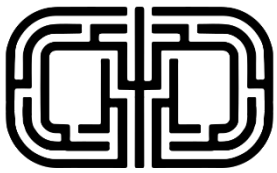
DEDALUS



DEveloping DAta Literacy courses for University Students

2019-1-IT02-KA203-063359

Implementation strategy

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1. INTRODUCTION

1.1. About DEDALUS project

Nowadays society is data-driven, and data is considered the most valuable economic resource. Therefore, it is not surprising that in the last few years the data scientist has been considered the most attractive job of the 21th century. Acquiring skills in data science increases employability as well as opportunities to find a new job or improve working conditions. As a consequence, well-known universities (e.g. Harvard,) and ICT big companies (such as IBM, SAS, and so on) have proposed specific courses and certification paths with the aim of developing skills and competences needed to become a data scientist. However, at present, these new learning opportunities have critical limitations that can be ascribed to the fact that:

- Courses are fragmentary in time and space.
- The syllabus of these courses are very different.
- A certification recognized at European level related to data literacy and data science profession does not exist.

Data literacy is a cross-cutting competence which is relevant in all disciplines since data are used in a multitude of domains and future entrepreneurs, regardless of the type of business they wish to run, need to deal with data and analytics to make quicker and more brilliant decisions and to get the most from business intelligence solutions. At the same data literacy is a difficult concept, since the required knowledge, skills and attitudes related to it are dependent on the context and so is the competence level. Indeed, courses and certification paths available on the market, as well as in universities are only scattered approaches that are lacking a convincing learning and study trajectory oriented towards a competence framework which maps the competences along the requirements of the study domain and the future field of application. The business sector, in turn, lacks a proper understanding of what digitalization means and which requirements it has to face in terms of expertise to cope with future challenges.

DEDALUS – DEveloping DAta Literacy courses for University Students – project **aimed to equip students with the necessary competences to cope with future digital challenges and to create an additional value for the enterprises and industries where they would be employed.** It did so by developing innovative modular, open and online learning curriculums to include data literacy competences in any study field. At the same time, through the continuous professional development (CPD) qualification for higher education (HE) professionals, it developed the digital competences of educators, enabling them to transfer such competences in their practice.

DEDALUS developed and piloted an approach to tackle data literacy competence shortage based on a long-term partnership of educational partners who have either worked in digital literacy and digital education projects, or on competence-oriented learning and validation of

non-formal and informal learning. Based on a sound stocktaking on successful approaches on how to include data literacy in university programmes, it set up a framework of competences on data literacy, taking in due consideration also the demand of the business sector. A modular learning and training approach was developed using high quality blended learning approaches combining face-to face, e-learning and practical learning on the job. The learning and training offers were also delivered on state-of-the-art learning technologies which will offer contents, courses, e-portfolios and validation interfaces as open educational resources (OER). The DEDALUS course and modules involved HE professionals that piloted the approach in different universities and study domains across Europe.

DEDALUS project aims to achieve two separate objectives:
Objective 1: To contribute in bridging the gap between business and academia and to put European enterprises in direct contact with potential future employees or business partners properly trained to understand and exploit data effectively.
Objective 2: To offer 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, and possibly to use as sound basis for further and more specialised training in data literacy and science.

DEDALUS partnership consisted of higher education institutions (HEIs) from the United Kingdom, Lithuania, Spain, Italy and Serbia which covered a large geographical scope and a number of cross-cutting disciplines. In particular, HEI from Serbia secured the transfer to the Balkan countries which need a culture shift towards data literacy and digital education. The partnership was led by the largest Italian Research Centre on Digital Education Technologies and was completed by a small medium enterprise (SMEs) with a large network working in the data educational domain and a European cooperative with a large European network in the field of competence-oriented learning and validation.

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1.2. DEDALUS implementation strategy

This implementation strategy is developed for HE staff across Europe to find details of possible implementation scenarios to include data literacy in academic offers permanently. Well-proven validation approaches are applied to assess and evidence learning. Competences are validated and connected to European validation and certification instruments. The strategy aims at promoting a wider inclusion of data literacy in higher education in an innovative way: not with general recommendations, but with concrete examples and direct feedback from the target groups, showing the benefits of the approach for students, in terms of preparation for the job market, and for HE personnel, in terms of continuous professional development. It

also explains how to deal with difficult implementation scenarios (for instance in institutions that have less flexible didactical organisation).

The implementation strategy is based on the DEDALUS partner experience reports and feedback. It is published on the platform and describes in details possible implementation scenarios, to include permanently data literacy in academic offers.

The strategy contains details on:
- Different models of data literacy inclusion in the academic offers, that reflect institutions' organisation and needs;
- Practical examples on effective blended training and initiatives to support students in developing data literacy competences;
- List of universities that have already included data literacy within their courses, to encourage synergies among European Universities in this field, in the form of shared projects, students mobility, etc.

This strategy is fundamental for the sustainability of the project, as it aims at supporting and promoting the implementation of the DEDALUS approach in other Countries with different higher education systems. The implementation strategy reflects the diverse experience gained in different geographical areas during the project, as Southern Europe, Northern Europe and the Balkan Region.

1.3. DEDALUS consortium partners

Istituto per le Tecnologie Didattiche (ITD) – Consiglio Nazionale delle Ricerche

The Istituto per le Tecnologie Didattiche (ITD) is a research Institute of the National Research Council (CNR) of Italy. The CNR is the largest public research institution in Italy, the only one under the Research Ministry performing multidisciplinary activities. CNR's mission is to perform research in its own Institutes, to promote innovation and competitiveness of the national industrial system, to promote the internationalization of the national research system, to provide technologies and solutions to emerging public and private needs, to advice Government and other public bodies, and to contribute to the qualification of human resources. CNR is distributed all over Italy through a network of 109 institutes aiming at promoting a wide diffusion of its competences throughout the national territory and at facilitating contacts and cooperation with local firms and organizations. The Istituto per le Tecnologie Didattiche (ITD) is a research Institute of the National Research Council (CNR) of Italy, founded in 1970. It has two branches in Genova and Palermo.

Dataninja

Dataninja is an award-winning company providing innovative data-driven services. Since 2016 core business is to help public institutions,

NGOs and SME to make a better sense of data. The company has developed training programmes for spreading data culture and skills among universities, newsrooms and communities. Dataninja is member of Digital Skills and Jobs Coalition promoted by EU Digital Single Market. Dataninja is a strong node of the European digital news ecosystem. In particular, Dataninja is a strategic partner of the Global Editors Network (www.globaleditorsnetwork.org) and it is active inside the International Fact-Checking Network (https://www.poynter.org/channels/fact-checking). Furthermore, thanks to its innovative projects awarded at European and Global level (e.g., Data Journalism Awards and European Press Prize), Dataninja has developed a series of strategic partnerships with the most important European publishers and newspapers such as Repubblica, Sole24Ore, El Confidencial, Liberation, Stern, Trinity Mirror. Finally, Dataninja has built the most important Italian community focused on the field of data journalism, with thousands of members and activists. Dataninja will activate its community by distributing the projects results by a facebook group of 2000+ members, a newsletter of 1500+ subscribers of selected professionals.

Vilnius University

Vilnius University seeks to provide high level universal education, encourages active international partnership with businesses and fosters coherent and open society. Key activities of VU are research and studies, which are unimaginable without international collaboration not only with other universities but also businesses. Highly acclaimed research work and close cooperation with businesses and other higher education institutions throughout the world have deservedly earned VU the status of high-quality research and studies' provider. The studies that are offered by VU are based on international-level partnerships. VU ensures that the quality of all forms of studies conforms to modern culture and technologies and pertains to the needs of the state and society by bringing in businesses into decision making process.

BLINC - BLENDED LEARNING INSTITUTIONS COOPERATIVE

In 2005 blinc, the blended learning institutions' cooperative was founded in Goettingen, Germany as a start-up network based on former EU-funded LIFE and eLearning projects in the health, social and environmental sector. It is consisting of 25 members forming an interdisciplinary team of project managers, trainers, teachers and coaches, programmers, media designers and blended learning creators. Since 2005 the blinc eG has been collaborating as partner organisation in 40 European funded projects, since 2017 it has been also lead partner in two ERASMUS+ projects Since December 2007 blinc eG has been appointed by its members to foster the valorisation of the LEVEL5 approach for Competence Oriented learning and Validation. Starting in 2012 we have been constantly customising and contextualising our approach and the related instruments in various informal learning areas; in Mobility Actions, Volunteering, Intercultural and Entrepreneurial learning programmes, European Project works and various learning on the job settings. We have been piloting LEVEL5 in different

sectors in continuing professional developments, for instance in the service sector, in HR development, CSR or in CPD projects for educational professionals. Since 2007 blinc has organised seven REVEAL conferences with more than 600 participants on innovative approaches on competence-oriented learning and validation. Since 2016 blinc has been focusing on innovative training and learning sectors like entrepreneurship education, design thinking, circular economy, sustainable development. Our vision is to provide innovative, technology supported learning offers to enhance the development in these domains.

