D-Reskill@U

Mapping Career Guidance & Upskilling and Reskilling Pathways For Lifelong Learners Using a Skills Gap Analysis

Project Result 1 Final Report

Report Outline

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An overview of D-Reskill@U core conceptual features

Virtual
Career Guidance

Competency-Based
Guidance & Training

ESCO Compatible

'Smart' Course Catalogue

The core conceptual features of the D-Reskill@U system include designing a mock-up of a **virtual career guidance system** driven by a competency-based and ESCO compatible 'smart catalogue' of training offers related to the occupational domains of Data Science and Chemistry.

Core users of the D-Reskill@U system

The D-Reskill@U system will support three central users:

- **Lifelong learners** are the primary users of the D-Reskill@U system, motivated by receiving actionable career guidance.

- **Teachers** and associated learning providers (i.e. mooc platforms, micro-credential portals etc.) support the D-Reskill@U system by adding short courses to the 'smart catalogue' that are deemed highly relevant for upskilling and reskilling pathways for in-demand occupations.

- **Industry partners** further support the system by rating Skill Proficiency levels for specific Occupational profiles in order to provide up-to-date labour market data on the key skills necessary for up-skilling and re-skilling for career growth and transitions.

T1: Defining user skill gaps for mapping to Up/Reskilling training pathways (UOC)

T2: Determining skill proficiency levels of training pathways identified through Skill Gap Analysis using the application of the EQF framework (UOC)

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1. Project Objectives

What are we trying to achieve through D-Reskill@U?

D-Reskill@U has been developed in response the European Skills Agenda and the challenges that Higher Education Institutions (HEI's) face in the field of lifelong learning, in the current context of health, socio-economic and environmental crisis. D-RESKILL@U recognizes that lifelong learners need effective up/reskilling and career guidance tools to enable them to enhance their employability in a period of rapidly changing work patterns. In this regard, D-Reskill@U's objective is to develop a dynamic mock-up for a career guidance tool which fosters inclusive lifelong learning based on identifying personalized and flexible reskilling and upskilling pathways.

Following a user-centred design approach, project objectives include:

- ⇒ Designing and developing a dynamic mock-up of a learner-centred career guidance software to make the provision of lifelong learning through digital reskilling and upskilling as inclusive as possible

- ⇒ Developing the conceptual, methodological, technical and strategic guidelines for designing an ESCO-compatible **smart digital course catalogue** of micro-credential compatible training pathways based on specific upskilling user profiles (i.e. training paths from one occupational profile such as "chemistry technician" to another profile, such as "analytical chemist").

- ⇒ Designing an innovative tool for identifying stackable micro-credential compatible training pathways, based on an identified Skill Gap Analysis (SGA) in the occupational domains of Data Science and Chemistry and linked to the evolution and demand of the European labour market.

- ⇒ Maximizing impact via an active dissemination plan to ensure visibility and continued project sustainability.

2. Project Context

What is the motivation behind the DRESKILL@U Project?

The future of work and the ever-changing demand of skills in the labour market has been a consistent debate and pressing challenge for higher education institutions (HEI's). Providing support and guidance for lifelong learners in a labor market in constant evolution has become a clear goal for governments and educational organizations. HEI's have a key role for empowering lifelong learning, helping individuals to participate fully in society and successfully manage career transitions in the labour market, including career growth and progression. In this setting, the DRESKILL@U project consortium has come together as practitioners, educational leaders, policy-makers, technologists and innovators to work to improve the flexibility and responsiveness of higher education systems. A focus of this work is on the empowerment of individuals to create new learning and career pathways using digital career guidance tools. HEI's must ensure that the qualifications and training pathways they offer are matched to the demands of an evolving labor market, including occupational shifts, skill gaps and work pattern disruptions in a dynamic, global, and digital economy.

D-RESKILL@U recognizes that lifelong learners entering the workforce need effective and timely up/reskilling and career guidance tools to enable them to enhance their employability, especially in a period of rapidly changing work, uncertainty and volatility. The project aims to examine how the possibilities of digital reskilling through career guidance software can be maximized and problems of adoption and sustainability can be minimized. To increase inclusiveness and sustainability, the solutions must be as effective and affordable as possible.

The D-RESKILL@U project is directly linked to the **"European Skills Agenda"** which prioritizes equity and inclusivity as a key instrument of socioeconomic development and excellence. The Skills agenda assumes that public universities can play a pivotal role in providing innovative lifelong learning pathways which support targeted employability in key economic sectors. D-RESKILL@U is vital in this regard, by providing a career guidance strategy for a lifelong learning training pathway. The project aims to be accessible, readily applicable, and responsive, thanks to its alignment with the European Skills/Competences, Qualifications, and Occupations (ESCO) database and its use of advanced digital tools for career guidance and support.

Economic growth across all sectors has been driven by the digitalization of public organizations and private enterprise. In this context, lifelong learners need insights into the new and different skills they will need for career growth. According to a report from Gartner (2020) digitalization-driven skills shifts can be described by three central tendencies:

⇒ **New skills are emerging**: driven by accelerating technological advancements. These skills include new-in-kind skills such as data analytics for business intelligence and blockchain.

⇒ **Skills are evolving:** As companies continue to embrace big data, employees with statistics and analytics backgrounds who have applied their skills through more legacy programs like Statistical Package for Social Scientists (SPSS) and Statistical Analysis System (SAS) are starting to shift toward big-data oriented tools like Python and Tableau. In this regard, Deming and Noray (2020) argue that " the overall rate of skill turnover is high. Among vacancies posted by the same firm for the same six-digit occupation, about 29% contained at least one new skill requirement in 2019 that was not required in 2007".

⇒ **Yesterday's skills are expiring:** This category includes skills that technology can perform faster and cheaper than humans. Examples range from cold calling to manual sorting to designing for print advertising — and could soon include a range of knowledge-economy skills that are displaced by artificial intelligence and machine learning.

How are HEI's responding to labor market needs?

