provides data literacy and developmental skills training to all levels of the organisation

- Opendata.ch are also advocates in digital transparency and circular regular newsletters.

- The Knowledge Academy provides Analytics Training where students successfully study different types of data and turn it into a valuable source of information.

- The *Hirschmann* Foundation offers co-financing under certain conditions to upskill in elearning and focuses on the SMEs.

- The Swiss are vigilant on Data security and innovations such as Opendata.ch association and "Data Café" which educate society of Data and Cybersafety.

There is no shortage of enterprise and others include We Are Play Lab Foundation, *Gebert Rüf Stiftung*, Jacobs Foundation, *Stiftung Mercator Schweiz*, *digitalswitzerland* next generation, *Beisheim Stiftung*, The Zurich University of Teacher Education (PH Zurich). These businesses are both profit and no-profit and teach skills from basic digital literacy to advanced digital skills.

The Swiss Statistical office positions itself as a reliable source of official data. Part of its work is to empower journalists to report data accurately.

a. Data literacy in Universities

The Switzerland government is active on teaching DL skills since a young age. The Computational Thinking Initiative (CTI), launched on the second Swiss Digital Day, aims to strengthen digital education, and develop basic know-how in primary and secondary schools. Switzerland uses the leverage of teachers to approach digital literacy, emphasizing education for the teacher to create a digital platform to expand digital learning.

In Higher Education institutions the swiss offer many opportunities to acquire introductory, Bachelors, Masters, and advanced studies in Data Science related competences, while none can be found on DL competences.

Within the studies, Switzerland widely caters to many of the eLearning platforms through Higher Education and E-portfolios such as ILIAS e-portfolios, Mahara & Selfpad, Stud.IP, OLAT in e-Portfolio and SWITCH portfolio (Mahara) are recognised.

University courses on data science:

- EPFL Master in Data Science, https://www.epfl.ch/education/master/fr/programmes/data-science/
- EPFL University of Lausanne Data Science and Management, https://execed.unil.ch/formation-continue/certificate-data/
- ETH Zurich Master in Data Science, https://ethz.ch/de/studium/master/studiengaenge/ingenieurwissenschaften/master-data-science.html
- *Fachhochschule Graubünden* Master in Data science Information and Data Management, https://www.fhgr.ch/studium/masterangebot/wirtschaft-und-dienstleistung/information-and-data-management/
- FHNW Bachelor in Data Science and Advanced Certificate in data science, https://www.fhnw.ch/de/weiterbildung/technik/cas-data-science
- Hochschule Luzern, Data Intelligence & Big Data (Overview), Certificate of Advanced Studies (CAS) Big Data Analytics
- *heg Haute école de gestion Genève*, Master in Data science and Technology https://www.hesge.ch/heg/formation-base/masters-science/sciences-linformation/plan-des-modules
- HSR Master in Data Science, https://www.hsr.ch/en/studies/master/profiles/data-science/overview/
- HWZ CAS in Big Data Analysis, https://fh-hwz.ch/produkt/cas-applied-data-analytics/

- *Supsi* Certificate of Advanced Studies CAS Applied Science, https://fccatalogo.app.supsi.ch/Course/Details/1000002368?Catalogo.KeySearch=&Catalogo.IdStudyLevel=&Catalogo.IdThematicCattegoryLevel1=&Catalogo.IdThematicCattegoryLevel2=&Catalogo.IsCourseOngoing=true&Catalogo.BeginDate=&Catalogo.EndDate=
- University of Berne Certificate of Advanced Studies CAS Applied Science, http://www.math.unibe.ch/continuing_education/cas_applied_data_science/index_eng.html
- Certificate of Advanced Studies CAS Applied Science
- The University of Geneva Masters in Business Analytics, https://www.unige.ch/gsem/en/programs/masters/business-analytics/
- ZHAW – School of Engineering Master of Advanced Studies (MAS) Data Science + Diploma of Advanced Studies (DAS) Data Science, https://www.zhaw.ch/de/hochschule/

b. Data literacy in the Enterprise domain

Upon viewing indeed Switzerland and researching job announcements it is possible to find a definite correlation between DL competencies in data related jobs.

Below are the most asked hard and soft skills:

Typical hard skills

- Research
- Data analysis
- Data management
- Assessments
- Data privacy policies
- Computer Literacy (Excel, intermediary level, ability to work with formulas)
- Security requirements
- Excellent command of formats, typography, colour, graphics, tables, and layout

Soft skills

- Evidence-informed decision-making
- Motivation
- Ability to be flexible
- Flexibility
- Leadership
- Team player
- High integrity
- Strong drive
- Problem solving capacity
- Proactive attitude

- Must be proficient on Mac and a PC platform
- Layout and typography
- Calenders
- Portfolio
- PC literate in all MS applications
- Generating high quality reports
- Excellent MS Office skills.
- Calculation process
- Publications and online tools
- Strong interpersonal skills and cross-cultural competence
- Entrepreneurial mind set
- Empathy

Switzerland invests a significant share of its financial resources in training. This guarantees greater openness to innovation and therefore creates an entrepreneurial space that is particularly diversified and responsive to changes related to technological advances, according with the Swiss Federal Council.

Furthermore, there is a direct link between opportunities for internships that displayed a high variety of hard skills, soft skills, and motivations, such those reported below. However, it is not clear if they are connected to university programs.

- **Digital Learning Content Creator Intern**: Develop e-learning content and on-course models. Descriptive Philosophy No motivating language. Key Qualifications Undergraduate in Communication / Business School / Adult Education. Additional information including course platforms, e-learning courses, videos, and other learning products to create effective e-learning or blended programs for the Group.
- **Junior digital fundraiser**: Global animal welfare organisation. Descriptive philosophy contributes to something meaningful and work with us along our mission. Key Qualifications no description of formal IT education mentioned, however good understanding of social media Additional information Socially conscious language eg. Reveals suffering, make a change, meaningful, under human influence.

There are many types of internships ranging from companies attracting highly skilled, innovative, and talented millennials with masters or PhDs while others are attracting and prospects with social awareness strategies in digital literacy, that are able to engage an audience with communication skills via newsletters and social media platforms. Some positions offer renumeration for their services whilst others offer opportunities to learn new skills and engage in social change, which coincides with the research of the millennial generation.

c. Data literacy related competences and validation

Under the report "Swiss digital future" (2016), Switzerland announced that "digital literacy programs both formal and informal, would increase the population's ability to effectively use digital devices". However, in Switzerland there is still a cloud over what digital competencies should be. Currently computational thinking is what Dr Seufert claim is problem solving with computers and the ICILS and the PISA convey average performance amongst swiss students, however these performances are displayed on application use such a Microsoft word, according with the Swiss science and innovation council. There is progress on these types of assessment and digital Switzerland refers to the "4C" competences (critical thinking, collaboration, creativity, and communication). The curriculum of German-speaking Switzerland, "*Lehrplan21*", includes several learning goals in computational thinking. This is based on a school approach and baes on analysing a computing problem, describing a solution, and developing and algorithm.

Regarding Curriculum development, the role of formal and informal education contexts in supporting the acquisition of digital competences needs to be acknowledged and taken into account.

Moreover, the swiss government acknowledges that skill requirements are changing, and automation is likely to replace and the automations are likely to replace certain job activities. There are certifications for short courses for a variety of courses that are based through private enterprise.

Finally, although there are comprehensive reports written by the European council reported about Switzerland on informal and formal learning, the specifics on the study of digital learning appear to be limited.

2.15. Tunisia

2.15.1. Scope

The desk research for Tunisia was developed by the consortium partner Evodevo, from Italy. The focus of this partner was to describe how DL is perceived in these countries, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.15.2. Desk Research Interpretation

Data literacy is perceived as really important. The Tunisian government is pushing hard in order to become the most important IT country in Africa mainly with the initiative "*Tunisie* Digital 2020", a five-year strategy targeting ICT technologies in order to significantly increase the number of jobs and export earnings within the ICT sector. This strategy aims to make Tunisia an international digital reference and make ICT an important lever for socio-economic development.