Universidad de Alcalá

University of Alcalá (UAH) was founded in 1499 and it is one of the oldest universities in Spain. It is located in Alcalá de Henares, a UNESCO world heritage site only thirty kilometres from the centre of Madrid. Today the University of Alcalá is a modern institution which offers a wide range of undergraduate and postgraduate degree programmes adapted to the European Higher Education Area and covering all fields of knowledge, from the humanities to engineering, and from the social sciences to experimental and biomedical sciences. UAH provided service to around 28,000 students in 2018: from them, 8400 were enrolled in life-long learning courses and cVET while 12400 are enrolled in official degree studies and 4000 in official postgraduate programs. Each year a large number of cVET courses and long-life learning training programs are organized involving thousands of attendants as well as tens of collaborating entities, trade unions and companies, addressing all disciplines. A specific department of academic Quality Assurance monitors all the activities and follows the internal rules of QA as well as the mandatory procedures of National Authorities. The activities of the University of Alcalá take place across its three different campuses: two in the city of Alcalá de Henares in the region of Madrid and one in Guadalajara, which belongs to another Spanish administrative region, Castilla La Mancha. The university also has 4 associated teaching hospitals, 10 multidisciplinary university institutes, 2 science and technology parks with tens of companies and numerous other installations devoted to experimental and biomedical research. In 2018, UAH run 293 research funded projects and 277 research and development contracts with external organisations and companies. In 2018, the Human Resources of UAH included 1686 university professors, 377 researchers and 803 employees in the areas of administration and services.

University of Novi Sad

The University of Novi Sad (UNS) was founded in 1960. It is the only state university in the Autonomous Province of Vojvodina, comprising 14 faculties and 2 research and developmental institutes. With 5000 staff and more than 50.000 students University of Novi Sad is the second largest University in Republic of Serbia and reputable educational and scientific institutions providing teaching and research. Being the regional stronghold in education and research, UNS naturally attract the best students and the best researchers. University is multidisciplinary, committed to excellence, and produce well-qualified and competent graduates, who find their place in the labour market. UNS showed great success in application of scientific results in practice, which was reflected

through FP7 and H2020 grants. UNS is well-networked university, already involved in ERA and EHEA whose researchers publish in leading journals and are part of many international consortia. UNS especially nurtures innovations in science, is experienced in spinning off new businesses, and is the owner of recognized national and international patents. The activities of UNS are realized through fundamental, applied and developmental research and teaching in the field of natural, technical, social, humanistic and medical sciences as well as arts. Faculty of Technical Sciences has started curricula in 2017, and has excessive experience in data science since Novi Sad, Vojvodina is considered as small Silicon Valley.

University of Milan

The mission of the University of Milan, established in 1924, is to contribute to society through the pursuit of teaching/education and research at the highest international levels of excellence. It is the only Italian member among the 23 prestigious Universities of the League of European Research Universities (LERU). With a teaching staff of about 2.200 tenured professors and with almost 60.000 students, the University of Milan is the largest university in Lombardy, one of the most dynamic and internationally-oriented EU regions. The University of Milan offers several study programmes covering three macro- disciplinary areas: i) Humanities, Social Sciences and Law, ii) Medicine and Healthcare, iii) Natural Sciences.

University of Southampton

The University of Southampton is one of the most prestigious in the United Kingdom, with a turnover of £500m, research income of more than £120m, with 23,000 students and 6,000 staff. The university is truly international, drawing students from over 130 different countries and benefiting from a wide and varied culture. It is ranked in the top 10 in the UK and is participating in a high number of collaborative research projects and related initiatives. The academic unit of Electronics and Computer Science (ECS) is the largest school of its kind in the UK. ECS is internationally regarded for its outstanding research, and for its ability to pursue new research directions with broad, transformative impact. In REF 2014, 100% of our computer science research impact was recognised as world-leading or internationally excellent. As part of ECS and the Web Science Institute, the Web and Internet Science (WAIS) research group led by Professor Leslie Carr is renowned for its role in developments in several critical areas of the digital economy: from Web science, semantic technologies, and linked data to crowdsourcing and social machines. WAIS scientists have actively shaped the evolution of these fields from their beginnings, among others through their role in the uptake of linked data by public offices in the UK and worldwide, and through the foundation of the Open Data Institute in 2012.

2. PROJECT IMPLEMENTATION

2.1. DEDALUS pathway description

DEDALUS project was structured in a set of 5 content related phases in which the main Intellectual Outputs were produced, integrated with a set of 4 supportive phases.

In the **first phase** (O1), a research on good practices related to the data literacy inclusion rate in university courses at EU level but also outside the Programme Countries were conducted. This phase also studied the validation systems put in place for data literacy competences adopted by universities and the key skills and competences related to data literacy requested by the business sector. Finally, a competence profile representing an inventory of data literacy competences and related sub-competences that a graduate should gain were created.

Based on this intellectual output, the **second phase** (O2) consisted in the development of the DEDALUS validation system. The competences identified in the first phase were described in order to define the related competence framework and the appropriate assessment methodologies.

In the **third phase** (O3), the DEDALUS learning platform was developed. This platform is an open learning environment to support blended learning activities which bridges learning, validation and certification. The research conducted in the first phase also provided details on best practices, needs and expectations of the target groups and main stakeholders (in particular, the business sector), that later supported the development of the components of the intellectual output (O4).

The **fourth phase** (O4) was the conceptual backbone for including data literacy in academic courses, in this phase the data literacy common syllabus was designed. Also, the training materials covering the data literacy inclusion in HE were created. These learning materials were used in the joint staff training event in which the participants will learn how to include the DEDALUS innovative approach in the HEIs efficiently. After the training event, the DEDALUS approach were finally experimented in pilot courses by the five universities participating in the project. The organization of the pilots was the responsibility of the hosting university that adapted the DEDALUS approach according to the topic of the departments, participating into the pilots and to the specific learning contexts.

After the piloting, every partner university prepared the Experience Report, which described the main outcomes and best practices for the Implementation Strategy (**fifth phase**, IO5).

The supportive phases were related to the Dissemination, Valorisation, Evaluation and Management of the DEDALUS project. Dissemination activities were carried out based on a

sound strategy. Newsletters, Publications and Media development were planned to disseminate the DEDALUS project and its outcomes to the partnership's extended networks through face-to-face, media and web activities.

In year 2, partners identified and mapped potential stakeholders, actors and policy makers that were targeted in order to further exploit the project outcomes. All the partners actively contributed to the communication, dissemination and networking activities, creating dissemination content, making intense use of the learning platform and attracting stakeholders to join the DEDALUS online community.

Erasmus Days (2020 and 2021 editions) were a crucial momentum to spread the project both for 2020 and 2021. In the 2020 edition, an online event has been organized to discuss the perception of data literacy among universities (**full recording available here**). While in the last 2021 edition, lessons learnt were shared during an online workshop with experiences from other projects (**full recording available here**).

A workshop focused on the Dedalus project has been during the 13th International ACM Conference on Web Science in 2021 (WebSci'21), an interdisciplinary conference where a multitude of research disciplines converge with the purpose of creating a greater insight into a complex global Web than the sum of their individual parts. More detailed information is available **in the specific section of this website.**

2.2. Data literacy across HEIs and SMEs in Europe

According to the DEDALUS project, "*Data literacy is the ability to read, write, critically assess, and communicate data in context, including an understanding of data sources and constructs, analytical methods and techniques applied — and the ability to describe the use case, application, resulting value, and its implications*." Consortium members developed a broad research to understand the state of data literacy perception and usage around Europe, even in Non EU programme countries. The research has been conducted among companies and higher education institutions, with the aim of identifying an appropriate validation system and of defining an inventory of competences related to data literacy.

Through desk research, project partners reviewed how data literacy modules and programmes are currently delivered in higher education (HE). Partners interviewed 16 senior employees in small and medium enterprises (SMEs) across Europe to discover the importance of data literacy in their organisations, and their views on how well employees are equipped for the data demands of the contemporary workplace. Four types of broad data literacies were distinguished. Basic digital skills are often learnt in school/first job, and basic data literacy is

often accumulated via job experience. Advanced data skills are often learnt through HE and job experience but advanced data literacy skills are more complex to acquire, however, this could be addressed in Higher Education or via on the job training (continuing professional development). SME employers are relatively clear on what data literacy means to them when thinking about the concept in the abstract. However, when they discuss the data literacy skills they hire for, these become subsumed beneath role specific technical skills, which frequently include data. This leaves quite a substantial gap in the workplace for the softer, less role-specific, less frequently evidenced skills such as critical assessment of data, data collection and transforming analysis into insight, and in particular, the understanding of the ethical implications of the use of data.