The Case of the Open University of Catalonia

Increasingly, universities are under pressure to offer innovative lifelong learning training pathways which rely on the potential of micro-credentials for unbundling, flexibilizing and re-bundling current course offerings. Among the biggest drivers of reskilling through micro-credentialing is to better match learners to jobs in a dynamic digital economy. This responsive process relies on deep insights into the occupations, skills, as well as the education and experience requirements in an ever-evolving labor market. HEI's in turn must be capable of offering lifelong learners timely and targeted career guidance, including identifying the reskilling and upskilling pathways necessary for learners to achieve their professional goals. In the current context, HEI's have a critical role in providing guidance and support

for lifelong learners by developing talent and capabilities and by offering a better skills match between training and the labor market. Below are some identified trends HEIs are undertaking to respond to emerging labor market needs.

Designing New Learning and Career Pathways

- **Prioritizing skills/competencies:** When competencies are prioritized**,** education is based on predetermined 'skills or competencies', often known as 'learning outcomes' which focus on real-world performance and consequences. In a competency-based reskilling/upskilling pathway, students demonstrate their learned knowledge and skills in order to achieve specific predetermined "competencies" through credentialing.
- **Integrating training cycles-** Creating upskilling and reskilling pathways for lifelong learners requires offering training cycles which can be made compatible with other professional commitments (i.e. part time or full-time work) or other responsibilities such as family life. Integration also refers to offering reskilling pathways that can be directly used for accessing new opportunities in the labour market (i.e. integrating training and the labour market).
- **Hybridizing pathways:** Offering learners a blend of online and in-person instruction. Online instruction can be asynchronous or synchronous. Hybridized pathways for lifelong learners are training experiences that are designed to combine both online and in-person instruction.
- **Unbundling program syllabus:** Unbundling and rebundling[1] are happening in different areas of Higher Education through new forms of teaching and learning provision and in different parts of the degree path. Micro-credentials (short learning qualifications which target industry specific skills) are one of the most common forms and can offer a timely and targeted response to shifts in the labor market, part of a broader effort to align qualifications and occupations and ensure employability for learners through flexible pathways.

Ensuring Guidance and Support for Lifelong Learners

- **Educating for employability:** An expectation of HE is to educate for employability, but how can we ensure universities design whole curricula and university environments that promote employability? Educating for employability involves intentionally integrating teaching and learning strategies that facilitate or enable employability across a range of sectors and industries. This process also relies on study programs gaining deep insights into the occupations and associated knowledge and skills needed in an ever-evolving labor market.
- **Scanning the labour market and offering career guidance and orientation**: Horizon scanning can help to identify the drivers and emerging trends in order to understand current and future labour market scenarios. Building tools that harness the power of big data and AI is an example of this in order to (1) help learners identify their career goals and the required lifelong learning pathways to achieve them, and (2) help universities identify program portfolios and course contents that address the labour market needs.
- **Stimulating Industry partnerships-** Internships, Co-ops and other forms of industry partnerships which are interconnected with the teaching mission are critical for providing career guidance and support for lifelong learners. Although models of University-Industry partnerships which focus on research, innovation and knowledge transfer are prevalent, teaching driven partnerships are less developed and there are several barriers which prevent U-I teaching-driven partnerships from fully developing.

[1] We use the term *unbundling* to mean the process of disaggregating educational provision into its component parts, very often with external actors. We use the term *rebundling* to mean the reaggregation of those parts into new components and models (Czerniewicz, L., 2018), such as a micro-credentialing pathway which leads to a micro-certification.

3. Relevant Literature & Policy Frameworks

The DRESKILL@U project builds on the most recent policy frameworks for the European Higher Education Area (EHEA), with a particular emphasis on the connections between education and training systems and the labour market. The current project complements the ongoing political discussion on tools and initiatives supporting people in their lifelong learning pathways established in the July 2020 Skills Agenda and the 2022 Council Recommendation on a European Approach to Micro-credentialing.

As a collaboration across 4 distinct national education systems (France, Budapest, Italy, and Spain), D-Reskill@U will use policy tools developed for the EHEA, including the European Qualifications Framework as seen in Table 1, and the European Credit Transfer and Accumulation System (ECTS). According to Europass (2022), the EQF "is an 8-level, learning outcomes-based framework for all types of qualifications that serves as a translation tool between different national qualifications frameworks. This framework helps improve transparency, comparability and portability of people's qualifications and makes it possible to compare qualifications from different countries and institutions". Using European Commission policy tools such as the EQF and ECTS, as well as the most recent recommendations on Micro-credentialing, will allow the D-Reskill@U tool to operate in a transparent and comparable method across distinct national higher education systems.

Table 1 EQF demonstrating levels relevant for the D-Reskill@U project (Level 5 & 6)

EQF Level	Knowledge	Skills	Responsibility and Autonomy	Example
	Knowledge is described as theoretical and/or factual.	Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) and practical (involving manual dexterity and the use of methods, materials, tools and instruments).	Responsibility and autonomy are described as the ability of the learner to apply knowledge and skills autonomously and with responsibility	
Level 5	Comprehensive, specialized, factual and theoretical knowledge within a field of work or study and an awareness of the boundaries of that knowledge	A comprehensive range of cognitive and practical skills required to develop creative solutions to abstract problems	Exercise management and supervision in contexts of work or study activities where there is unpredictable change; review and develop performance of self and others	Foundation Degree, Certificate of Higher Education, Diploma of Higher Education,
Level 6	Advanced knowledge of a field of work or study, involving a critical understanding of theories and principles	Advanced skills, demonstrating mastery and innovation, required to solve complex and unpredictable problems in a specialised field of work or study	Manage complex technical or professional activities or projects, taking responsibility for decision-making in unpredictable work or study contexts; take responsibility for managing professional development of individuals and groups	Bachelor's degree without honours,; (Spain) Diplomado or Grado; (Italy) Laurea Triennale, Professional Bachelors Degree, France,

4. D-Reskill@U Phase 1 Results

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Lifelong Learner

Teacher Partners
Learning Providers

Industry Partners

The D-Reskill@U system will support three central users:

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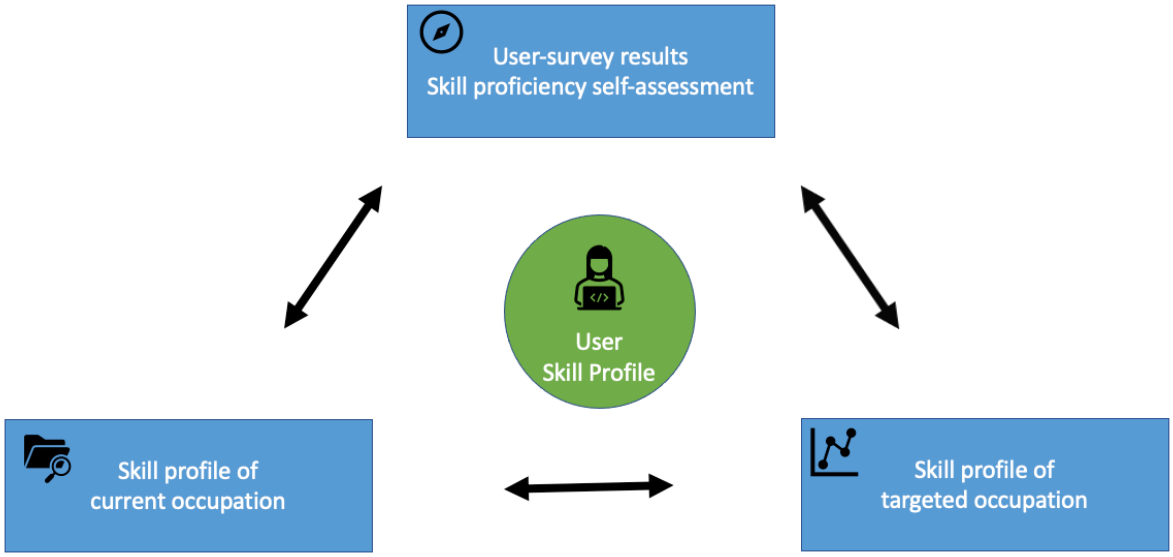
- **Industry partners** further support the system by rating Skill Proficiency levels for specific Occupational profiles in order to provide up-to-date labour market data on the key skills necessary for up-skilling and re-skilling for career growth and transitions.

The specific goal of PR1 was to create a set of guidelines for mapping career guidance to upskilling and reskilling pathways using a Skills Gap Analysis. The mapping is based on specific skills as categorized in the ESCO skills database and will allow users to easily understand offerings based on their reskilling and upskilling needs **determined by the development of a user skill profile**. A **user skill profile** can be created by correlating (1) a user's skill proficiency self-assessment survey; (2) skill profile of current occupation and (3) skill profile of targeted occupation, as depicted in the image below.



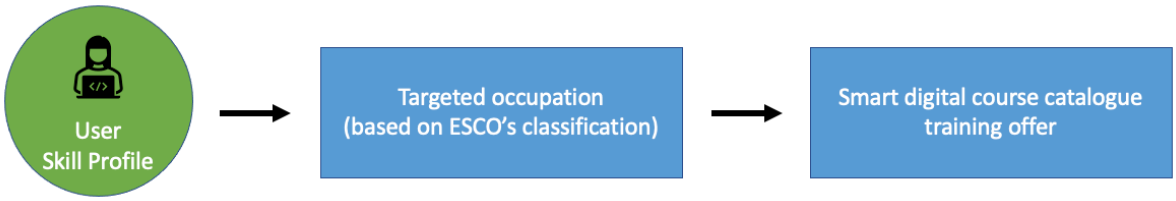
To foster new learning pathways, guidelines for the design and development of a **smart digital course catalogue** have been developed. The granularity of the learning path was a vital element to address, because it links:

(1) a user's skill profile to

(2) a targeted occupational skill profile (i.e. Data Science or Chemistry) to

(3) a corresponding training offer using ESCO's classification through a **smart digital course catalogue**.

This particular 'smart' design formula is something unique from the support and guidance learners receive at the undergraduate level, and is a defining feature of the DReskill@U project, depicted in the image below.



The below sections will discuss in details the specific tasks (T1-T3) which configure the work of PR-1.

T1: Defining user skill gaps for mapping to Up/Reskilling training pathways (UOC)

How can a Skills Gap Analysis be used to empower individuals for career transitions and growth?

How can a Skills Gap Analysis be used to specify and determine learning pathways for new employability opportunities within the DReskill@U career guidance software?

The 'Skills Agenda' is a well-established EU policy related to employment, social development and inclusion (European Commission, 2022). The year 2023 has been designated the European Year of Skills. A major motivation for the "Skills Agenda" is the existence of a *skills gap* between job-seekers in the labour market, which has been described as:

"a fundamental mismatch between the skills that employers rely upon in their employees, and the skills that job seekers possess. This mismatch makes it difficult for individuals to find jobs and for employers to find appropriately trained workers" (Brookings Institute, 2022).

Given that skill gaps might be one of the biggest barriers for individual career progress, including competitivity, participation and transitions in the labour market, developing tools to help users define skill gaps that are intelligently linked to reskilling and upskilling pathways seems like an appropriate and urgent course of action, directly linked to Action 2 in Europe's Skills Agenda, strengthening skills intelligence.

A **Skill Gap Analysis** is a procedure central to the methodological and technical specifications of the DReskill@U software, which we define below.