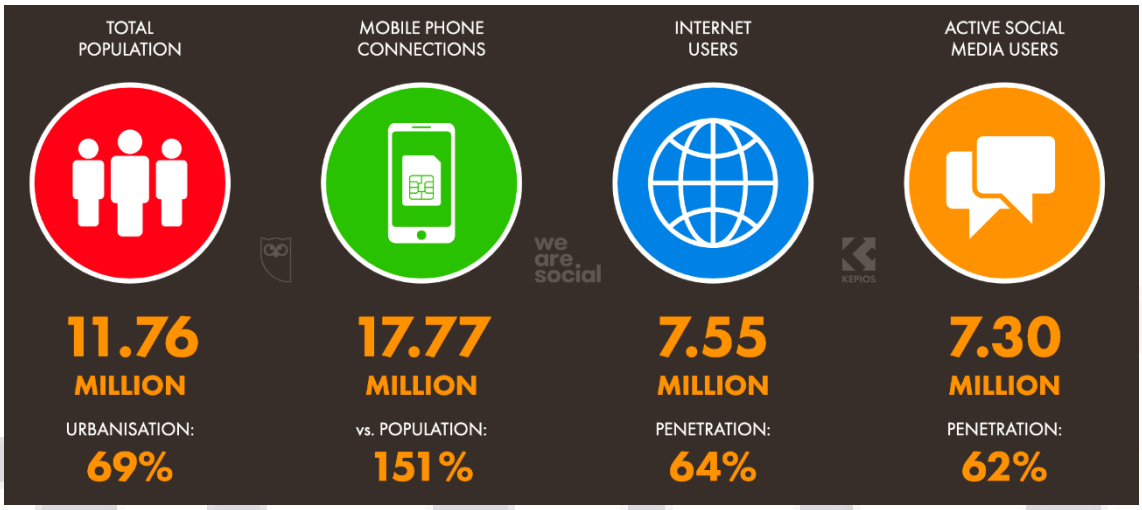


Figure 7. Infographic about Tunisian population.

The initiative is widely known between young people and entrepreneurs; many universities have key faculties dealing with data. At the political level, there is the recognition that to improve the Tunisian economic status is related to gathering and analysis of the data. Indeed, the government created an analysis think-tank for strategic studies named ITES, *Institut Tunisien des Études Stratégiques* (http://www.ites.tn/), directly under the control of the President of the Republic, in order to push for data analysis and improve DL between students, as for example with "*Stratégie numérique en Tunisie - Internet des objets* 2018-2025".

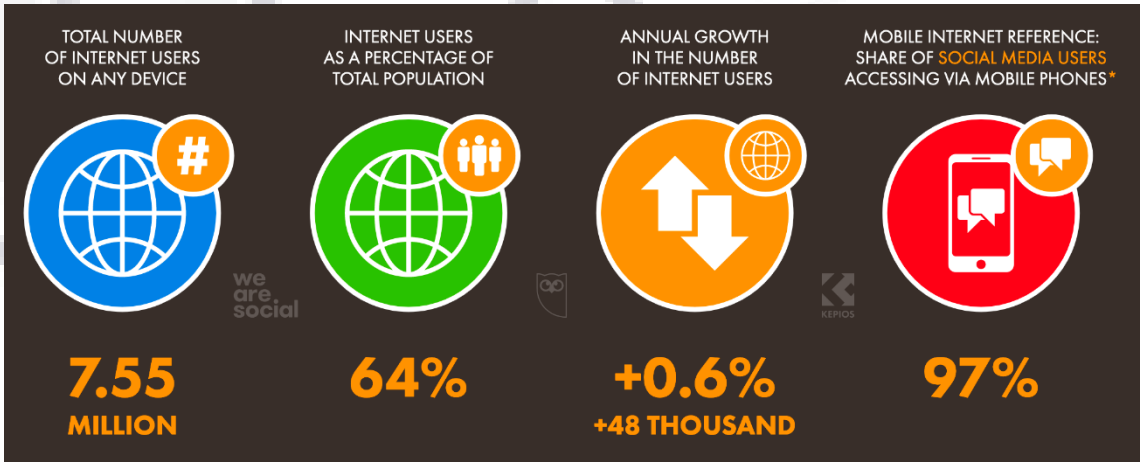


Figure 8. Infographic about Internet users among the Tunisian Population

There is definite trend in Tunisia to raise the level of literacy, especially in higher education schools. The young people (age 15-24) literacy is around 80% but the data is for 2015, just after the revolution. Nowadays, there is a very important market on private universities, so we assume that the main stakeholders are the students and the universities. There is a big difference in the tertiary education level between male and female, with female absolutely more present in higher education (see the figure), hence we can say that education in Tunisia is even promoting the gender equality. Then it is not a surprise to discover that Tunisia Ranked third on the list of countries with high numbers of women working in science and is also one of the countries most advanced in terms of women's rights overall.

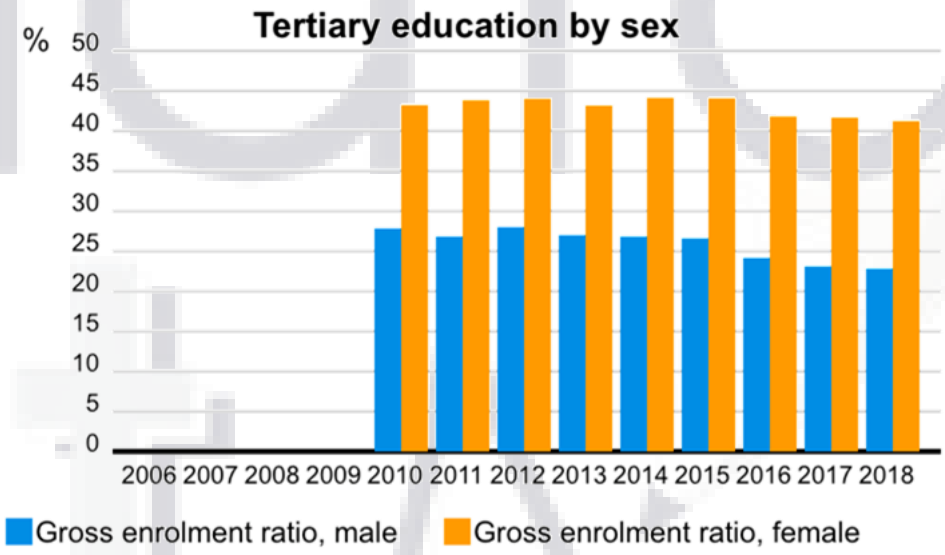


Figure 9. Tertiary education by sex. Source UNESCO http://uis.unesco.org/country/TN

Driven by the success of the "*Tunisie* Digital 2020" initiative, there are many companies, not just IT, that are looking for staff with data related skills, from the use of Excel to the most advanced data mining.

There is a wide audience about big data and artificial intelligence. For example, the meeting of Human Resource Managers held by MEDRH (*Les Rencontres Méditerranéennes Des Ressources Humaines*) include workshops on these topics, such as "*Impact des technologies émergentes sur les organisations*", "*Le BIG DATA et l'IA en*

santé pour le profilage de patients : quelles possibles adaptations et applications dans le domaine des RH".

There are private companies offering courses on data, for example Gtec (http://www.gtec.com.tn/) or BMC (http://www.bmc.com.tn/). These are companies working on data that want to train people to recruit. Universities are the most important organizations delivering training on data, even with collateral initiatives. Finally, there are the startup incubators that delivers courses to their startup companies, for example the Smart Tunisian Technoparks (http://www.elgazala.tn/).

E-learning is not widely used in Tunisia. The main reason is that the approach of universities training is based on project development with the guide of professors, so the "on the hand" approach is more common.

The support from the public or other parties to promote the acquisition and validation of DL related competences is done not as formal certification, but after the Tabarka meeting on 2013 initiated by the Minister of Information and Communication Technologies in collaboration with the private sector, telecom operators and the main computer centers, adopted the vision to make Tunisia a regional digital platform and to make digital an engine of economic and social transformation in order to improve the quality of life of the citizen and accelerate the competitiveness of businesses and institutions. As already said, the initiative "*Tunisie* Digital 2020" is the most important element of that strategy, so digital and data literacy are supported by the government, even with tax discount for startup.

Given the support of the government for innovation startup companies, several large corporation had started incubator initiative in which training and competences building is an asset not only to promote the incubator, but even the main company. An example is B@Lab (https://www.biatlabs.com), from BIAT Bank, the most important one in Tunisia. Specialized workshops, mentoring & hand-on support are an important part of their strategy.