As a result of the research, five insights of data literacy across European HEIs and SMEs were produced:

1. **More technically skilled employees are perceived as more data literate**

Employers in more technical industries express greater satisfaction with their employees' level of data literacy, similarly, staff in more technical roles in non-technical industries are also perceived to be more generally data literate. This suggests there is still an issue around the idea that someone who specifically works with data is 'data literate', rather than having fully assimilated the idea of a generic data literacy. However, a number of employers are aware that a need is opening up for more generic skills and this needs to be addressed. Such generic skills are those around issues like communication and understanding; extracting meaning from visualisations and interpreting data. These are softer, less technical skills that are applicable across multiple roles, tools and activities. They are less easy to articulate, specify and assess on a job description.

2. **General data literacy is required in the workplace**

More data literate staff were perceived as helping the organisation in its environment, understanding the market and customers better, and being better able to deal with clients and suppliers. There was an understanding that data is not only about being online and digital, but is equally important for delivering offline products and services. There was an interesting dichotomy between specialisation and generalisation – sometimes present in the same employer – regarding whether it was preferable to have an extremely data literate person, a data expert in the company whom everyone could consult and be used as a resource, or whether enabling everyone to be autonomously capable in data was the right way to go. However, those who had very data literate employees who were used as a resource by less literate colleagues found this inefficient. Having particularly skilled data specialists in an organisation of low data literacy levels also means that there is a gap between the commercial arm and the data people, which may lead to failure to exploit the data, to create truly valuable activities, the ones that will initiate the economic growth.

3. **Employers still think mainly in terms of specific software skills when hiring**

The level of data competence sought when recruiting is hugely dependent on job level, position and description. At an entry or junior level data literacy is functionally described as the ability to use software such as Office, Excel, or spreadsheets. At a more senior level employers described looking for skills such as big data; ability to merge different datasets; programming in R, Stat, Matlab; data mining; artificial intelligence; forecasting; customer relationship management; automation marketing; web and social media analysis; database management; Google Adwords; SPSS; data processing and visualisations. These can largely be characterised as pertaining to specific packages or job roles. Some employers articulated that they also recruited for more general data literacy skills, such as the ability to comprehend various data resources, to interpret the client needs from the data, to have the capacity of abstraction and generalization of the data, understanding of what questions can be answered by data and an understanding of possible data sources and not only knowing how to read them but to handle them responsibly. Even those with excellent technical skills may lack these more general data communication skills.

4. **General data literacy can be usefully framed as a soft competence**

The organisations were experienced in identifying and recruiting for soft competencies. Despite the fact that these are not as simple to evidence, employers had devised a range of ways to assess these crucial attributes. A number of these 'soft competencies' identified by interviewees already align with data literacy skills, such as, creative and analytical capacity, presentation, and problem solving. Interestingly, one respondent said, we prefer soft skills. Hard skills could be learned, and it is interesting to view data literacy through this lens. In the same way, specific software can be easily learned, but broader critical skills are not so simply acquired. Some areas in which organisations were already assessing crucial data literacy skills through soft competence assessments included a test for the ability to be a 'completer finisher' that reviewed the ability of candidates to understand what a document that was appropriate in detail for the chief executive officer might look like.

5. **While previous experience is prized, universities are seen as responsible for furnishing young employees with appropriate skills**

Previous experience in a job and, long and boring practice are seen as desirable by employers, as this knowledge is perceived to be consolidated and internalised. It is acknowledged that younger and more junior employees, without experience, should be acquiring these skills at university, and both age (older employees will not have had the same opportunity to learn data literacy at university) and career stage (younger employees will not have had time to learn on the job) affect the expectations of employers. At the same time, if employees are learning – or honing – their data skills on the job, this means it is harder for new skills to be acquired within industries. While some organisations or employers may make an effort to ensure new and innovative data skills are brought into the organisation, the cost of the time and financial resource this requires is prohibitive. Continuous Professional Development (CPD) was not suggested as a solution by many employers. This approach leaves a gap for new skills

to be identified and acquired, and as more new employees enter the workforce, this gap can be filled by universities.

In addition, the project partners identified three key actionable insights for data literacy programmes in HE to support SMEs in being able to access a suitably data literate workforce:
1. Ensure the provision of the full spectrum of data literacy, and not just data skills;
2. Build on generic computer science modules with bespoke, relevant elements for specific fields and professions, to help graduates develop the ability to extract value from data insights and application earlier in their careers;
3. Develop ways to evidence and certify the knowledge and insight aspects of data literacy, in order that employers are more able to identify and recruit for these skills.

Please find more details and the full report downloadable at this web address.

2.3. DEDALUS Validation system

From the preliminary need analysis carried out by the partners in preparation of the project proposal, it emerged that even a few examples of data literacy inclusion in university curricula already exist, it would be the first attempt to create a system to validate data related competences, taking into account not only mastery of data scientists, but also low-medium competence levels highly demanded by and for students and young professionals with all academic backgrounds.

DEDALUS validation system was created in accordance with the evidence emerging from the research phase. Based on the LEVEL5 approach, the DEDALUS validation system was based on the three dimensions of Knowledge, Skills and Attitude, to be declined along 5 levels of acknowledge.

The validation system aimed at better describing the identified competences and create the so called competence framework, by using the LEVEL5 system, a fully-fledged validation tool developed over the last ten years by the members of REVEAL, a European Educational Network for Competence Oriented Learning and Validation, chaired by blinc. LEVEL5 has been already piloted in several European projects and different learning contexts. The system is designed to ease the application of competence-oriented approach in training design, by reducing the complexity when visualising and describing learning outcomes and therefore provides an attractive presentation and documentation system for learning.
LEVEL5 consists in a three-dimensional model which maps the development of:

- Knowledge (à cognitions)
- Skills (à actions)
- Attitudes (à emotions and values)

Also, there are five quality levels – from beginner to competent expert. Each quality level of the three dimensions are described and complemented with specific indicators in so-called

reference systems. Once the competence framework was integrated into the LEVEL5 validation system, it became possible to issue certificates that visualise the learning pathway and the progression from one level to another (certificates were produced through a web-based software that automatically generates individual learners' certificates). In addition, a repository of assessment methods will also be created, to support self, peer and external assessments.

The system was linked with the first levels of EQF to integrate the evidenced based learning outcomes in individual competence profiles that are based on standardised European systems. For this purpose, the two systems were connected with the help of indicators that facilitated the comparison of descriptors of the different levels and dimensions and contributed to a transfer of assessed learning outcomes from LEVEL5 to EQF.

Blinc guided the consortium partners in setting up of the competence framework, when each main competences were structured in sub-competences and combined with other generic social, organisational and personal competences. More than 20 competences (and sub-competencies) were included within the repository and aligned with the levels of the LEVEL5 methodology. After having completed the catalogue of competences and sub-competences, partners designed the corresponding reference systems that consist of a grid of competences in the data literacy sector. According to the LEVEL5 methodology, the reference systems included include 5 levels of descriptions for the three dimensions of the LEVEL5 cube. These descriptions were made available for each competence included into the DEDALUS competence repository. Specific indicators were selected in order to focus the assessment and evidence to the specific learning context. One data literacy competence (Reading/creating data classification or rules) reference system is provided as an example below.