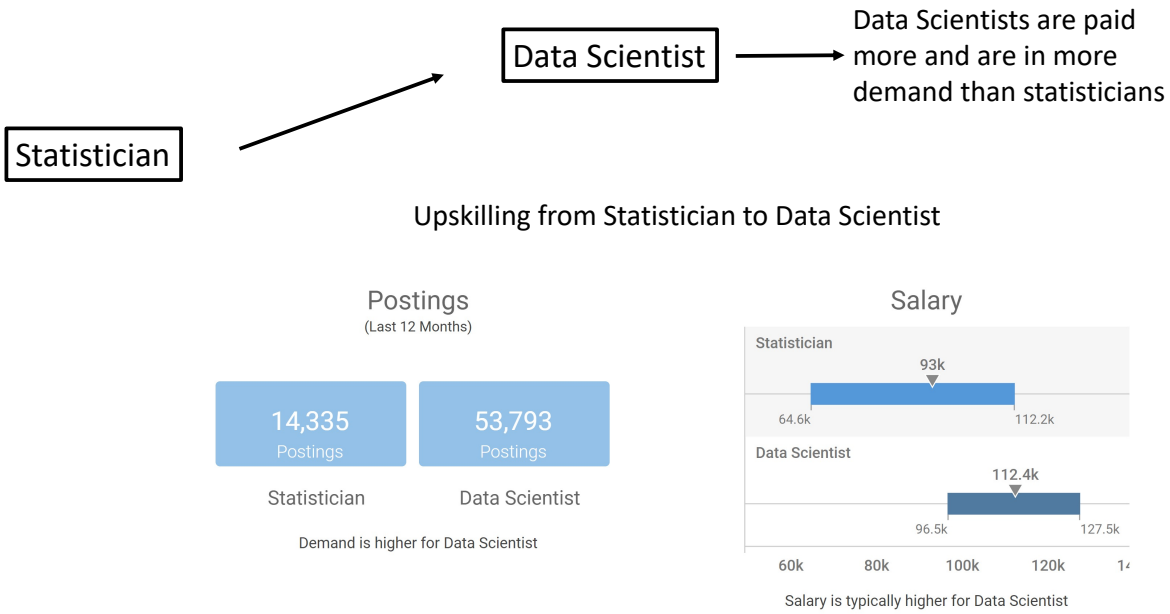
Method	Definition
Skill Gap Analysis	The disparity between a user's: **(a)** current skill profile based on (i) educational level, (ii) skill self-assessment survey and (iii) current occupation and associated skill profile AND **(b)** a desired target occupation and associated skill profile

The central goal for T1, therefore, has been to develop methodological guidelines for identifying user skill gaps, based on ESCO's skills classification within specific occupational domains (Data Science and Chemistry). Most examples of Skill Gap Analyses come from the world of work as strategies for human resources executives to maximise business potential and growth. Skill gap analyses are not commonly used in higher education and therefore we have developed a specific *use case* for career transitions in the occupation of Data Scientist, as is presented below.

i. DReskill@U use case: career transitions toward Data Science

We recognize that a skills gap analysis for lifelong learners is distinct from a skills gap analysis conducted for work teams or entire organizations. In a Higher Education context, a personalised design process for lifelong learners is required. In the current use case, considerations such as disciplinary domain and educational level, current and desired occupational domain, and, most importantly, the user's current skill proficiency level are all critical. In the DReskill@U use case, we've emphasized the need to define a user's current skill profile in a given domain. This process allows users to determine the size of their skill gap (when compared to a target occupation) to determine whether it can be bridged through short reskilling or upskilling pathways or through longer training programs in more traditional degrees.

The below image reflects the motivation and/or incentivization for an individual when pursuing an upskilling pathway between a two occupational profiles: from Statistician to Data Scientist.



The labour market data from the U.S. context, courtesy of Lightcast software (Formerly Burning Glass software), for the featured upskilling path reveals a higher demand and increased salary between the two adjacent occupations of Statistician and Data Scientist.

Continuing with this example in the current Data Science use case, and using ESCO's skills classification for Statistician and Data Scientist, we conducted a Skill Gap Analysis by analyzing the disparity between the two skill profiles, as shown in Tables 2 and 3, representing (1) skills/competencies and (2) knowledge. In this use case, the Source and Target Occupation Skill proficiency level are not rated, however we have surveyed Data Scientists working in industry (n=10) using the skill proficiency scale to rate the proficiency level needed by a job-seeker in order to fulfil the requirements for an entry-level role as a data scientist. The highest mean rating was 3.2 (Advanced) while the lowest was 1.8 (Experienced). The mean Proficiency level across all skills and knowledge was 2.5 (between Experienced and Advanced, see skill Proficiency Scale in Table 4).

Table 2 Skill gap analysis between target and source occupation, based on ESCO's skills classification

Target Occupation: Data Scientist Skills/Competencies	**Source Occupation:** Statistician Skills/Competencies	**Skills Gap**	**Industry Ready Skill Proficiency level**
apply for research funding	**manage open publications**	Deliver visual presentation of data	3,2
apply research ethics and scientific integrity principles in research activities	**manage personal professional development**	Design database scheme	2,7
communicate with a non-scientific audience	**evaluate research activities**	Interpret current data	2,7
conduct research across disciplines	**execute analytical mathematical calculations**	Report analysis results	2,7
manage findable accessible interoperable and reusable data	**perform scientific research**	Develop data processing applications	2,5
demonstrate disciplinary expertise	**apply for research funding**	Establish data processes	2,5
execute analytical mathematical calculations	**interact professionally in research and professional environments**	Handle data samples	2,5
disseminate results to the scientific community	**manage findable accessible interoperable and reusable data**	Implement data quality processes	2,4
draft scientific or academic papers and technical documentation	**manage intellectual property rights**	Use data processing techniques	2,4
manage intellectual property rights	**mentor individuals**	Normalise data	2,3
evaluate research activities	**promote inclusion in research**	Perform data cleansing	2,3
develop professional network with researchers and scientists	**operate open source software**	Manage data collection systems	2,2
manage open publications	**draft scientific or academic papers and technical documentation**	Use databases	2,1
increase the impact of science on policy and society	**apply research ethics and scientific integrity principles in research activities**	Build recommender systems	1,8
interact professionally in research and professional environments	**manage research data**	Collect ICT data	1,8
manage personal professional development	**promote open innovation in research**		
manage research data	**promote the participation of citizens in scientific and research activities**		
mentor individuals	**promote the transfer of knowledge**		
operate open source software	**publish academic research**		
perform project management	**speak different languages**		
perform scientific research	**synthesise information**		
promote inclusion in research	**think abstractly**		
promote open innovation in research	**think analytically**		
promote the participation of citizens in scientific and research activities	**write scientific publications**		
promote the transfer of knowledge	**communicate with a non-scientific audience**		
publish academic research	**conduct research across disciplines**		
speak different languages	**demonstrate disciplinary expertise**		
synthesize information	**develop professional network with researchers and scientists**		
think abstractly	**disseminate results to the scientific community**		

think analytically	**increase the impact of science on policy and society**
write scientific publications	**perform project management**
establish data processes	identify statistical patterns
handle data samples	process data
implement data quality processes	conduct quantitative research
interpret current data	apply scientific methods
normalise data	apply statistical analysis techniques
perform data cleansing	gather data
use data processing techniques	perform data analysis
use databases	
develop data processing applications	
manage data collection systems	
report analysis results	
build recommender systems	
collect ICT data	
deliver visual presentation of data	