The job ads are in line with the European approach, asking for open mind and specific competencies. For example, looking for a fraud analyst, SIGOS asks a profile such that:

> *"You thrive when you are encouraged to use your problem-solving skills. You have an analytical, studious mind"*
>
> *"Experience with big data or SQL knowledge is a plus"*

Or Vistaprint, for a position of Data Reporting Analyst, tries to attract talents in this way:

> *"We are looking for a passionate Data Analyst, who will be creating magic with numbers, helping the employee technology team to continuously improve our services by providing insightful analytics and KPI performance dashboards."*

BMC stress that they can improve your performance: "*Votre partenaire BI pour une amélioration continue de vos performances*"

In general, in Tunisia references to digital and data is considered a way to show how the company is new and valid.

a. Data literacy in Universities

There are specific courses involving HE, for instance "ERP (Enterprise Resource Planning)/Business Intelligence option" for the Esprit University (http://en.esprit.tn/it-specialty/).

IHEC - *Institut des Hautes Etudes Commerciales* - have a large number of courses about finance, marketing, computer science, each one with a specific training of DL.

This approach is more common with private universities because there is more competition and because there are several branches of USA universities.

The faculties that have specific training for DL are the technical ones, in particular engineering, and the business schools.

There are not partnerships with other foreign institutes linked to DL, although the Tunisian Universities are very interested in collaborations. Some universities are part of

the "*Conférence des Grandes Écoles*", a French national institution providing representation, research, and accreditation for the best universities. Of course, the universities that are part of an international network make advantage of their background, for example the Tunisia center of the Columbia University (https://globalcenters.columbia.edu/tunis).

There are no specific general actions managed by a single actor outside universities. The government is funding startups with a special focus on big data and artificial intelligence. The same is done by venture capitalists such as the banks (a good example is BIAT Bank).

Local universities are strongly interested in business enterprises and ask them to suggest the most current course curriculum and to offer workshops. For instance, Evodevo (one of the Datalit partner) is part of the IHEC Big Data Science Club, in order to suggest actions and arguments for IHEC University curricula and held workshops in Esprit University about data visualisation.

Almost all the students of the technical Tunisian universities have an internship with private companies. So the students with a specialization in data (mainly business intelligence) will work on data related project during their internships.

b. Data literacy in the Enterprise domain

Job announcements held by the specialized website https://www.tanitjobs.com/jobs/ were analysed. Looking for "*données*" (data) there are no job posts. Business intelligence gives 11 jobs posts. To have a measure, looking for "*développement Informatique*" lead to 98 jobs post and "java" to 186 posts. "Data mining" just to 4.

Using another job post website, https://www.farojob.net, we got more job posts. Looking for "*données*" it returns 809 job posts, with offerings about data entry, database experts, marketing, office works and so on. Looking for "Business intelligence" leads to 64 positions, almost all in the city of Tunis. To have a measure, looking for "*bureau*" (office), we got 1233 job posts.

We found that there is a definite request of DL competences in data related jobs and some degree of request in more general jobs. The most important area is that of data visualisation. In particular, we select the most asked hard and soft skills:

HARD SKILLS

- Relational Databases
- SQL Language
- Business Intelligence platforms such as Tableau, Qlik, Business Intelligence, Cognos, PowerBI
- Excel
- Data visualisation / Dashboarding
- Data warehouse
- No-SQL (Mongo DB, Cassandra, HBase)
- ERP
- Linux
- Big Data (Hadoop, Spark, Elastic Search)
- Data Mining / Machine learning
- Data Programming languages such as R, Python, SAS, Scala
- ETL Tools such as Talend, Datastage, Informatica
- Artificial intelligence

SOFT SKILLS

- Seriousness
- Attention to details
- Communication skills
- Problem-solving capabilities to discover, address and resolve issues
- Analytical mind
- Team worker
- French and English fluency
- Enjoy working with internal and external customers

These competences are sometimes/often asked for non-data specialist positions, such as secretary or accountant. In particular, knowledge of Excel and basic reporting capabilities are the most asked, general hard skills, while attention to details and ability to understand business requirements are the most asked soft skills.

The Universities in Tunisia are widely open in integrating enterprises in the design of courses and letting them the opportunity to manage workshops. For example, Evodevo (partner of Datalit) is part of the IHEC Big Data Science Club, in order to suggest actions and arguments for IHEC University curricula and held workshops in Esprit University about data visualisation.

There are courses on specific topics, such as Power BI, Qlik View or Tableau, mainly manage by international training agencies or by the technology partner (for instance, BMC (http://www.bmc.com.tn/formation#.Xrkhe5rOPjA) offers training on DL related topics, and BMC is a Tableau Partner)[176].

It is interesting to notice that in Tunisia the Business Intelligence is considered part of the more general topic of "Business and Management Consulting", with a clear focus on management control.

The enterprises are trying to hire data scientists, data analyst, big data and/or data warehouse specialist and so on, but trained people are very difficult to find, so the normal approach is to ask for *stageurs*.

c. Data literacy related competences and validation

In the universities, there are specific courses on Data Management, Business Intelligence and Business and Management. The validation is through the final exams.

There is no National assessment for DL, in Tunisia.

The validation of informally acquired competences for educational institutes (HE and VET) isn't so important. There are enterprises' associations, in particular UTICA (*Union Tunisienne de l'industrie, du commerce et de l'artisanat* - https://www.utica.org.tn/Fr/#) that is trying to train enterprises in order to understand the advantages of recognizing and training the soft skills.

2.16. United Kingdom

2.16.1. Scope

The desk research for the United Kingdom (UK) was developed by the consortium partner Q21, from Germany. The focus of this partner was to describe how DL is perceived in these countries, how it is covered by Universities courses, how is DL in the enterprise domain, and, finally, what are DL related competences and validation.

2.16.2. Desk Research Interpretation

There is no current National Data Literacy Strategy (NDS) in the UK. The Department for Business, Innovation and Skills launched the "Data Capability Strategy" in October 2013. The strategy sets out the government's commitment to the sustained development of the UK's data agenda through strategic investment in capital and skills. The focus of the report is on data capability related to the business domain and academia in form of a skilled workforce and data-confident citizens. Their understanding of a skilled workforce related to data capability is an individual who has skills in data management, data analysis and business/policy insight. Therefore, they are planning to develop an all-educational-level approach from equipping school children with basic mathematics and analytics skills, through ensuring the wider workforce remain abreast of developments in data use, to funding doctoral students working at the cutting-edge of data analytics.

Since 2019 the Government in the UK have been starting the development of a nationwide "National Data Strategy". The aim of the National Data Strategy is to drive the collective vision that will support the UK to build a data economy and to ensure that people, businesses and organizations trust the data ecosystem, are sufficiently skilled to operate effectively within it, and can get access to high-quality data when they need it [177].

The NDS will also provide coherence and impetus to the wide range of data-led work across government while creating a shared understanding across the economy of how data is used. The NDS is being developed and delivered by the Department for Digital, Culture, Media & Sports (DCMS), which leads across government on data-related policy issues, both within government and the wider economy. The final strategy report should be finished in 2020.

Also, the government itself wants a better use of data in the public domain to provide better services for their citizens. In 2017, they established a Government Transformation Strategy to enable the public service to digitalize more and more services for their citizen. Therefore, they want to improve their workforce through further education, cultural awareness of digital needs of their customers and within the organization [178].

a. Data literacy in Universities

Some universities (e.g. the University of Southampton, University of Edinburgh) approaches DL across all its faculties from a wide variety of angles. Explicit actions to the development of DL are evident at all levels: doctoral, Masters, and undergraduate.

Doctoral level:

The development of DL is an important activity in doctoral programs at the University of Southampton. The Doctoral College offers DL related courses to all doctoral students of the university. In fact, there are three mandatory training programs, and two of them are related to DL:

- Data management plan (DMP): all PhD students have to complete training about how to produce a DMP for the data that they produce to comply with FAIR principles: Findable, accessible, interoperable, and reusable. In this training they also learn how to keep their data secure and compliant with existing regulations such as GDPR.
- Ethical research and research integrity training: this research ethics course touches upon data in great measure. It focuses on the sensible use of personal data and how sensitive this can be.
- The EPSRC has established cross-discipline doctoral centers to unite computer science and mathematical science disciplines and skill at postgraduate level. Computer science, mathematical science and physical science graduates are able to apply to the doctoral centers. This approach enables students to develop a discipline focus at undergraduate level, which can be applied and expanded through interdisciplinary postgraduate work. The centers focus on various areas

of data analysis, including financial computing and analytics; data science; cloud computing for big data; and statistical applied mathematics.