Reading/creating data classification or rules – Reference system

	KNOWLEDGE		SKILLS/CAPABILITIES		ATTITUDES/VALUES	
L	Level Titles	Level description	Level Titles	Level description	Level Titles	Level description
5	Knowing where else (strategic transfer)	Knowing what kind of unspecified data can fit to his/her task/purpose. Knowing how to distinguish relevant data according to adopted or independently developed classification rules from the abundance of open data sources. Knowing how to transfer this data into other contexts. Knowing how to find and collect data if there are no ways to get row data.	Developing, constructing, transferring	Being able to distinguish relevant data according to adopted or independently developed classification rules from the abundance of open data sources and develop strategies how to use that data in the new professional and personal contexts. Actively planning and creating new respective activities.	Incorporation	Having internalised reading/creating data classification or rules for data processing as a personal and professional key competence and the respective mindset. Being an inspiration for others in their respective data processing activities.
4	Knowing when (implicit understanding)	Knowing when (in which situation and to which extent) to apply suitable tools when collecting data and creating data classification or rules, how to select proper methods and models (ways of results´ processing and anticipation of new aspects of available data) including respective computer programmes. Knowing how to develop new data classification ways, how to create data classification rules evaluating various aspects of data from available data sets.	Discovering acting independently	Deliberately searching for and selecting or adapting available data sets or new (even - unexpected) possible/available data collecting sources which could be used for the own professional and personal field including: be able to apply a variety of data analysis methods for different data sets; be able to develop own rules and strategies for distinguishing of relevant data for specific purposes from available data sets; be able to classify data according known or newly created rules in a methodologically correct way for different purposes; be able to identify a new classification criteria according to the need and based on available information; be able to create new rules for data classification, based on the new classification criteria.	Self-regulation, Commitment	Being open minded to new ideas for creating data classification or rules in the own environment. Finding it important to be creative in this respect.
3	Knowing how	Knowing the theory of different approaches, techniques and instruments (including relevant computer programmes as data processing tools) related to: reading and interpreting available data, and how to use it for specific purposes; breakdown data to the relevant data clusters according known data classification rules; mastering the main/most common data processing methods; ability to use at least one computer programme dedicated for data processing (e.g. Excel, IBM SPSS, STATA, Eviews, R etc.).	Deciding/ selecting	Actively taking part in relevant data collecting, distinguishing and/or processing activities as they are offered by others in safe (undisturbed) contexts. Choosing singular tools, evaluation strategies and data grouping methods including respective available software.	Motivation	Valuing data in general including developed certain personal qualities: having curiosity to test information and to seek evidence, being open to new ideas of data trends and forecasting; having scepticism about reliability and validity of available data, if it is not supported scientifically or officially; having the humility to admit that the way of data collecting, distinguishing and/or chosen data analysis methods may be wrong when facing new information, experience or evidence that states otherwise. Being motivated to develop own respective data classification and rules.
2	Knowing why (distant understanding)	Having basic understanding on data collection methods and tools. Having basic knowledge on data analysis methods and ways of results´ processing including respective computer programmes (as data processing tools).	Using, imitating	Occasionally taking part in non-structured activities related to data collection, distinguishing relevant data from available data sets (using / imitating specific tools and data analysis methods) including respective computer programmes (as data processing tools).	Perspective taking	Being curious and interested in certain aspects related to data classification and rules distinguishing data from available data sets and the respective computer programmes (as data processing tools).
1	Knowing what	Understanding that collecting, distinguishing or/and analysis for all kinds of data must be based on data classification or rules	Perceiving	Perceiving available data sets without relating them to oneself. Being able to recognise, read and understand available data classification and rules directly, without taking actions or reflecting on them and their potentialities.	Self-orientation	Being interested in data classification and rules without relating them to oneself.

In parallel, a repository of the assessment methods suitable for data literacy competences were set up in the project. The assessment methods took into account learning objectives, needs and learning outcomes of the learners. Different assessment methods were identified accordingly. Moreover, the assessment methods can be specialized for self, peer or external evaluation procedures. Taking into account the specific field, the assessment methods also included very practical, exercise-based methods (for instance publication of personal data visualisation e-portfolio, exploration of specific datasets, etc.). The repository was later useful for the learners, team mates, trainers, HE staff, facilitators and assessors. Each method was described through the general idea, the specific purpose and the methodology of the assessment.

2.4. DEDALUS Learning platform

The lead organization CNR coordinated the consortium to establish the learning ecosystem of the project. It has been defined a strategy for managing the educational content created during the project and the piloting phase with target groups. The consortium has chosen to host all content under the Moodle platform offered by the REVEAL network, within the REVEAL learning offers, in order to emphasize the dissemination of the DEDALUS content.

The DEDALUS platform is a rich open learning platform which facilitates blended learning and delivers a fully-fledged learning environment which bridges learning, validation and documentation in three areas (LMS, LEVEL5 and e-Portfolio). This way the system provides learning technologies for different target groups (HE professionals but also adult educators who want to qualify themselves as well as those who are interested to look for solutions for challenges in practical learning situation or simply offer new attractive fields of learning and training). All instruments can also be accessed separately.

The platform was developed by using Mahara, an open source fully featured web application. Mahara contains many functionalities to create journals, portfolios, private and public websites, to upload and share files, to embed social media links and resources from the web, like videos, and to collaborate with other users in groups.
This virtual place will be used for many purposes:

- To make available in open format the modular competence-oriented learning system (O4) for HE staff that will be developed and piloted during the course, in order to exploit the project products beyond the project life time;
- To offer the users (ad in particular HE professionals) the opportunity of uploading their own data training resources (not only modules/lessons but also open datasets to explore, data visualisations, dashboards, etc,);
- To allow HE staff, students, trainers, to create their own data-related e-portfolios where to show and share vivid proofs of what they have produced (e.g. artefacts of works, essays, dashboards, data elaborations) in connection with their CV and the proofs of their competence developments (LEVEL5 certificates) and qualifications (e.g. badges and ECTS points or modular course certificates).
- Offer the opportunity to validate data related competences Expected impact.

The platform benefited the project's target groups by:

- Giving to academic personnel a virtual space where to find easily all the resources to integrate the university's offer with data literacy courses/workshops/projects;
- Connecting people interested in this topic, creating a community of interest that can go beyond higher education, triggering synergies among different educational fields (adult education, VET, CPD).

It increased attention around the project and the topic and will support the project sustainability in the long-term.

The platform itself was not entirely new, but it was partly based on instruments which have been developed over the last years. Otherwise, such a powerful open learning space with innovative software components would not have been affordable and feasible within an ERASMUS+ project. However, the combination into one overarching platform was rather new.

3. DEDALUS PILOT COURSES

After the research phase, the consortium managed the courses creation and the piloting phase.

After the research phase and training events, five partner universities oversaw handling their lessons with students. The universities involved in the project were asked to pilot the approach and resources developed and to report on their experience. The pilots were constantly supported and monitored by the partners, however, universities were free to design different types of pilots, according to their needs and students' interest.

More than 120 students were part of the piloting phase and their acquired competences were assessed and validated along the DEDALUS validation approach. Each partner supported the universities in its own country to explain the project's activities to the university staff and plan together the pilots. The training activities were then announced and face to face meetings and webinars were organised to recruit the students.

Vilnius University coordinated this activity and oversaw the pilots' progression in different countries. It also provided universities with common reporting tools, to draw up the experience reports in a consistent format. All partners supported the collection of data from the pilots, and will guide the universities in choosing the better methodologies (with interviews, questionnaires, etc.). Each pilot was accurately described in an experience report, that contained details on the activities, courses, and projects realised. The experience report included feedback and recommendations from all the target groups involved – not only HE professionals, but also students. Vilnius University analysed the information and data from the experience reports and used them to prepare this implementation strategy.

Partners were piloting their approaches in different contexts such as standard class-based courses, cycles of thematic workshops, including theoretical and practical lessons on already existing academic courses. This section summarizes the results of the pilots.

3.1. University of Novi Sad (Serbia)

3.1.1. Local context of data literacy

Serbian HEIs do not recognize or exclude competences related to data literacy. The only recognized terms are information literacy and data science. However, there are some initiatives at the higher education. For instance, University of Novi Sad study programme "Master 4.0" covers courses such as data analytics, bioinformatics, Internet of Things, machine learning, artificial intelligence, and virtual reality.

University of Novi Sad (UNS) consists of 14 faculties and there are 50,000 students enrolled at the UNS. Faculty of Technical Sciences (FTS) and Faculty of Science (FS) have study programs that include data literacy training. At the FTS, data literacy courses are manly related to the programming and information technologies. Around 1,500 students are part of these study programmes. At the FS, these figures are smaller, around 300 students are enrolled at the study programs related to the data literacy. In 2021, at the FTS study programme "Master 4.0"

was offered for the first time. This study programme offered students to pursue a digital carrier. Data analytics, bioinformatics, Internet of Things, machine learning, artificial intelligence, and virtual reality were covered within the programme.

At the University of Novi Sad, FTS course related to data literacy is “Electronic business” and it exists under the study programme “Engineering management”. The objective of the course is to introduce the concept of electronic business and to understand how electronic business affects enterprises.

3.1.2. Pilot design and impact

The University of Novi Sad, Department of Industrial Engineering and Management delivered the course “Electronic business” to the junior students of the study programme “Engineering Management”. The course was scheduled for the spring semester of the academic year 2020/21, from February 22, 2021 until June 4, 2021.

The students developed competencies related the data literacy – how to interpret data from charts and how to make charts according to the exercise needs. These competencies are needed for the future work within the industry. The concepts of COL&V methodology were transferred during the course, and the course was delivered in the following sequence: Planning, Delivery, Validation of competence development, and Evaluation of the learning. The concepts of Design thinking were included in the practical exercises via MS Excel. This helped students to better interpret data and graphs in their exercises. Also, following methods were used: Blended learning and coaching, Internal workgroups, Weekly Synchronous MS Teams sessions, Self-assessments (electronically, issuing competence profiles), Collaborative via LMS (team presentations), Design Thinking, and Practical learning.