Table 3 Skill gap analysis for essential knowledge between target and source occupation, based on ESCO's skills classification

Target Occupation: Data Scientist Knowledge	**Source Occupation:** Statistician Knowledge	**Knowledge Gap**	**Industry Ready Skill Proficiency level**
statistics	**statistics**	Visual presentation techniques	3,1
information categorization	data quality assessment	Data mining	2,8
information extraction	mathematics	Query Languages	2,7
resource description framework query language	scientific research methodology	Data Models:	2,6
visual presentation techniques	statistical analysis system software	Information Categorization	2,6
data mining		Information extraction	2,5
data models		Online analytical processing	2,3
online analytical processing		Resource description framework query language	2
query languages			

Identified skill gaps will be used to define learning pathways matched with course offerings with the smart digital course catalogue within the career guidance software.

T2: Determining skill proficiency levels of training pathways identified through Skill Gap Analysis using the application of the EQF framework (UOC)

Determining skill proficiency levels which link DReskill@U user profile to reskilling pathways is a core challenge of the project. Table 4 below presents the **Skill Proficiency Scale** which has been developed as an indispensable feature of the DReskill@U career guidance software. This scale has been adapted for precision and clarity from previous European projects, namely OpenSkimr, which aimed to match learners with in-demand skill development for career transitions and development, as well as from the National Institute of Health Competency Proficiency Scale (NIH). The scale is an instrument to rate skill proficiency levels at different qualification levels and their associated educational levels, according to the European Qualification Framework (EQF 5-8). The Skill Proficiency scale will be used as a general support for the attribution of proficiency-levels to occupational skill profiles, trainings and for the self-assessment of users current skill profile. Users will freely use the scale as a guiding tool for their attributions.

From the point of view of the software system, the Skill Proficiency Scale constitutes the basis for comparing the skills and the attributed proficiency-levels of these entities .

Table 4 D-Reskill@U Skill Proficiency Scale

D-Reskill@U Skill Proficiency Scale					
EQF Level	**N/A**	**EQF-5 <----------EQF6----------EQF7----------→EQF-8**			
Example Educational Level	N/A	**Undergraduate<----------Masters----------→Doctoral**			
Skill Proficiency Scale	No Experience/ Competence **Level 0**	**Novice Level 1**	**Experienced Level 2**	**Advanced Level 3**	**Specialized Expert Level 4**
Self-Assessment Survey Scale	N/A	User has limited skill/knowledge experience	User has some skill/knowledge autonomy, although some help may be required	User has full skill/knowledge autonomy, and is capable of coaching others	User is a recognized authority

The D-Reskill@U skill proficiency scale will be used by the three core users (Learners, Teachers, Industry Partners) of the D-Reskill@U system as a quantitative specification for 3 interrelated annotations[2].

(1) Student skill proficiency level rating → used to rate student self-assessment surveys for creating user skill profiles

(2) Learning outcomes skill proficiency level rating → used by participating teachers in the DReskill@U project to rate at what proficiency level course learning outcomes (i.e. skills/competencies) will be taught to, based on ESCO's classification.

Learning outcomes skill proficiency level ratings will link course learning outcomes to three interrelated annotations as depicted in Table 5.

(a) Learning outcome skill proficiency levels (Level 1-4)
(b) Prerequisite skill proficiency levels (Level 1-4)
(c) Qualification level (i.e. depth of learning) (EQF levels 5-8)
(d) Volume of learning (i.e. commitment/effort required) = ECTS (>1<6)

Table 5 Example of Teacher Skill Proficiency Level Rating in the Smart Digital Course Catalogue

Learning Outcomes	**Skill Descriptors**	**Skill Proficiency Level**	**Qualification Level**	**ECTS Rating**

[2] Annotation is a term used in computer programming to refer to documentation and comments that may be found on code logic. Annotation is used by programmers of **DReskill@U** as an explanation of the rationale behind the code logic or even an explanation of how the logic accomplishes its purpose or goal. Thus, an annotation, or explanation, will be included within the code.

Build recommender systems	Construct recommendation systems based on large data sets using programming languages or computer tools to create a subclass of information filtering system that seeks to predict the rating or preference a user gives to an item.	**Level 2** Experienced	**EQF 7** (Masters)	**2 ECTS** (50 hours of coursework)
Collect ICT data	Gather data by designing and applying search and sampling methods.	**Level 3** Advanced		
Deliver visual presentation of data	Create visual representations of data such as charts or diagrams for easier understanding.	**Level 3** Advanced		
Design database scheme	Draft a database scheme by following the Relational Database Management System (RDBMS) rules in order to create a logically arranged group of objects such as tables, columns and processes.	**Level 2** Experienced		
Develop data processing applications	Create a customised software for processing data by selecting and using the appropriate computer programming language in order for an ICT system to produce demanded output based on expected input.	**Level 2** Experienced		

(3) Industry partners skill proficiency level rating → used to rate job-ready skill proficiency levels for a specific professional occupation. Ratings will be collected from experienced industry specialists. Industry skill proficiency ratings will help determine if ESCO skill pillars for specific occupations effectively cover job-ready skill sets, or if there are certain skills missing from ESCO's database, which can then be extended

i. Linking DReskill@U to the Overarching Framework of Qualifications of the EHEA

In order to **determine skill proficiency levels through the application of the EQF framework,** we have identified the connection between EQF, ECTS and different levels of education, learning, or training, as presented in Table 6. The table reflects the most recent European policy and practice developments, including the most recommendations on a *European Approach to Microcrednetialing for Lifelong Learning and Employability (2022)*, with a particular emphasis on the emerging Micro-credentials ecosystem.