There are also several actions aimed at training students into qualitative and quantitative data analysis. In this sense, courses on statistics packages such as R and SPSS and qualitative data analysis packages such as nVIVO are available for all students across all faculties. Doctoral training centers at the university also put emphasis on DL, by providing specific training in this matter, some examples are:

- The ESRC South Coast DCT network offers courses in Python for data analysis to social scientists, in order to move beyond traditional spreadsheet and statistics packages, by using more powerful and open tools.
- The Web Science Doctoral training center offers specific training to its students into different aspects of DL, ranging from data analysis with R and Python, data visualization, and data retrieval with tools such as web scrapers. This DTC has many members researching and producing literature specifically on data literacy. A significant example is the work of two of its students who edited a special issue in the Journal of Community Informatics, which compiled a set of interesting data literacy papers.

Masters level:

DL is present in a wide range of modules of a wide range of programs at master's level in Soton uni. But perhaps more significant is the master's programs fully touching on DL. These are at least three:

- Data Science MSc: Offered by the Electronics and Computer Science department, these programs are aimed at graduates in math's and computing related subjects and has two core modules that require and enhance DL: data visualization and Foundations of Data Science. The latter delves in detail into the whole data science pipeline (retrieving, analysing, visualizing)
- Data Analytics for Government: Offered by the School of Economic, Social and Political Sciences, these programs are addressed at a wide range of

graduates from the social sciences domain. The programs have statistical programming and Data Science foundations as core modules.

- MSC Data and Decision Analytics: Offered by the School of Mathematics, this MSc welcomes graduates from a wide range of subjects. The programs aim at enhancing data analysis skills to students who are not necessarily computer science experts, having compulsory modules such as Introduction to Python, Machine Learning, and Statistical Computing for data Scientists.

The University of Essex has several Master Courses with different foci related to data:

- M.Sc. Big Data and Text Analytics: hands-on experience with various types of large-scale data and information handling, and start by providing you with a solid understanding of the underlying technologies, in particular cloud computing and high-performance computing and also mobile & social application programming, human-computer interaction, computer vision, computer networking & computer security
- M.Sc. Data Science: computer science, programming, statistics, data analysis & probability
- M.Sc. Business Analytics: Business analytics helps to predict market trends and improve business processes. It empowers managers to make strategic decisions to improve performance in areas such as product development, operations, marketing, sales, and supply chain management. They are trained to organize, integrate, and interpret data so they can make insightful forecasts into all aspects of business operation and implement appropriate actions.
- M.Sc. Finance and Data Analytics:

Undergraduate level:

Several institutions are offering or developing cross-disciplinary undergraduate programs which are jointly taught by mathematical sciences and computer sciences departments. For example, in 2014, eight universities announced data science degree programs to start in either 2015–2016 or 2016–2017 (University of Bedfordshire, Bournemouth University,

the University of Essex, the University of Nottingham, Sheffield Hallam University, Teesside University, the University of Warwick and the University of the West of England, Bristol). All of the data science courses announced emphasize the importance of developing a full range of skills, teamwork and effectively communicating findings to specialists and non-specialists alike. The University of Essex has an own undergraduate course (B. Sc. Data Science and Analytics). The universities stressed out that several challenges remain to be addressed:

1) **Defining the skills shortage**: The data skills shortage is not always well understood and that the data needs of organizations can vary both between and within industries. Due to the value of quantitative data in academic research across subject areas, universities can identify needs based on developments in the use of certain methods within disciplines and through the identification of postgraduate skill shortages. This does not necessarily align directly with the needs of businesses.
2) **Facilitating transitions to higher education**: Course providers consistently recognizes three areas (variable mathematical knowledge & training; computer science & coding skills; data are rarely embedded in previous courses) where this transition was problematic and at times constrains the level of training that universities can provide to undergraduates.
3) **Gender issues**: In 2013–2014, women constituted just under 40% of entrants for A-level mathematics. The gender divide is even more acute for entrants for further mathematics, where less than 30% of entrants are female.29 This trend is apparent even though there are no significant differences in the performance of girls and boys at GCSE level. Gender divides are also evident in undergraduate mathematical and computer sciences, where often some of the most advanced teaching in data analysis is provided. In 2013–14, 39% of full-time entrants to mathematical sciences were women. The imbalance is more acute in computer sciences, where just 15% of 2013–2014 entrants were female [179].

Besides the university's own programs, some of them (London School of Economics LSE) taking part in the Qlik Academic Program, adding DL classes into their Business Management and MBA courses. With the QAP, institutions such as the London School of Economics (LSE), Kingston University and Bournemouth University are running dedicated sessions on DL and data science, helping their students learn the data analysis skills needed to thrive in the business world.

- LSE has benefitted from the Qlik Academic Program is the London School of Economics (LSE). During the last academic year, the University worked with Qlik to offer students studying for various health-related masters courses a session on data analytics. The session covered anything from applied data science in general through to detailed case studies looking at how healthcare organizations are benefitting from improved services thanks to making better use of their data. The session, which was very well-received by students, also included the opportunity to analyse some data first-hand to get their own insights.
- Kingston University wanted to add DL to its MBA portfolio of skills, after both a call from students and an understanding from professors that students should learn about data while completing their studies.
- Bournemouth University has already run the course for its MBA students twice. Students wanted a greater understanding of data analysis and how finding insights from data can work.

b. Data literacy in the Enterprise domain

Most businesses (63% globally, 68% in Europe) are actively looking for candidates that can demonstrate their ability to use, work with and analyses data in all parts of their organization – presenting a good opportunity for those who can demonstrate these valuable skills. Indeed, data-driven decision makers that have a foundational understanding of data and analytics will account for one-third of the job market for those with data skills, with a projected increase of 110,000 position by 2020 - that equates a 14% increase since 2015, according to IBM. However, despite recognizing the value of on-the-job experience and data certifications, 50% of companies said they don't provide

DL training to their own employees, with only 34% of decision makers stating they have programs in place. Eighteen percent (18%) of business decision makers said that a data-skills certification – something that can be earned well after college or formal education – was the best indicator of a candidate's DL and demonstrated the ability to use the techniques most required today. This means – according to this study – that anyone who invests in improving their data skills – no matter what existing qualifications – can access more career opportunities associated with DL.

c. Data literacy related competences and validation

Nothing specific about this subject was found.

3. Desk Research overall results and main conclusions

The desk research consists in the analysis of different sources, by all partners of the DATALIT consortium, for 19 countries. The multidisciplinary approach of this research allows us to observe how data literacy status is in each country. Although, some countries provide more information than others, we could still retrieve important information, which main conclusions are as follows.

The term 'data literacy' isn't well known in most of the countries analysed. The most widely used terms are 'digital literacy', 'information literacy', 'data competence', 'media literacy', 'statistical literacy', 'computer/IT literacy', among others. In most countries is closely related to digital skills. Some countries, like Belgium or Serbia, don't even recognize or have a direct translation of the term itself. Although, all countries agree that 'data' is very important and how people use, analyse, and perceive that data is essential for today's job market and decision making.

Every desk research agrees with the existence of different stakeholders related to DL, namely individuals, business, universities, government, media, NGOs, research institutes, and others (i.e. all those who work with data). Relative to DL stakeholders' statistics, in the different countries, the information is scarce. For example, in Lithuania there is a vast and various information about DL stakeholders; in Portugal there is statistical information

about digital literacy stakeholders, not DL; and other countries have little to no statistics on DL stakeholders.

Universities are still the main providers of DL related courses, but there are other organizations that also provide DL courses or DL related courses. Each country has specific private companies/NGOs/government entities, that provide these courses, like, for example, DigitYser is the Digital Innovation Hub of Brussels (Belgium), or Digital Serbia Initiative (Serbia). At an international level, there are a few companies that deliver specific DL courses/programs/certifications and are the greater players in this field, namely Qlik (with the 'Data Literacy Program'), Microsoft (with the 'Microsoft Data Science' program), Data Literacy Project (from Qlik, with several courses on DL), and online providers, like Coursera, edX, Udemy, etc. Learning Management Systems are widely used in most countries, especially Moodle, also e-portfolio Mahara, and other proprietary tools.

In some countries there is support from public and private institutions for the acquisition and validation of DL related competences, like IEFP in Portugal, or the Department of work in Belgium, for example.

In HEIs/Universities, there is a great range of DL related degrees (bachelor, masters, PhD, and others), that include courses in data science, big data, business intelligence, artificial intelligence, and other IT related subjects, but there seems to be an increase in interest on DL related subjects in non-IT degrees, like marketing, tourism, journalism, social sciences, etc. In HEIs we can see that DL is always part of a degree, or course, not exactly the whole course. Many universities have partnerships with private companies/institutions, that in one way or the other influence the path of these HEIs courses, and help with students' internships, mentoring and projects.