Visuals from the online course:

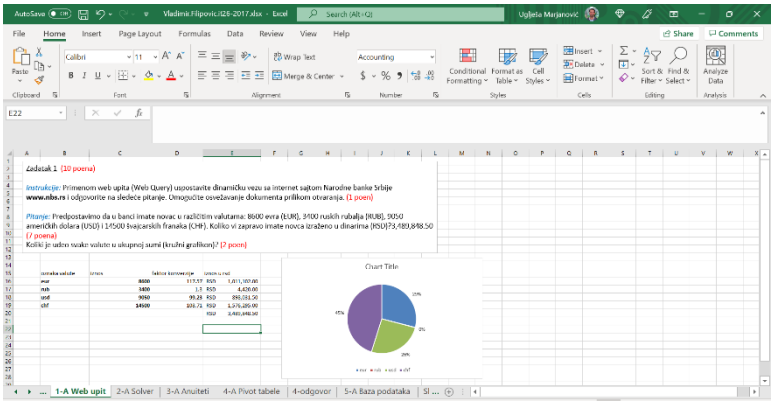
Apart from theoretical part, the students have learned how to analyze, visualize, and interpret data with spreadsheet software Microsoft Excel. They also learned how to use Gantt chart, Solver analysis, Monte Carlo Simulation, etc. The knowledge from this course could be incorporated into other courses, which influence students to increase their critical thinking. Visuals from student's project:

After the course, the students have had opportunity to practically test competences and gain LEVEL5 certificate. Following competence was validated: Reading and Creating Data Visualization.

COVID-19 restrict us to deliver the pilot in face-to-face settings. This has created lack of social aspects within the students. Techno-stress was present due to excessive use of technology.

3.1.3. *Elements of innovation*

The pilot was delivered via learning management system in a combination of communication platform. These two platforms are presenting innovation to the previous deliver modes. Also, LEVEL5 assessment techniques were applied for the first time at the UNS.



3.1.4. Transferability potential

The pilot provided innovative ways how to learn data visualization. The video materials and step-by-step guidance help students to learn new tools. The pilot can be used in other related study programmes.

Electronic copy of the course was created. It can be easily posted at the University learning management system and make it available to all the students. All other faculty staff could use one or more segments from the course within their courses.

3.1.5. Feedback and recommendations

It is concluded that it is more convenient to integrate Data literacy elements into existing course rather than offering it as a standalone one.

During the Data Literacy course, it was learned how to use Design Thinking in the teaching process. In future courses, the university will introduce some Design Thinking tools such as Miro or Mural.

The next round of course delivery needs to involve some additional knowledge from Data Visualization based on Big Data Analysis. Moreover, the students need to learn new tools for Data Visualization such as Ucinet, which could help them to know how to use Social Network Analysis method.

3.2. University of Milan and University of Southampton (Italy and United Kingdom)

3.2.1. Local context of data literacy

The Italian context offers a very large and complex offer in terms of education. Many actors (higher education institutions, local authorities, market) deal with data literacy course at different levels. At the education level, the so-called “Liceo Scientifico” is still one on the most important and established. Nevertheless, especially at the university level, students appear to attend social sciences rather than data-oriented ones.

The University of Milan, where the course took place, and particularly the Faculty of Political Science, offers 11 different degrees among undergraduate and postgraduate. In the last decade, the most part of the degree courses has been offering at least on subject about data collection and analysis. Starting form 2020, two degrees entirely dedicated to data science and data analysis (from a social science perspective) were established.

Within the Political Science faculty at the University of Milan, 11 degrees mentioned above offer different data oriented courses that are organized in traditional way (i.e. 40 or 60 hours

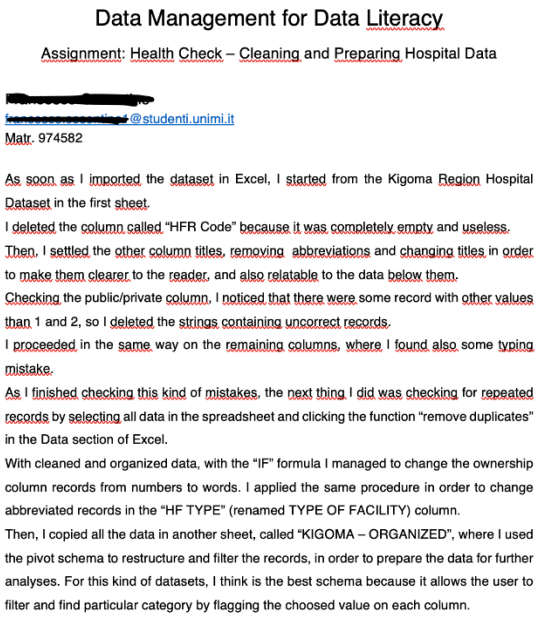
of a course). Some of those courses also include the usage of software such as SPSS, STATA or R. They generally are more focused on data analysis rather than data visualization.

3.2.2. Pilot design and impact

The course was organized in cooperation with the University of Southampton. The pilot was designed by the University of Southampton, it was provided online. The aim of the course was to "Develop and pilot a standard class-based course (with two modular levels, from basic to medium) selectin students with a low knowledge about data analysis". It included two online meetings and individual assignments. Sat the end of the course, students provided written output. The format can easily be applied to different basic context.

In module 1, students were taught what data science is and the key examples of data science in action. They overlapped with data journalism and open data to look at how data science is changing the way we tell stories.

In module 2, students were taught about the first stages of the data science process, namely data management, including looking at the critical aspects of data management. The overall provision of the course also included a forum where teachers and students could interact and collect more data science examples as well as look at the applications in their domain. Visuals of coursework:



Data Management for Data Literacy

Assignment: Health Check – Cleaning and Preparing Hospital Data

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Matr. 974582

As soon as I imported the dataset in Excel, I started from the Kigoma Region Hospital Dataset in the first sheet.
I deleted the column called "HFR Code" because it was completely empty and useless.
Then, I settled the other column titles, removing abbreviations and changing titles in order to make them clearer to the reader, and also relatable to the data below them.
Checking the public/private column, I noticed that there were some record with other values than 1 and 2, so I deleted the strings containing uncorrect records.
I proceeded in the same way on the remaining columns, where I found also some typing mistake.
As I finished checking this kind of mistakes, the next thing I did was checking for repeated records by selecting all data in the spreadsheet and clicking the function "remove duplicates" in the Data section of Excel.
With cleaned and organized data, with the "IF" formula I managed to change the ownership column records from numbers to words. I applied the same procedure in order to change abbreviated records in the "HF TYPE" (renamed TYPE OF FACILITY) column.
Then, I copied all the data in another sheet, called "KIGOMA – ORGANIZED", where I used the pivot schema to restructure and filter the records, in order to prepare the data for further analyses. For this kind of datasets, I think is the best schema because it allows the user to filter and find particular category by flagging the choosed value on each column.

Two traditional online lectures, and the use of the forums to discuss with teachers and between students have been implemented to:

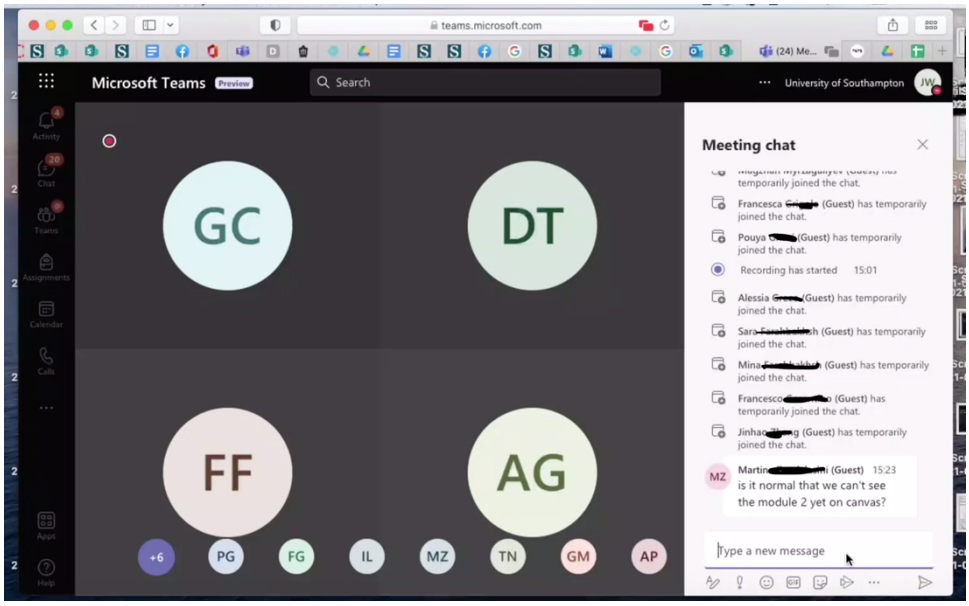
- Explain the key concepts in data science and its real-world application.
- Classify the different types of data available along with rights for usage.