Table 6 Connecting EQF with ECTS through the QF-EHEA levels can be presented now as follows from micro to masters degrees: Overarching Framework of Qualifications of the European Higher Education Area (revised 2018)

Educational Level	EQF Level	ECTS Equivalent
Micro-learning Unit	EQF Level 5-8	<1 ECTS
Micro-credential course	EQF Level 5-8	1 to 3 ECTS
Micro-credential program	EQF Level 5-8	4 ECTS or more (typically 20-40 ECTS)
Foundation Degree (Short-cycle qualifications)	EQF Level 5	120 ECTS
Bachelor Degree (First-cycle qualifications)	EQF Level 6	180 or 240 ECTS
Master's Degree (Second-cycle qualifications)	EQF Level 7	90 or 120 ECTS

This annotation scheme will provide specifications for the appropriate design of the smart digital course catalogue. It can be used to integrate the offer of micro-credentials at the institutional, regional, national, European or International level into the smart digital course catalogue, which presents the available trainings and for sorting the course catalogue using different filters: «occupational field/sector», «time length-ECTS» «Mastery of Skill=EQF» and «skills»

T3: Designing the digital course catalogue for training pathways (SU)

i. Introduction: Approach at SU

We recall the goals of the PR1.T3 work package as defined in the initial proposal:

PR1.T3: Designing the digital course catalogue for training pathways:

- Define guidelines for creating a course catalogue of lifelong learning (LLL) offers of our partner universities (possibly using available training pathways).
- Include critical information and requirements that can be sorted using several filters: «field/sector», «time length» and «skills».
- Develop a mapping of skills that each training will provide the learner with. The table uses:
    - ESCO ontologies
    - an industry-ready proficiency level

The methodology adopted at Sorbonne Université was to gather together a group of professors and assistant professors from various backgrounds in chemistry (6-8 persons) and Francesco Bullini from "Bullini Entreprise" (computer Scientist/ software Engineer) in charge of creating the "smart catalogue" (PR1.T3) and the mockup of the digital orientation tool (PR2). Decisions were made based on majority votes.

We decided to adopt an experimental approach based on a practical case of upskilling in the field of chemistry, considering occupations already defined in the European ESCO base. The ESCO ontology was chosen after examining other skill and knowledge definitions in a particular French base. The latter one, used to define job posting in the universities would have appeared initially more topical and precise concerning the "upskilling experiment", but it may be far from the general market place occupations (too related to research objectives) and lacking the inter-european dimension. This decision to use ESCO ontologies was based on consensus among the team, and was aimed to avoid possible "biases''. Nevertheless, the ESCO base may lack precision or be lacunary. This point will be addressed later on.

ii. Industry ready annotation of occupation

Industry experts will be able to annotate occupations (or "job" in the future) with skills and knowledge proficiency levels, with the common agreed scale (1-4). The so-called industry-ready scale will be used in the skill and skill-gap analysis. The 1-to-4 scale was validated by UOC in terms of adequacy with the European Qualification Framework (EQF). After several online meetings we agreed on the rating used by and adapted from the Openskimr project. This allows us to find equivalences with the EQF scale (please see table 4, T2 paragraph).

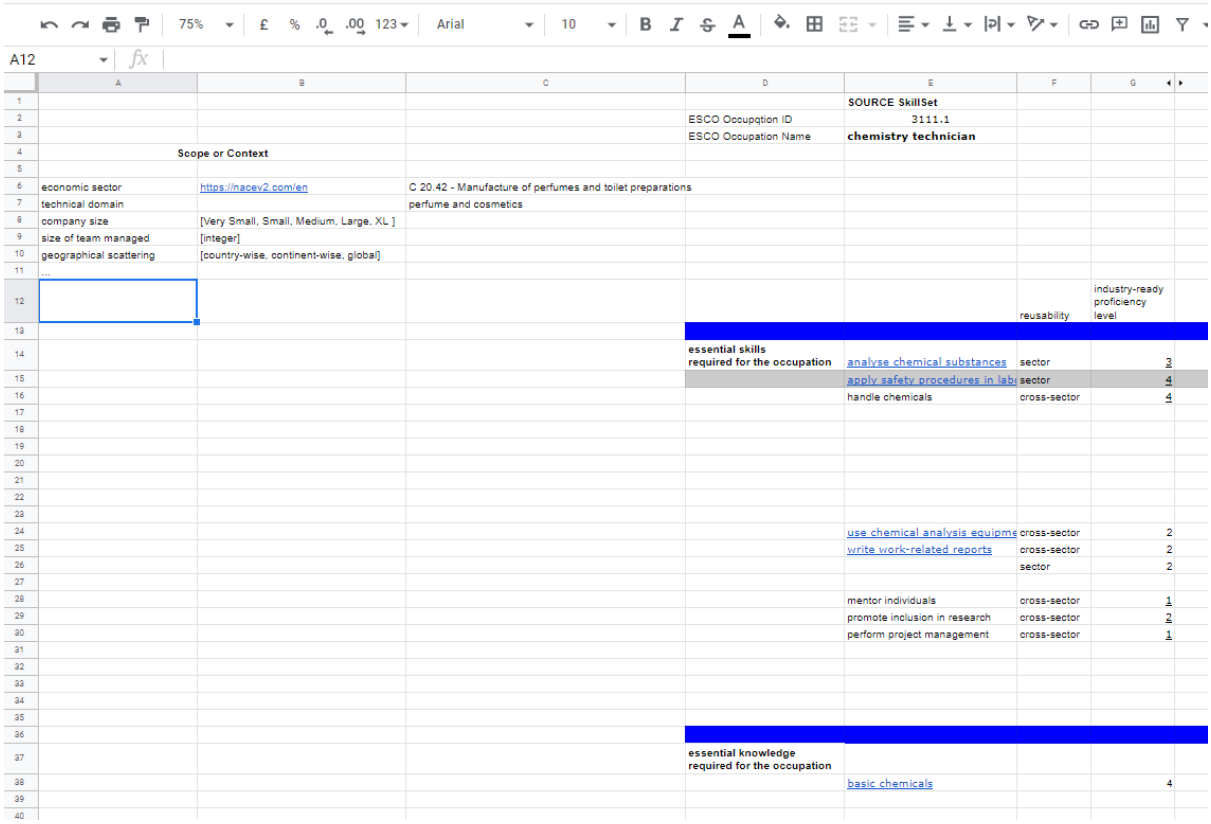
Contextualization (taking into account the context of the company where the occupation will take place)