In the enterprise domain, several job websites were analysed, and the research shows that for the specific term 'Data Literacy' there isn't many offers, but when it comes for the terms data, data science, big data, AI, and other IT related subjects, there is a great demand for professionals that are data literate, and have great programming skills. Other offers, like administrative roles, HR, accountant/finance roles, also demand professionals with

some sort of data literacy, like managing databases, using MS Office, and other kind of programs/software/tools. Many different hard skills are asked in these job announcements, but overall the soft skills are more or less the same: motivation, flexibility, leadership, team player, problem solving capacity, proactive attitude, strong interpersonal skills and cross-cultural competence, empathy, attention to details, communication skills, independent worker, English fluency, etc. It seems to be a rise in demand for professionals that know how to work with data.

In terms of DL related competences and validation many of the countries in this research don't have a validation approach to DL, other than formal education. Most validation processes include certifications delivered by private institutions/NGOs (e.g. The Data Literacy Project), ECTS delivered in universities, and certifications delivered by government/public entities (e.g. Portuguese Agency for Qualifications (ANQEP), in Portugal for competences related to DL, but not DL exactly). Most DL competences are recognized in the business sector and internally validated, but there isn't quite a structured system/tool or framework to assess these competences for the general public. Some countries (e.g. Serbia) don't have institutes or organizations, involved in working on Validation of Informal and Non-Formal Learning (VINFL), others (e.g. Spain) use European frameworks for this, like DigiCom 2.0.

The main conclusions in this desk research are that there is a lack of understanding of what 'Data Literacy' is and what a data literate person knows and does. There is a clear confusion between different kinds of literacy, specially between digital literacy and data literacy. In many countries data literacy = digital literacy, and this is a false statement. It becomes necessary to clarify the meaning of each type of literacy - data, digital, information, media, statistical, and others - and how they interact with each other, because none of them is totally independent of the other. In every country there is a qualification system or framework for different DL related competences, but specifically for DL this is non-existent. DL involves different soft skills, that are appreciated and recognized by the business sector and are validated in an internal level, but there isn't a way to assess these skills for the general public or validate them. Although there are private entities/NGOs that offer different types of validation and assessment and some

governments are involved in different projects with this in mind, there a shortage of tools and frameworks to properly do this at a national level. 'Data literacy' is a term that is not well known, but everyone uses DL competences/skills, within those who work with data, so a strong structure of the concepts and of the technical and non-technical skills is needed to help identify a data literate person and create more competent professionals.

References

[1] N. Bhargava, R., Deahl, E., Letouzé, E., Noonan, A., Sangokoya, D., & Shoup, "Beyond data literacy: Reinventing community engagement and empowerment in the age of data.," 2015.

[2] C. Ridsdale *et al.*, "Strategies and Best Practices for Data Literacy Education," *Knowl. Synth. Rep.*, 2015.

[3] M. Bonikowska, Aneta; Sanmartin, Claudia; Frenette, "Data Literacy: What It Is and How to Measure It in the Public Service," *Anal. Stud. Branch, Stat. Canada*, 2019.

[4] D. Conway, "The Data Science Venn Diagram," 2010. [Online]. Available: http://drewconway.com/zia/2013/3/26/the-data-science-venn-diagram.

[5] W. fo O. Data, Österreich, and L. data. gv. a. in Kreis, "Big Data in Austria - Österreichische Potenziale und Best Practice für Big Data," 2019. [Online]. Available: https://www.data.gv.at/katalog/dataset/big-data-in-austria-osterreichische-potenziale-und-best-practice-fur-big-data.

[6] FFG, "#Big Data in #Austria," 2014. [Online]. Available: https://www.ffg.at/sites/default/files/allgemeine_downloads/thematische programme/IKT/big_data_in_austria.pdf.

[7] IG Kultur, "AK-Zukunftsprogramm: Förderungen für Weiterbildung und Projekte im digitalen Bereich," 2019. [Online]. Available: http://www.igkultur.at/service/weiterbildung/ak-zukunftsprogramm-foerderungen-fuer-weiterbildung-und-projekte-im-digitalen.

[8] FFG, "Digitalisierungsagentur," 2018. [Online]. Available: https://www.ffg.at/dia.

[9] WIFI, "WIFI Österreich," 2020. [Online]. Available: https://www.wifi.at/start.

[10] KMU DIGITAL, "KMU Digital - the Austrian Digitalization Initiative for SMEs," 2020.

[11] Studieren.at, "Data Science Studium," 2020. [Online]. Available: https://www.studieren.at/studien/data-science/.

[12] Universität Salzburg, "Data Science," 2019. [Online]. Available: https://datascience.sbg.ac.at/.

[13] FOM university, "Big Data & Business Analytics." [Online]. Available: https://www.fom.de/studiengaenge/it-management/master-studiengang/big-data-und-business-analytics.html.

[14] Karriere.at, "karriere.at," 2020. [Online]. Available: https://www.karriere.at/.

[15] Microsoft, "Microsoft," 2020. [Online]. Available: https://education.microsoft.com.

[16] LPI, "Linux Professional Institute," 1999. [Online]. Available: https://www.lpice.eu/de.

[17] Oracle, "Oracle Academy," 2020. [Online]. Available: https://academy.oracle.com/de/resources-oracle-certifications.html.

[18] K. Luomi-Messerer, "Die österreichische Validierungsstrategie. Hintergrund, Entwicklung,Ausrichtung und erste Umsetzungsschritte," 2019. [Online]. Available: https://www.pedocs.de/volltexte/2019/17821/pdf/Erwachsenenbildung_37_2019_Luomi_Messerer_Die_oesterreichische.pdf.

[19] NQR, "Qualifikations Register," 2019. [Online]. Available: https://www.qualifikationsregister.at/.

[20] D. Minded, "Data Minded," 2019. [Online]. Available: https://www.dataminded.be/who-we-are.

[21] DigitYser, "DigitYser," 2018.

[22] A. & D. C. of Belgium, "The AI & Data Science Community of Belgium," 2014. [Online]. Available: https://datasciencebe.com/.

[23] DigitYser, "Di-Academy," 2018. [Online]. Available: https://digityser.org/di-academy/.

[24] DigitYser, "Data Science Bootcamp," 2018. [Online]. Available: https://digityser.org/data-science-bootcamp/.

[25] DigitYser, "Job Fairs," 2018. [Online]. Available: https://digityser.org/job-fair/.

[26] Flemish Ministry of Education and Training, "Besluit van de Vlaamse Regering tot codificatie van de decretale bepalingen betreffende het hoger onderwijs (Codex Higher Education)," 2013. [Online]. Available: https://data-onderwijs.vlaanderen.be/edulex/document.aspx?docid=14650.

[27] Department of Education and Training. Higher Education and Adult Education Department, "Bewijs je bekwaamheid.Studievoortgang op grond van eerder verworven kwalificaties (EVK) en competenties (EVC)," 2006. [Online]. Available: https://www.vlaanderen.be/publicaties/bewijs-je-bekwaamheidstudievoortgang-op-grond-van-eerder-verworven-kwalificaties-evk-en-competenties-evc.

[28] D. of E. and T. H. E. and A. E. Department, "Decreet betreffende het volwassenenonderwijs.," 2007. [Online]. Available: https://data-onderwijs.vlaanderen.be/edulex/document.aspx?docid=13914.

[29] Departement Werk 6 Sociale Economie, "Departement Werk 6 Sociale Economie," 2020. [Online]. Available: https://www.werk.be/.

[30] V. overheid (Flemish Government), "Ervaringsbewijs." [Online]. Available: https://www.vdab.be/ervaringsbewijs.

[31] Flemish Ministry of Education and Training, "Decreet betreffende het secundair na secundair onderwijs en het hoger beroepsonderwijs," 2009. [Online]. Available: https://data-onderwijs.vlaanderen.be/edulex/document.aspx?docid=14112.

[32] "Sociaal Economische Raad van Vlaanderen," 1998. [Online]. Available: https://www.serv.be/serv.

[33] D3, "Developing Digital Data literacy)," *2019*. [Online]. Available: https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2019-1-BE02-KA201-060212.

[34] ARIS, "Artificial Intelligence skills for ICT professionals," 2019. [Online]. Available: https://ec.europa.eu/programmes/erasmus-plus/projects/eplus-project-details/#project/2019-1-BE01-KA202-050425.

[35] DIGConsum, "Training Path and OERs for Digitally Competent Consumers," *2018*. [Online]. Available: https://www.digconsum.eu/.