- Implement an effective data collection and management strategy.
- Prepare data ready for analysis

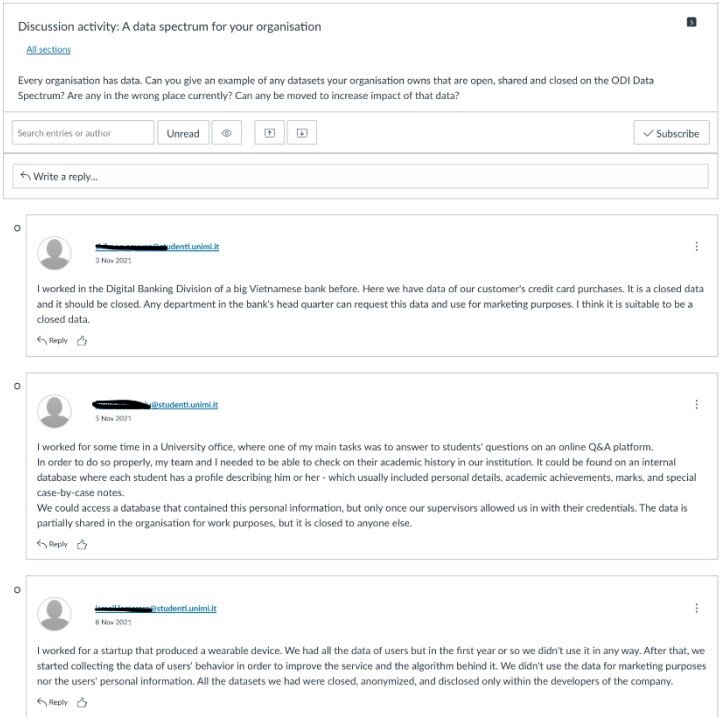
3.2.3. Elements of innovation

The most innovative part is the combination of data analysis skills with data visualization. In a short time (two weeks) the students were able to acquire basic but solid knowledge that they could apply autonomously.

Although it took place fully online, the course can be considered a blended learning experience, because there were synchronous, asynchronous, and semi synchronous elements. Synchronous elements were live online group tutorials, which took place in each of the weeks of the course. In those tutorials, the students had the chance to discuss data management and preprocessing aspects with the tutor. Visuals of group tutorials:



There were also semi synchronous elements, namely discussion forums. In those discussion spaces, students shared their experiences around data management, and data literacy-related insights. Students also completed a project-based assignment due by the end of the course, to which the tutor provided not only a mark, but also written feedback. Visuals from forum contributions:



Finally, there were asynchronous elements, consisting of the consumption of e-learning materials and formative tests consisting of quizzes for self-assessment.

3.2.4. Transferability potential

The format can easily be applied to different basic contexts.

3.2.5. Feedback and recommendations

From project experience, it appeared more effective to provide short course with a small number of students, because this format collects more the enthusiasm and eagerness to learn rather than traditional 40/60 hours courses.

Some of the participants were more involved to get their pay-off (ECTS) rather than understanding the importance of what they were learning.

The overall suggestion is that the difficulties of what it is taught should not influence the complexity of the courses provision. That is, blended and light-offer can be used even if the topic is complex and rather scientific.

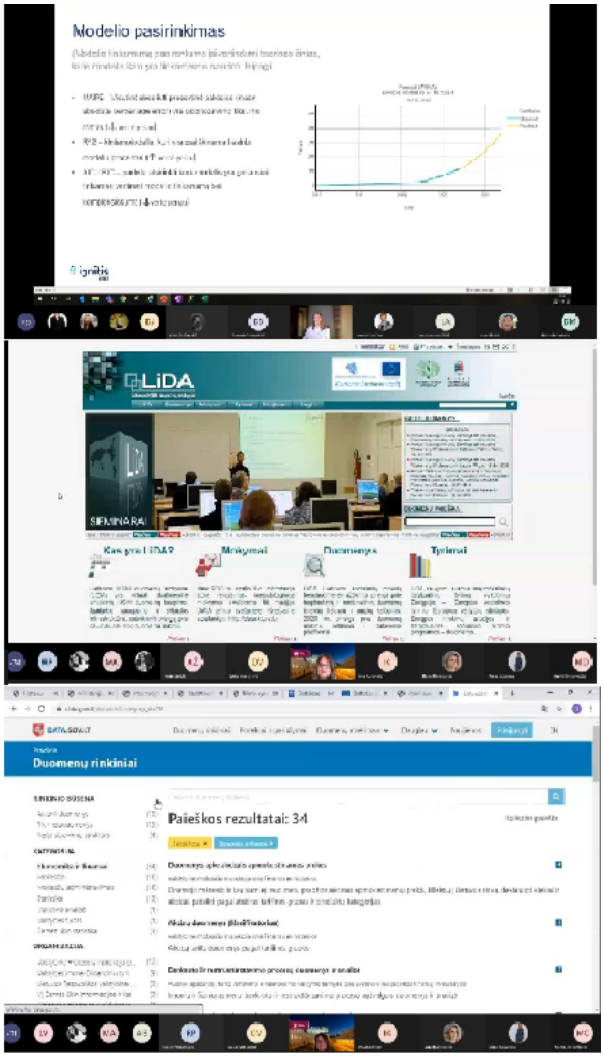
3.3. Vilnius University (Lithuania)

3.3.1. Local context of data literacy

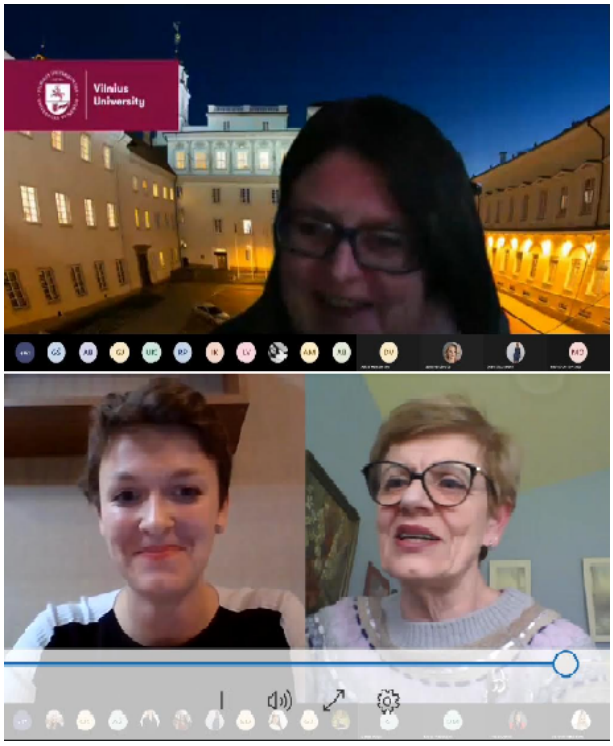
The project was implemented in Vilnius University, Faculty of Economics and Business Administration and aimed to increase students' attitudes, knowledge and skills of data literacy competence "reading/creating data classification or rules". The faculty did not hold any practice of teaching its students data literacy, therefore, it was a new and innovative field of education for existent faculty students. It is important for faculty students to be aware and learn data literacy in order to understand how to read data and be able to distinguish relevant data from data abundance, to be able to apply data classification rules created by others, or to create their own, based on a theoretical background. Usually, students learn basic technologies in the faculty, and get familiarised with research methods, which help them later while working with data and providing researchers in their bachelors and masters degree theses. However, by simply learning the usage of data in various research applications, students do not focus on the variety of available data, patterns and decision making based on the data acquired. Therefore, this project was an eye opener for many of the students and received great support from Vilnius University faculty administration.

3.3.2. Pilot design and impact

The team brainstormed what was needed to the University students and what they could use after the study processes end. It was concluded that one of the most necessary competence, also needed in project management, design thinking, strategic planning and other business processes, is reading and creating data classification or rules. Therefore, this competence was chosen to develop. From there on, the team approached the leadership of the Faculty of Economics and Business Administration at Vilnius University, to define the finest pathway of the project delivery. Finally, it was agreed that the project and the training within it will be accessible to the widest range of students, so that maximum number of students could benefit from its advantages. Project team started the training part of the project when they already had Action field and Reference systems of "Reading/creating data classification or rules" competence, which helped project team to have a structured view of what we wanted the students to know at the end of the project. It also helped to define a clear training programme, which would encompass both theoretical and practical parts of the competence. Visuals of the pilot implementation are below.



The project team invited the students to a range of weekly two-hour lectures, during which different aspects of the competence were presented, discussed and exercised. After the sessions took place, the students were invited to conclude homework and test their skills of "reading/creating data classification or rules" competence themselves, also providing proof of knowledge to the project team. Students had to submit practical work (parts of their own researches) which would clearly show the practical application of the competences acquired. They also had to provide the written feedback with explanations, where, how and why they used the data classification or rules. Visuals from pilot implementation are below.