In order to refine the proficiency assignment, the context of the occupation must be made more explicit (e. g. communication and language skills may be different in a small size business and in a worldwide corporate):

As an example, we can consider these following components:

- Economic sector of the company (according to last NACE[3] standard)
- Specific domain of application (This part is still open to discussion and more feedback and concrete examples from the group are required.)
- Size of the company
- Size of the managed team …
- Hierarchy level
- Reach (country-wise, continent-wise, global)
- Others…

Table 7: Example of considering the context in the attribution of proficiency level to an occupation



1					SOURCE SkillSet		
2				ESCO Occupqtion ID	3111.1		
3				ESCO Occupation Name	**chemistry technician**		
4		**Scope or Context**					
5							
6	economic sector	https://nacev2.com/en	C 20.42 - Manufacture of perfumes and toilet preparations				
7	technical domain		perfume and cosmetics				
8	company size	[Very Small, Small, Medium, Large, XL]					
9	size of team managed	[integer]					
10	geographical scattering	[country-wise, continent-wise, global]					
11	...						
12						reusability	industry-ready proficiency level
13							
14				**essential skills required for the occupation**	analyse chemical substances	sector	3
15					apply safety procedures in lab	sector	4
16					handle chemicals	cross-sector	4
17							
18							
19							
20							
21							
22							
23							
24					use chemical analysis equipme	cross-sector	2
25					write work-related reports	cross-sector	2
26						sector	2
27							
28					mentor individuals	cross-sector	1
29					promote inclusion in research	cross-sector	2
30					perform project management	cross-sector	1
31							
32							
33							
34							
35							
36							
37				**essential knowledge required for the occupation**			
38					basic chemicals		4
39							
40							

iii. Defining the Skill Gap

Experimental choice

To measure a skill gap between two occupations, we consider a source and target. To make the exercise simpler for the SU team, the source was **Chemistry Technician** (ESCO ID 3111.1) and the target was **Analytical Chemist** (ESCO ID 2113.1.1). This is a typical case of upskilling frequently

[3] https://nacev2.com/en

encountered in the industry, corresponding to a transition from a “bachelor” level (high school +2/3) to a “master level” (high school + 5) or higher (PhD).

The SU team produced an EXCEL table with several columns. For “chemistry technician” and “analytical chemist” we created two columns collecting “essential or optional skills/knowledge” provided by the ESCO base. Each skill or knowledge (e. g. “handle chemicals”) was assigned an “industry-ready proficiency level” defined on a scale from 1 to 4, as discussed before. Considering that the aim of the project is the design of a smart catalogue/orientation software, the industry-ready proficiency level was determined after a debate among SU professors, with no input from industry experts yet. The scale, and the measured skill-gaps seemed reasonable and sufficient for the exercise. Naturally the software will allow industry experts to rate industry-ready skill proficiency levels that will be contextualized according to § 2.2 (à revoir Table 4 dans T2 + &ii T3).

Figure 1. The Skill-gap EXCEL Table (without considering the context)

Report_Examples

Fichier Édition Affichage Insertion Format Données Outils Extensions Aide Dernière modification il y a quelques secondes

	Chemistry Technician				Analytical Chemist			Skill gap	
7	essential skills required for the occupation	analyse chemical substances	sector	3	analyse chemical substances	sector	4	analyse chemical substances	1
8		apply safety procedures in lab	sector	4	apply safety procedures in laboratory	sector	4	apply safety procedures in laboratory	0
9		handle chemicals	cross-sector	4	handle chemicals	cross-sector	4	handle chemicals	0
10					apply statistical analysis techniques	cross-sector	4	apply statistical analysis techniques	4
11					apply scientific methods	cross-sector	4	apply scientific methods	4
12					execute analytical mathematical calculations	cross-sector	4	execute analytical mathematical calculations	4
13					perform scientific research	cross-sector	3	perform scientific research	3
14					perform laboratory tests	cross-sector	4	perform laboratory tests	4
15					use chemical analysis equipment	cross-sector	4	use chemical analysis equipment	4
16					identify purpose of analysis	cross-sector	4	identify purpose of analysis	4
17		use chemical analysis equipme	cross-sector	2	use chemical analysis equipment	cross-sector	4	use chemical analysis equipment	2
18		write work-related reports	cross-sector	2	write work-related reports	cross-sector	4	write work-related reports	2
19			sector	2	analyse experimental laboratory data	sector	4	analyse experimental laboratory data	2
20					**develop scientific research protocols**	cross-sector	4	**develop scientific research protocols**	4
21		mentor individuals	cross-sector	1	mentor individuals	cross-sector	3	mentor individuals	2
22		promote inclusion in research	cross-sector	2	promote inclusion in research	cross-sector	3	promote inclusion in research	1
23		perform project management	cross-sector	1	perform project management	cross-sector	3	perform project management	2
24					disseminate results to the scientific community	cross-sector	3	disseminate results to the scientific community	3
25					publish academic research	cross-sector	2	publish academic research	2
26					manage personal professional development	cross-sector	3	manage personal professional development	3
27					think abstractly	cross-sector	3	think abstractly	3
28					think analytically	transversal	3	think analytically	3
29									
30	essential knowledge required for the occupation								
31		basic chemicals		4	basic chemicals	cross-sector	4	basic chemicals	0
32					analytical chemistry	cross-sector	4	analytical chemistry	4
33					chemical processes	sector	4	chemical processes	4

The original Skill-Gap EXCEL Table can be retrieved from the Google Sheet:

https://docs.google.com/spreadsheets/d/1NrHSlV2U8gIfwoSVngmCE6YKZeZb94FnYX4jZSIsI7M/edit#gid=1926157102

under Tab: Job_and_Skill-Gap_Example

The same exercise can be carried out on different job occupations.

iv. Building a “smart catalogue of offers”

1. Preliminary

Discussion among SU experts led to the conclusion that the digital smart catalogue and orientation tool would be a success among trainers offering potential courses only if the methodology underlying the software would enable them to:

- project in a seamless way already existing courses (LLL or traditional) in terms of the ESCO ontology;
- give them the possibility of defining themselves skills/knowledges absent in the ESCO database according to ESCO guidelines, that will be incorporated in the software itself;
- use the ESCO concepts like skill and knowledge as a feedback loop to modify/upgrade their classes or imagine entirely new courses coping better with the targeted occupations and the *overlap* of skills and knowledge provided by different courses.