[36] DLP, "Data Literacy Project," 1993. [Online]. Available: https://thedataliteracyproject.org/.

[37] Qlik, "Qlik Academic Program," 1993. [Online]. Available: https://www.qlik.com/us/company/academic-program.

[38] E. C. for the development of V. T. CEDEFOP, "Country Report Belgium .French," 2016. [Online]. Available: https://www.cedefop.europa.eu/files/2016_validate_be_fr.pdf.

[39] OECD, "OECD Skills Studies," 2019. [Online]. Available: https://www.oecd-ilibrary.org/education/skills-matter_1f029d8f-en.

[40] OECD, "Basic skills of Finnish adults one of the best in the OECD countries," 2013. [Online]. Available: https://finlandabroad.fi/web/oecd/ajankohtaista/-/asset_publisher/TV8iYvdcF3tq/content/suomalaisten-aikuisten-perustaidot-oecd-maiden-parhaimmist-2/384951.

[41] M. of E. and Culture, "Media Literacy in Finland," 2019. [Online]. Available: https://medialukutaitosuomessa.fi/mediaeducationpolicy.pdf.

[42] National Statistical office Statistics Finland, "Need for better statistical literacy," 1999. [Online]. Available: http://www.stat.fi/isi99/press_1708.html.

[43] OECD, "Country Specific Material," 2013. [Online]. Available: https://www.oecd.org/skills/piaac/publications/countryspecificmaterial/#d.en.489838.

[44] DQ INSTITUTE, "DQ Global Standards Report 2019 Common Framework for Digital Literacy, Skills and Readiness," 2019. [Online]. Available: https://www.dqinstitute.org/wp-content/uploads/2019/03/DQGlobalStandardsReport2019.pdf.

[45] M. Kangas, "Promoting multiliteracy in the Finnish educational system," *2019*. [Online]. Available: http://www.marjaanakangas.net/?p=2661.

[46] Brill, "Introduction to the Finnish Educational System," 2019. [Online]. Available: https://brill.com/flyer/title/54458?print=pdf.

[47] Statistics Finland, "Training and learning," 2020. [Online]. Available: http://www.stat.fi/tup/koulutus/index_en.html.

[48] SAS ACADEMY FOR DATA SCIENCE, "Data Curation Professional," 2020. [Online]. Available: https://www.sas.com/fi_fi/training/academy-data-science/big-data-certification.html.

[49] FindAMaster, "Masters Degrees in Finland (Data Science)." [Online]. Available: https://www.findamasters.com/masters-degrees/finland/?40g110&Keywords=data+science&PG=2.

[50] StudyPortals - Admissiom Test Portal, "Study abroad in Helsinki, Finland: Most popular universities for Data Science & Big Data.," 2020. [Online]. Available: https://admissiontestportal.com/studyabroad/finland/helsinki/data-science-big-data.

[51] E. Commission, "EACEA National Policies Platform - 6.4 Validation of non-formal and informal learning," 2020. [Online]. Available: https://eacea.ec.europa.eu/national-policies/en/content/youthwiki/64-validation-non-formal-and-informal-learning-finland.

[52] F. Foundation, "International Data Literacy Conference," 2016. [Online]. Available: http://dataliteracyconference.net/2016/.

[53] F. Foundation, "International Data Literacy Conference," 2017. [Online]. Available: http://dataliteracyconference.net/2017/.

[54] F. Foundation, "International Data Literacy Conference," 2018. [Online]. Available: http://dataliteracyconference.net/2018/.

[55] F. C. of the O. K. Foundation, "French translation," 2013. [Online]. Available: https://fr.okfn.org/ecole-des-donnees/.

[56] Association Fréquence Ecoles, "Fréquence Ecoles," 2017. [Online]. Available: https://www.frequence-ecoles.org/.

[57] Infolabs.io, "Le portail de la communauté des infolabs," 2013. [Online]. Available: https://infolabs.io/.

[58] F. Foundation, "Fing Foundation." [Online]. Available: https://fing.org/.

[59] B. Arruabarrena, G. Kembellec, and G. Chartron, "Data littératie & SHS : développer des compétences pour l'analyse des données." 2019.

[60] CNAM, "Conservatoire national des arts et métiers," 2007. .

[61] de la R. et de L. Ministètre de L'Enseignement Supeérieur, "Ci2 certifications, the national certification on IT skills," *2015*. [Online]. Available: https://c2i.enseignementsup-recherche.gouv.fr/.

[62] A. Beky, "Littératie des données : point faible des salariés français ?," 2017. [Online]. Available: https://www.silicon.fr/litteratie-donnees-salaries-francais-187011.html.

[63] Qlik, "Qlik," 1993. [Online]. Available: https://www.qlik.com/us.

[64] EBG, "Data literacy ou data-alphabétisation : nouvel enjeu pour réussir sa stratégie Data ?," 2017. [Online]. Available: https://www.ebg.net/evenements/Data_literacy_ou_data_alphabetisation_nouvel_enjeu_pour_reussir_sa_strategie_Data_-2809.htm.

[65] Qlik, "Qlik - Data Literacy Consulting," 2020. [Online]. Available: https://www.qlik.com/us/-/media/files/resource-library/global-us/direct/datasheets/ds-data-literacy-consulting-en.pdf?_ga=2.111707910.342633209.1586181485-371601736.1585861745&_gac=1.179498384.1586206442.EAIaIQobChMImN2NuNfU6AIVkMmyCh0L0QPWEAAYASAAEgIR_vD.

[66] Qlik, "Qlik - French DL Program," 2018. [Online]. Available: https://www.qlik.com/fr-fr/services/data-literacy-program.

[67] Qlik, "Certifications et qualifications Qlik," 2018. [Online]. Available: https://www.qlik.com/fr-fr/services/training/certifications-and-qualifications#tabsTarget1.

[68] Data recrutement, "Data Recrutment," 2019. [Online]. Available: https://datarecrutement.fr/.

[69] GEN, "Grande École du Numérique," 2019. [Online]. Available: https://www.grandeecolenumerique.fr/qui-sommes-nous.

[70] Simplon.co, “Simplon.co,” 2013. [Online]. Available: https://simplon.co/.

[71] PIX, “Les compétences évaluées par Pix.” [Online]. Available: https://pix.fr/competences.

[72] EU Science Hub, “DigiComp (The Digital Competence Framework for ctizens),” 2019. [Online]. Available: https://ec.europa.eu/jrc/en/digcomp/digital-competence-framework.

[73] Qlik, “Qlik learning,” 1993. [Online]. Available: https://learning.qlik.com/mod/page/view.php?id=24704.

[74] I. für D. Transformation, “Förderprogramme für Digitalisierungsprojekte durch die Bundesländer,” *2019*. [Online]. Available: https://transformation-it.de/foerderprogramme-digitalisierungsprojekten-durch-die-bundeslaender/.

[75] HRK, “German Rectors‘ Conference.” [Online]. Available: https://www.hrk.de/home/.

[76] Hochschulforum Digitalisierung, “Hochschulforum Digitalisierung,” 2014. [Online]. Available: https://hochschulforumdigitalisierung.de/.

[77] Stifterverband, “Stifterverband.” [Online]. Available: https://stifterverband.org/.

[78] Hochschule Mannheim, “Mannheimer Modell Data Literacy Education (modal).” [Online]. Available: https://www.modal.hs-mannheim.de/ansprechpartnerinnen/kooperationspartnerinnen.html.

[79] P. Zend, “PHP Certification.” [Online]. Available: https://www.zend.com/training/php-certification-exam.

[80] ProfilPASS, “ProfilPASS,” *2004*. [Online]. Available: https://www.profilpass.de/.

[81] Bundesagentur für Arbeit, “MYSKILLS – Berufliche Kompetenzen erkennen.” [Online]. Available: https://www.arbeitsagentur.de/institutionen/myskills.

[82] REVEAL, “LEVEL5,” 2012. [Online]. Available: https://reveal-eu.org/level-5/.

[83] A. Aboard!, “All Aboard! Digital Skills in Higher Educaion,” 2017. [Online]. Available: https://www.allaboardhe.ie/.

[84] Enterprise Ireland, “Innovation Partnership - Big Data,” 2020. [Online]. Available: https://www.enterprise-ireland.com/en/funding-supports/Company/Esetablish-SME-Funding/IPP-Big-Data.html.

[85] DATA.GOV.IE, “IRELAND’S OPEN DATA PORTAL,” 2019. [Online]. Available: https://data.gov.ie/.

[86] C. S. Office, “Central Satatistics Office, Ireland,” 2019. [Online]. Available: https://www.cso.ie/en/index.html.