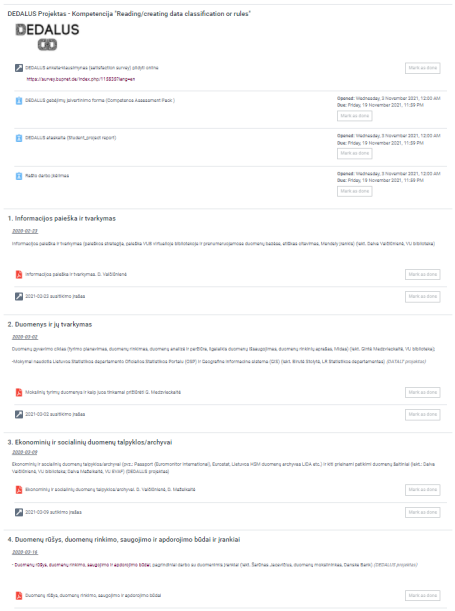
The feedback gave the project team clear evidence, that the student community not only listened to the information provided, but also received the skills to use it individually in their own written work. Finally, all students had to provide feedback of the project and explain its impact to their own research and work.

Vilnius University project team was very satisfied with the project implementation, final results and the support received from other members of the consortium. It was a great experience for all of us, which not only largely improved data literacy in Vilnius University, but also helped students to obtain one of the most important 21st Century skills.

3.3.3. Elements of innovation

Due to Covid-19, students had to participate online; however, the sessions were not only lecture type, but also involved group workshops, discussions, and in-class presentations.

The University used Moodle online environment to conduct the course, upload study materials and collect assignments. This paid off, because all students had access and had a centralized environment, where all materials are to be found. Visuals of the online learning platform:



3.3.4. *Transferability potential*

The final conversations with the students clearly shown that the course went on successfully, having impacted the students attitudes, knowledge and skills of data literacy. Students noted that they receive understanding on relevant aspects of reading and creating data classification or rules related to special tools and methods, evaluation strategies and ways of results' processing and got knowledge about the variety of relevant data sources. We expect the project to continue while offering more opportunities to students across Vilnius University, but it is also easily transferrable to any other HEIs abroad or in the country.

3.3.5. *Feedback and recommendations*

The most challenging part was to receive the interest from the students, because the project training had to take time during quarantine and school closure period, prevalent due to the global Covid-19 pandemic. It looked like it was going to be a challenge to invite the students to yet another training programme. However, it was soon seen that students enjoy the opportunity to learn and acquire new skills during the project, therefore, the vast number of students finally enrolled to the programme and participated throughout it. This was also due to the fact that the programme offered skills, relevant to the study processes, such as writing

the final study theses, required to obtain the degree. Therefore, there was a great interest in the programme, which offered the knowledge, relevant to successful end of the study cycle.

3.4. University of Alcalá (Spain)

3.4.1. Local context of data literacy

Around 28,000 students — approximately 16,000 undergraduates and 12,000 postgraduates — are currently reading for a regulated degree at the University of Alcalá (UAH). The Department of Computer Sciences within the University is having a total number of more than 50 full time researchers and teachers, around 30 part-time as well as over 15 research assistants and ICT technicians.

UAH is an official examination center of ICDL certification (more than 20 years of history and more than 16 million certified people in the world) with content related to data literacy or that help to improve data literacy skills. ICDL certification is available in over 100 countries and have more than 16 million people certified worldwide. In some countries as Malta, this certification is mandatory to enroll to the university.

The course offered by this programme was structured to provide the students the wide vision about digital literacy, developing the key concepts in different areas in order to provide a full vision on different contents. Previous research has shown that most of the students related to communication degrees were not familiarized with data literacy field, so the decision was to create a complete pathway in this topic to show the students how the data can help them to communicate an idea in more effective way.

3.4.2. Pilot design and impact **[PV1]** [PV2]

University of Alcalá carried out two pilots. On one hand, the first strategy was develop a separated Transversal Course (this type of courses is known at UAH as “cursos de extensión universitaria”). It consisted in a 15 hours course with award of 1 ECTS with enrolment at no cost (only 15€ per student which this time was funded by UAH as part of the project) and open to all types of students (with those outside UAH). The goal of this strategy was to analyse the attitude of students towards this type of training, as they decide by themselves to take this course or not. This allows to have a first vision regarding the identification of training needs in this field by the students themselves and also their interest in this topic. The final number of students was eight.

On the other hand, our second strategy was the integration of the information literacy training directly into a six ECTS last year optional course of "new digital formats" in the Audiovisual Communication degree of UAH. This degree is strongly related to the use of

different media devices and the way of communicating information. In general, the students only have basic IT skills, so they are not familiarised with topics like digital security, data analysis, skills related to computer usage. Although this course is optional in the learning program, the direct integration of DEDALUS as part of the subject can provide a vision regarding the effectiveness of integrating the syllabus directly into the degree programs. Following this strategy, it was possible to get 25 students for the training in information literacy.

The summarized structure of our course was as follows:

- Information analysis: DEDALUS project description, ICDL certification description, what is and ways to measure the information, decisions based on information, evaluation and types of information.
- Information search: browsers, academic articles search and analysis, social media to protect, obtain and evaluate information.
- Information evaluation: evaluation, academic publishing, patents, spam detection, digital signatures.
- Information management: organization, reference the information and tools to organize the information, project management repository tools, backup, privacy.
- Presentation of the information: legal aspects, how to perform an effective presentations, basic Excel usage to process information.

All aspects were covered by practical examples and exercises to be performed by the student in order to better acquire the planned competences.
The learning pathway is structured in five different modules:

- Module 1: Information analysis: determine what online information is needed to meet a particular requirement.
    - DEDALUS project description
    - What is information and how to measure it
    - Understand the different types of online information
    - Different fonts of information: browsers engine, deep web, web archive, open databases, surveys and how to manipulate a survey
- Module 2: Information search: Search securely for online information using search engines and social media applications.
    - Browser's engine advanced search features
    - Google scholar
    - Public information
    - Community data (Wikipedia, OpenStreetMap's, others)
    - Social media
    - RSS channels
- Module 3: Information evaluation: Critically evaluate information using a range of criteria.
    - How to evaluate the information: authors, date, used language.

  - How the academic world works and how you can find a precise information
  - Patents
  - Information security: identification of phishing emails, false news, digital signatures
- Module 4: Manage information: Manage and organise information using a range of tools.
  - Properly organize the information
  - How to reference the information: using MS Word, Zotero
  - Store the information and backup: cloud, others
  - Don't allow to track yourself in internet: cookies, track blockers, specific search engines (DuckDuckGo), permissions, privacy in social media
- Module 5: Deliver the information: Plan, draft, review and deliver online information
  - How to redact and present the information
  - Effective presentations with PowerPoint
  - Excel usage to filter information

All these modules were also adapted to LEVEL5 certificates. The original competence designed for LEVEL5 certificate which has the best similarity with this course was “Digital Creation Literacy”, which was aligned to the proposed cluster of competences during this course. However, during the development of this course it was possible to identify some of the changes in the proposed competences in this cluster. This lead to adapt the cluster to this learning materials, having to adapt the LEVEL5 certificate for this course.

The main methodology which applied to both pilot courses consisted in develop key concepts based on ICDL certification, complement this information, and develop practical examples. During the course we also promoted ICDL certification as we find it very relevant to develop competences not only, but also, related to data literacy, and which ones can improve this field.

All the learning materials were supported by gamification and practical activities to make the content practical, useful and applicable to the students’ daily activities. The experience has shown that the students were interested in the activities as all of them were collaborative in order to following they.

The learning materials and the activities was uploaded to Moodle platform provided by BLINC partner (https://moodle.level5.eu/login/index.php) in the first pilot and in BlackBoard platform provided by our institution, UAH (https://uah.blackboard.com/) for second pilot. Both platforms are well known by students and allows to easily and effectively export the information to reuse the learning materials in future.

Due the pandemic situation, both pilots were carried out in online format based on the Moodle platform provided the partner Blinc. The second pilot was possible to be carried out in person in the classroom, but we preferred to keep it online in order to compare the results extracted from both pilots.

The participant recruitment was carried out by promoting the course in different ways. As the University was closed during the pandemic and the lectures were online, the promotion through flyers and ads in the university building was not possible. The course was promoted in the following ways:

- Online flyer containing information about the course: https://drive.google.com/file/d/19tMQbuI2D1T-_Ue3m0P8yWeGst-KSjea/view
- Promotion of the course in the official website of our university: https://www.uah.es/es/vivir-la-uah/actividades/cursos-de-extension-universitaria/cursos-de-extension/21861-Aprendizaje-conocimiento-y-habilidades-para-la-alfabetizacion-informacional-Information-Literacy/
- Promotion of the course directly in the university subjects where DEDALUS project team are lecturers.