[87] N. S. Board, “National Statistics Board (Ireland),” 2014. [Online]. Available: https://www.nsb.ie/.

[88] C. of M. and I. (CMIT), “CIW Data Analyst (Big Data / Analytics),” 2019. [Online]. Available: https://www.cmit.ie/web-design-and-ecommerce-distance-learning-courses/ciw-data-analyst-digital-analytics/.

[89] Qualifax, “National Learners Database,” 2020. [Online]. Available: https://www.qualifax.ie/.

[90] SFI Centre for Research Training in Foundations of Data Science, “SFI Centre for Research Training in Foundations of Data Science,” 2020. [Online]. Available: https://www.data-science.ie/.

[91] Go Ireland, “Ireland Education Consultant in India,” 2017. [Online]. Available: https://www.goireland.in/.

[92] U. of D. Trinity College Dublin, “Business executive education creating business value,” 2020. [Online]. Available: https://www.tcd.ie/business/executive-education/creating-business-value.php.

[93] Analytics Institute of Ireland, “Analytics Institute of Ireland,” 2019. [Online]. Available: https://www.analyticsinstitute.org/.

[94] NFQ, “IRISH NATIONAL FRAMEWORK OF QUALIFICATIONS (NFQ).” [Online]. Available: https://nfq.qqi.ie/.

[95] QQI, “Quality an Qualifications Ireland,” 2018. [Online]. Available: https://www.qqi.ie/.

[96] CEDEFOP, “European inventory on validation of non-formal and informal learning 2014 - Country report Ireland,” 2014. [Online]. Available: https://cumulus.cedefop.europa.eu/files/vetelib/2014/87062_IE.pdf.

[97] LUISS University, “LUISS University,” 2020. [Online]. Available: https://www.luiss.it/.

[98] ConfIndustria, “ConfIndustria,” 2019. [Online]. Available: https://www.confindustria.it/home.

[99] Bocconi University, “Bocconi University.” [Online]. Available: https://www.unibocconi.eu.

[100] DataNinja, “DataNinja School,” 2018. [Online]. Available: https://school.dataninja.it/.

[101] Adfor, “Adfor,” 2020. [Online]. Available: http://www.adfor.it/.

[102] L. Learning, “Life Learning,” 2020. [Online]. Available: https://lifelearning.it/.

[103] E-magister, “E-magister,” 1999. [Online]. Available: https://www.emagister.it/.

[104] AlmavivA, “AlmavivA,” 2018. .

[105] Vilnius, “ŽINIASKLAIDOS PRIEMONIŲ NAUDOJIMO RAŠTINGUMO LYGIO NUSTATYMO TYRIMAS,” 2017. [Online]. Available: http://lrkm.lrv.lt/uploads/lrkm/documents/files/Ziniasklaidos_vartojimas12_galutine.pdf.

[106] BlueBridge, “BlueBridge - IT žinių centras.”

[107] School Education Gateway, “School Education Gateway - Internetinė Europos mokyklinio ugdymo platforma,” 2020. [Online]. Available: https://www.schooleducationgateway.eu/lt/pub/resources/tutorials/digital-competence-the-vital-.htm.

[108] LRT, “Senjorų kompiuteriniu raštingumu rūpinsis Trečiojo amžiaus universitetas,” 2018. [Online]. Available: https://www.lrt.lt/naujienos/lietuvoje/2/231964/senjoru-kompiuteriniu-rastingumu-rupinsis-treciojo-amziaus-universitetas.

[109] L. Statistika, “Oficialiosios statistikos portalas - Informacinės technologijos.” [Online]. Available: https://osp.stat.gov.lt/informacines-technologijos.

[110] LVBOS, “Skaitmeninio raštingumo skatinimas vietos bendruomenėse,” 2019. [Online]. Available: https://www.lvbos.lt/skaitmeninio-rastingumo-skatinimas-vietos-bendruomenese/.

[111] U. Viparkas, “Informacijos valdymas.”

[112] V. C. School, “Vilnius Coding School.” [Online]. Available: https://www.vilniuscoding.lt/mokymai/duomenu-analitika-big-data-vilniuje/.

[113] P. Lietuva, “Mokymai pažengusiems,” 2014. [Online]. Available: https://www.prisijungusi.lt/mokymai/norintiems-pagilinti-zinias/.

[114] V. University, “Duomenų mokslas,” 2020.

[115] cv.it, “Kas yra kompetencijos ir ar lengva jas keisti,” 2015. [Online]. Available: http://manokarjera.cv.lt/Default4.aspx?ArticleId=1a1c2a56-86fb-4f1b-97d2-fe0b2161831b.

[116] M. L. Academy, “Kokias kompetencijas reikia nuolatos tobulinti, kad susirasti naują darbą arba neprarasti esamo?,” 2011. [Online]. Available: https://manager.lt/kokias-kompetencijas-reikia-nuolatos-tobulinti-kad-susirasti-nauja-darba-arba-neprarasti-esamo/.

[117] I. Lietuvoje, “DARBO RINKOJE REIKALINGŲ KVALIFIKACIJŲ IR KOMPETENCIJŲ UGDYMAS LIETUVOJE,” 2017. [Online]. Available: http://kurklt.lt/wp-content/uploads/2017/07/Analizė.-Darbo-rinkoje-reikalingų-kvalifikacijų-ir-kompetencijų-suteikimas.pdf.

[118] D. S. Lab, “Data Science Lab.” [Online]. Available: https://www.facebook.com/pg/datalablv/community/?ref=page_internal.

[119] V. Lietuva, “Kompetencijų vaučeris,” 2017. [Online]. Available: https://www.verslilietuva.lt/paslaugos/kompetenciju-vauceris/.

[120] OECD Publishing, *Government at a Glance*. 2019.

[121] Centre for Quality Assessment in Higher Education (SKVC), “Study Fields‘ Descriptors,” 2020. [Online]. Available: https://www.skvc.lt/default/en/quality-assurance/study-program-descriptions.

[122] Ministry of Education and Science, “Neformaliuoju ir savišvietos būdu įgytų kompetencijų, susijusių su aukštuoju mokslu, vertinimo ir pripažinimo bendrieji principai (The General Principles for Assessment and Recognition of Competencies in Higher Education that Were Acquired Through Non-for,” 2017. [Online]. Available: https://www.etar.lt/portal/en/legalAct/b765dae028ca11e78397ae072f58c508.

[123] Cabinet of Ministers, “Regulation Nr 505 Ārpus formālās izglītības apgūto vai profesionālajā pieredzē iegūto kompetenču un iepriekšējā izglītībā sasniegtu studiju rezultātu atzīšanas noteikumi (Rules for the Recognition of Competences Acquired Outside Formal Education or Profes,” 2018. [Online]. Available: https://likumi.lv/ta/id/301013-arpus-formalas-izglitibas-apguto-vai-profesionalaja-pieredze-iegutokompetencu-un-iepriekseja-izglitiba-sasniegtu.

[124] Cabinet of Ministers, “Regulation No. 264 Noteikumi par Profesiju klasifikatoru, profesijai atbilstošiem pamatuzdevumiem un kvalifikācijas pamatprasībām (Regulations on Classificator of Occupations, Basic Tasks Corresponding to the Occupation and Basic Requirements of the Quali,” 2017. [Online]. Available: https://likumi.lv/doc.php?id=291004.

[125] Ministry of Education and Science, “Asmens įgytų kompetencijų vertinimo tvarkos aprašas (Description of the Procedure for the Assessment of Competences Acquired by a Person Concerned).,” 2015. [Online]. Available: http://www3.lrs.lt/pls/inter3/dokpaieska.showdoc_l?p_id=1004517.

[126] Cabinet of Ministers, “Regulation Nr 662 Profesionālās kvalifikācijas eksāmenu norises kārtība akreditētās profesionālās izglītības programmās (Procedure of Vocational Qualifications Examination in Accredited Vocational Education Programmes),” 2011. [Online]. Available: http://likumi.lv/doc.php?id=235206.

[127] Lithuanian Parliament, “Užimtumo įstatymas (Law on Employment),” 2016. [Online]. Available: https://e-seimas.lrs.lt/portal/legalAct/lt/TAD/b9ca8ad03de611e68f278e2f1841c088/asr.

[128] Ministry of Social Security and Labour, “Užimtumo rėmimo priemonių įgyvendinimo sąlygų tvarkos aprašas (The Description of the Procedure Implementing Employment Support Measures),” 2017. [Online]. Available: https://www.e-tar.lt/portal/lt/legalAct/cb5242b05fd811e79198ffdb108a3753/asr.

[129] R. Vuorikari, Y. Punie, S. Carretero, and L. Van Den Brande, *DigComp 2.0: The Digital*

Competence Framework for Citizens. 2016.

[130] FCT, “Portugal INCoDe.2030,” 2017.

[131] Rumos, “Rumos,” 2018.

[132] SAS, “SAS Analytics Software & Solutions,” 2016. [Online]. Available: https://www.sas.com/pt_pt/home.html.

[133] AMA, “Agência para a modernização administrativa,” 2016. [Online]. Available: https://www.ama.gov.pt/web/agencia-para-a-modernizacao-administrativa/inicio.

[134] IEFP, “Instituto de Empregos e Formação Profissional,” 2014. [Online]. Available: https://www.iefp.pt/.

[135] FFMS, “Fundação Francisco Manuel dos Santos,” 2012. [Online]. Available: https://www.ffms.pt/en.

[136] FFMS, “PORDATA,” 2012. [Online]. Available: https://www.pordata.pt/.

[137] INE, “Instituto Nacional de Estatística (INE),” 2014.

[138] ANACOM, “Digital Literacy in Portugal (2017),” 2018. [Online]. Available: https://www.anacom.pt/render.jsp?contentId=1459335.

[139] European Commission, “Digital Economy and Society Index Portugal report,” 2019.

[140] Rumos, “Rumos - Pós-graduação em Data Science (PGDS),” 2018.

[141] Lisbon Data Science Academy, “Lisbon Data Science Academy,” 2020. [Online]. Available: https://www.lisbondatascience.org/.

[142] Ironhack, “Ironhack,” 2013. [Online]. Available: https://www.ironhack.com/pt.

[143] Governo Português, “IEFP e Politécnicos assinam acordos de formação em competências digitais para diplomados do ensino superior desempregados,” 2018. [Online]. Available: https://www.portugal.gov.pt/pt/gc21/comunicacao/comunicado?i=iefp-e-politecnicos-assinam-acordos-de-formacao-em-competencias-digitais-para-diplomados-do-ensino-superior-desempregados.

[144] Nova IMS, “Master Degree Program in Data Science and Advanced Analytics, with a Major in Business Analytics,” 2019.

[145] Nova IMS, “Certificate in Geospatial Intelligence geoint,” 2017. [Online]. Available: https://www.novaims.unl.pt/geoint.

[146] ISCTE, “Master in Telecommunications and Computer Engineering.” [Online]. Available: https://www.iscte-iul.pt/course/11/master-msc-in-telecommunications-and-computer-engineering/employability.

[147] EDIT, “Data Science & Business Analytics,” 2020. [Online]. Available: https://edit.com.pt/formacao/curso-data-science-business-analytics-lisboa/.

[148] citeforma, “Formação na área da Data Science,” 2016. [Online]. Available: https://www.citeforma.pt/noticias/formacao-na-area-da-data-science.

[149] vantagem+, “Big Data Analytics,” 2018. [Online]. Available: https://www.vantagem.com/pt/curso-CBI026/.

[150] Bright Concept, “Academia de Inteligência Artificial,” 2020. [Online]. Available: https://www.brightconcept-consulting.com/pt/solucoes/academia-de-inteligencia-artificial.

[151] Microsoft, "MCSE: Data Management and Analytics," 2020. [Online]. Available: https://docs.microsoft.com/pt-br/learn/certifications/mcse-data-management-analytics.

[152] DC4WORK project, "What kind of digital competences do you need in your business?," 2019. [Online]. Available: https://www.dc4work.eu/.

[153] S. Verbić, "Šta je Data Literacy, Inovacija, Opservatorija Društvenih," 2019. [Online]. Available: https://odi.rs/sta-je-data-literacy.

[154] S. Kos, D., Spiranec, "Podatkovna pismenost: temeljni izazov otvorene znanosti u Hrvatskoj? Data literacy: a key challenge for open science in Croatia?," 2017. [Online]. Available: https://www.bib.irb.hr/899784.

[155] S. Olena, "Data gathering and analysis of the information. Student's Mobility Capacity Building in Higher Education in Ukraine and Serbia.," 2019. [Online]. Available: https://sova.uns.ac.rs/user/index.php?id=27.

[156] University of Zagreb, "West University of Timisoara (Late) Summer School," 2020. [Online]. Available: http://www.unizg.hr/nc/vijest/article/west-university-of-timisoara-late-summer-school.

[157] Digital Serbia Initiative, "Master 4.0," 2019. [Online]. Available: https://www.dsi.rs/master40/program/master-4-0-master-informacionih-tehnologija/?doing_wp_cron=1579601666.4034180641174316406250.

[158] European Commission, "Education and Training Monitor -Croatia," p. 39, 2019.

[159] Microsoft; eDx, "Free online courses from Microsoft," 2019. [Online]. Available: https://www.edx.org/microsoft-professional-program-data-science#edx-product-discovery-cards.

[160] ECDL, "ECDL and DIGICOMP," 2017. [Online]. Available: https://www.ecdl.rs/dokumenti/ecdldigcomp.pdf.

[161] EliNET project, "Country Report - Literacy in Romania," 2015. [Online]. Available: http://www.eli-net.eu/fileadmin/ELINET/Redaktion/user_upload/CR_Romania_18052015.pdf.

[162] European Commission, "Survey of Schools. ICT in Education: Benchmarking Access, Use and Attitueds to Technology in Europe's Schools," 2013. [Online]. Available: https://ec.europa.eu/digital-agenda/sites/digital-agenda/files/KK-31-13-401-EN- N.pdf.

[163] J. Pérez-Tornero, "Research on Existing Media Education Policies: Romania. Country Overview," 2014. [Online]. Available: http://eumedus.com/images/Romania CO.pdf.

[164] R. Grosseck, G., Malița, L., Bran, "Digital University - Issues and Trends in Romanian Higher Education. BRAIN – Broad Research in Artificial Intelligence and Neuroscience," vol. 10, no. 1, 2019.

[165] M. R. S. Cimpoeru, "Statistical Literacy and attitudes towards statistics of Romanian undergraduate students," *J. Soc. Econ. Stat.*, vol. 7, no. 1, 2018.

[166] C. T. A.L. Dumitrescu, E.E. Iorgulescu, C.B. Dogaru, C. Duta, "ASSESSMENT OF COMPUTER LITERACY OF UNDERGRADUATE ROMANIAN STUDENTS," in *ICERI2013*, 2013, pp. 2901–2907.

[167] Lateralia, "Data Literacy: el poder de la alfabetización de datos," 2019. [Online]. Available: https://lateralia.es/data-literacy-alfabetizacion-datos/.

[168] Universitat Oberta de Catalunya, "Data Literacy," 2017. [Online]. Available: http://dataanalysis.blogs.uoc.edu/2017/10/30/data-literacy/.

[169] SEPE, "Servicio Público de Empleo Estatal," 2018. [Online]. Available:

http://www.sepe.es/HomeSepe.

[170] European Commission, "Digital Economy and Society Index Spain report," 2019. [Online]. Available: https://ec.europa.eu/digital-single-market/en/scoreboard/spain.

[171] SEPE, "OFERTA DE FORMACIÓN ESTATAL," 2018. [Online]. Available: http://www.sepe.es/HomeSepe/Personas/formacion/ofertas-formativas/oferta-formacion-estatal.html.

[172] EL PAÍS, "Institutos y universidades apuestan por la plataforma libre de 'e-learning' Moodle," 2006.

[173] BTS, "Barcelona Technology School," 2020. [Online]. Available: https://barcelonatechnologyschool.com/.

[174] BTS, "Career Development," 2020.

[175] European Commission, "European Centre for the Development of Vocational Training (Cedefop)," 2017. [Online]. Available: https://www.cedefop.europa.eu/en/news-and-press/news/spain-common-digital-competence-framework-teachers.

[176] BMC, "Formation BMC," 2014. [Online]. Available: http://www.bmc.com.tn/formation#.Xrkhe5rOPjA.

[177] GOV.UK, "National Data Strategy," 2019. [Online]. Available: https://www.gov.uk/guidance/national-data-strategy.

[178] GOV.UK, "Government Transformation Strategy," 2017.

[179] GOV.UK, "A level and other level 3 results: 2013 to 2014 (revised)," 2015. [Online]. Available: https://www.gov.uk/government/statistics/a-level-and-other-level-3-results-2013-to-2014-revised.