All these actions were especially important for the first pilot, which was the extension course, as for the second pilot the learning materials were directly integrated into the course of the degree where the students were enrolled.

The results were diverse:

- Extension course: only 8 students enrolled and only 6 of them completed the course earning the LEVEL5 certificate and 1 ECTS credit.
- Subject in the Audiovisual Degree: 25 students are enrolled to the subject, but only 20 had actively participated in class, earning the LEVEL5 certificate. All the students were awarded with 6 ECTS once they have completed the whole program of the course where the pilot was integrated.

3.4.3. Elements of innovation

The method was composed by key concepts explanations, practical examples, guided exercises, gamification activities and exercises to be performed by the student. Each theme contained the following activities:

- Determine what online information is needed to meet a particular requirement:
  - Kahoot as self-assessment.
  - Videos showing examples of the discussed topic.
  - Guided activity: how to plan and structure the information research.
  - Proposed activity: decide a topic to research, plan the searching strategy, elaborate a survey to gather data.
- Search securely for online information using search engines and social media applications:
  - Bamboozle forming a team as self-assessment.
  - Proposed activity: elaborate a search strategy based on idea of previous day.
- Critically evaluate information using a range of criteria:

  - Online game to detect if you are being phished.
  - Proposed activity: search academia articles related to the chosen topic.
- Manage and organise information using a range of tools:
  - Guided activity: how to cite the information, how to use tools for information citation.
  - Group activity: review and discuss the privacy of the Google account.
  - Proposed activity: create a Zotero account and organize and cite the information found on previous days.
- Plan, draft, review and deliver online information:
  - Guided activity: Excel usage to filtering data
  - Proposed activity: present the obtained information from the previous activities using PowerPoint.

The students had to work in the activity based on all the acquired information during all the modules, which consisted in develop a survey to gather data, search academic publications related to the gathered data, use a tool organize the information and to cite these publications, and write a report effectively showing the processed data and its meaning.

Both implemented options are awarded with ECTS credits:

- Extension course: 15h of online teaching (complemented by hours of student's work) corresponds to 1 ECTS.
- Data Literacy integrated into last year optional course of official degree program: 15h of data literacy (complemented by hours of student's work) corresponds to 1 ECTS, but the whole official course where it was integrated is awarded with 6 ECTS, as it is shared with other contents related to new digital formats, which are also related to data literacy.

The pilot was innovative as two implementation options has been tested: extension course awarded with 1 ECTS of 15h of duration, integration of the course directly into a last year optional courses awarded with 6 ECTS.

3.4.4. Transferability potential

The University of Alcalá team who participated in DEDALUS project are working in Computer Science department, being their field of work IT. The team are also lecturers and professors at the university in subjects related to IT, management, and digital competences, being familiar with different approaches of data literacy and having experience in teaching and creating new contents.

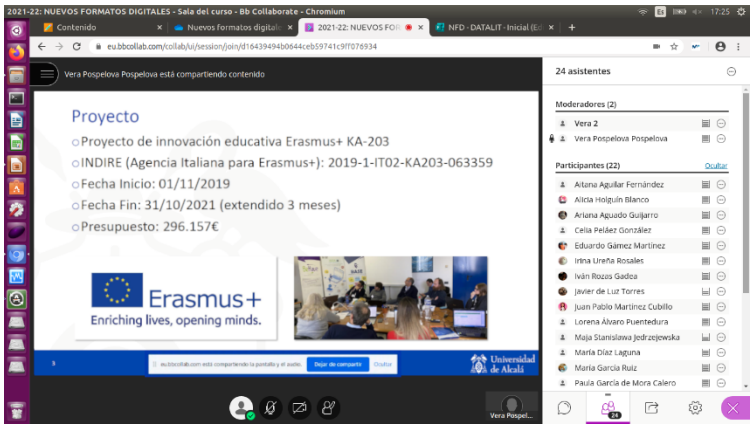
From team's experience and perspective, it is important not only to learn technical abilities for the students after completing the degree, but also abilities to communicate and research using data. An idea populated with data can be transformed into a fact rather than a simple idea, and this is important in many aspects of personal or professional life.

Working in a European team in order to successfully complete the proposed aims in this project has been very important as it provided a vision from other European universities and entities. This was very helpful to understand which could be the problem in the educational system of a specific country. Apart from this, the acquired experience in Spain may be helpful to other countries to better develop competences in data and information literacy.

The development steps of the pilots are important to measure the usefulness of the learning materials and also the satisfaction of the students with the contents or course. However, this is something that can be only measured once the course is completed. UAH team believes that is the most important step to develop and integrate the course into the course with a long-term perspective. The team believes that short-term integration is difficult to succeed, but long-term integration can provide better results achieved during this project.

The most valuable experiences during the course, especially in the second pilot, was to see how the people not related to IT studies were trying to define, in front of the whole class, the specific points they assured to know and asking them to give further details or place them into a specific situation and see how they solve the question. This helped them to understand that, although they believe to know the topic explained, they should keep listening, as they never know if somebody can teach them new things.

This project helped the project team to discover some aspects and ideas not completely explored before and opened our mind in order to improve some degree learning programmes to help the students to be better prepared for their future. Visuals from project implementation:



3.4.5. Feedback and recommendations

These are the conclusions and lessons learnt during the two pilots as well as and some reflexions in order to improve future editions of this learning program:

- The contents should be adapted depending on the student's degree: the first pilot with eight students from a wide range of areas of knowledge such as history, social sciences, finance or IT has shown that for some students the discussed topics were mostly known, while for the students not related to IT they were completely new. This gave us a perspective that the learning materials should be adapted according to the degree and background of students: e.g., for those in the IT field the materials should be levelled up, while for degrees not related to IT should be maintained as they are.
- The contents should be extended: the course should be extended in hours to have more time to have more practice on specific points during the course.
- Public speech: the last learning contents about how to present the information in front of the audience and how to support and highlight this information with data should be practiced more deeply.
- It is believed that it is better to integrate the Data Literacy topics into a subject rather than offering a free course awarded with ECTS, as the students are more committed in a regular course, where it is also easier to reach more students.

From trainers perspective, the following points were observed:

- The students have some theoretical concepts acquired but have lack in practical approach: for example, the IT students which completed this course perfectly knew the theorical point of view of the databases, but they were struggling in create a query for a publicly available database. From this we can learn the perspective that the practical approach has the same importance as theorical one, so it made us think that maybe some subjects at our university have wrong focus.
- Some students during the course expressed their interest in continuing the studies to earn a PhD. During our course we have shown how the academic world works, but this made us reflex that maybe the interest in research should be emphasized during the degree program, rather than in an optional course.
- In general, the team observed that most of the students, independently of their studies field have lack in some basic digital competences, which can be addressed if the university facilitates to the students obtain a certification as ICDL, being at the same time UAH an official examination centre.

In general, the team observed that all the students, independently of their studies field have a deficit in presentation of information to others, and they are not capable to support the presented information with solid data. The university has a specific transversal subject to address this problem, but as the subject is transversal, is not chosen by many students. An additional problem is that this course is offered during the first course of the degree, while from team's point of view should be offered during the last ones.

4. CONCLUSIONS

DEDALUS – DEveloping DAta Literacy courses for University Students – project aimed to equip students with the necessary competences to cope with future digital challenges and to create an additional value for the enterprises and industries where they would be employed. It did so by developing innovative modular, open and online learning curriculums to include data literacy competences in any study field. At the same time, through the continuous professional development (CPD) qualification for higher education (HE) professionals, it developed the digital competences of educators, enabling them to transfer such competences in their practice.

DEDALUS developed and piloted an approach to tackle data literacy competence shortage based on a long-term partnership of educational partners who have either worked in digital literacy and digital education projects, or on competence-oriented learning and validation of non-formal and informal learning. Based on a sound stocktaking on successful approaches on how to include data literacy in university programmes, it set up a framework of competences on data literacy, taking in due consideration also the demand of the business sector. A modular learning and training approach was developed using high quality blended learning approaches combining face-to face, e-learning and practical learning on the job. The learning and training offers were also delivered on state-of-the-art learning technologies which will offer contents, courses, e-portfolios and validation interfaces as open educational resources (OER). The DEDALUS course and modules involved HE professionals that piloted the approach in different universities and study domains across Europe.
DEDALUS project aimed at promoting a wider inclusion of data literacy in higher education in an innovative way: not with general recommendations, but with concrete examples and direct feedback from the target groups, showing the benefits of the approach for students, in terms of preparation for the job market, and for HE personnel, in terms of continuous professional development. It also shown how to deal with difficult implementation scenarios, for instance in institutions that have less flexible didactical organisation. This implementation strategy has shown various approaches taken by different universities of integrating data literacy courses in the teaching processes and its transferability to other training environments.