2. The smart Catalogue Entry Table

In order to create a catalogue a training offer must explicitly show general information on the different courses being offered, including the skills and knowledge addressed by the course.

1) General information about the course,
    a) title, link to the website, provider etc.
    b) Volume (ECTS), hours, qualification levels, Microcredentials, etc.

    Entries for point 1) have been taken, as discussed during the various Sprint meetings from the Australian document "National Microcredentials Framework".[4] These entries can be further refined/discussed. The question of Microcredentials is essential (a training can be full-fledged Microcredential) but a LLL session can be not (yet) aligned with the Microcredential framework.[5] As a guideline we tentatively propose the following Table:

Table 8. Tentative Microcredential reference table.

	EQF Level		ECTS		Duration [hours] 1 ECTS = 25 H		Duration [hours] 1 ECTS = 30 H
micro-credentials	Min	Max	Min	Max	Min	Max	
LLL unit	5	8	0	0,9	0	22,5	
LLL course	5	8	1	3	25	75	
LLL program	5	8	4	40	100	1000	

[4] https://www.education.gov.au/higher-education-publications/resources/national-microcredentials-framework

[5] We recall that at SU a typical M2 level Unité d'Enseignement (learning Unit) is 6 ECTS (60 ECTS are needed per year). The prerequisite and learning outcomes are exposed in the syllabus.

Foundation Degree (Short-Cycle Qualification) 2 years	5	5	120	120	3000	3000
Bachelor Degree (First-Cycle Qualification) 3 years	6	6	180	180	4500	4500
Master Degree (Second-Cycle Qualification) 2 years	7	7	120	120	3000	3000

---

2) Information in terms of skill and knowledge provided by the course
    a) Prerequisites in terms of skills and knowledge needed to attend the course. The 1-to-4 scale should be used in harmony with the 1-to-4 scale of the industry ready proficiency level
    b) Learning outcomes in terms of skills and knowledge provided by the course to the learner, at the end of the training. Again the 1-to-4 scale is used.

    Entries for point 2) must be chosen by the teachers from the ESCO skills and knowledge. If more skills and knowledge are needed teachers can add new items they define themselves. Importantly, the 1-to-4 scale is not limited to industry-ready proficiency.

    It is of paramount importance to note that:

- **the proficiency levels of a skill and knowledge required to perform in an occupation (or job);**
- **the proficiency levels of a skill or knowledge - prerequisites and learning outcomes - of a training/course (given by teachers/trainers);**
- **the proficiency levels of the skills and knowledge self-assessed by the learner himself in the survey;**

    are all based on a common 1-to-4 scale, as the one agreed by all participants to the project, (see details in the related paragraph of this document). In fact, the system has to compare these elements (occupations, training and user skill profile) using the related skills and knowledge.

In order to provide concrete examples, this information can be included in one EXCEL table. In particular, adding more than one training (i.e. adding more columns), will make explicit the overlaps between the proposed training and skills and knowledge.

https://docs.google.com/spreadsheets/d/1NrHSlV2U8gIfwoSVngmCE6YKZeZb94FnYX4jZSIsI7M/edit#gid=0

Tab: CatalogOfTranings

Figure 2: Template related of the first group of information (the mandatory information) of a training.

GENERAL INFORMATIONS of a training	
Link to website	http://www....
Title	The Training Title
Provider	Name of University or Institution
Content Description	...
Delivery Mode (mainly in-person, online, hybrid)	...
Language	...
Duration [h]	...
ECTS ("equivalent"/portables entre universités e.g. Erasmus; measure of volume)	...
EQF (depth/quality)	...
Micro credential: Unit/Course/Program ...	...
Micro Creditial RELEASED "OPENBADGE"	...
Country	...
Learning Provider	...
Learner Effort	...
i. Number of hours of in-person face-to-face contact with teaching staff.	...
ii. Number of hours of synchronous online contact with teaching staff.	...
iv. Estimated number of hours of asynchronous online content and readi	...
v. Estimated number of hours spent on assessment.	...
Inherent Requirements	...
Price and Financial Assistance	...
Assessment	...
Certification	...
Credit/ Other Recognition	...
Quality Assurance (EU standards?)	...
Prerequisites	...
ESCO related Occupations	...

Figure 3: Information of a training described in terms of skill and knowledge (pre-requisites and learning outcome)

		skill or knowldege	IN ESCO/ NOT IN ESCO	proficiency level of each skill and knowledge **of a training**
		String	boolean	integer
		[skill | knowldege]	[true|false]	[0 | 1-4]
Prerequisites (in terms of SKILLs and KNOWLEDGE)				
	skill-X	skill	TRUE	2
	skill-F	skill	FALSE	1
	knowledge-Y	knowledge	TRUE	3
	knowledge-F	knowledge	FALSE	2
LEARNING OUTCOMES (in terms of SKILLs and KNOWLEDGE)				
Essential Skills				
	skill1	skill	TRUE	0
	skill2	skill	TRUE	1
Essential knowledge				
	knoledge1	knowledge	TRUE	2
	knowldge2	knowledge	TRUE	1
Optional Skill				
	opt-skill1	skill	TRUE	2
Optional Knowledge				
	opt-knowldge1	knowledge	TRUE	1

Template of the 2 subgroups of information of a training, expressed in terms of skills and knowledge. In this template, the last column represents a training offer, the lines represent the skill and the knowledge provided by the training to the learner. The cells of the last column on the right represent the proficiency levels provided by the training for each individual skill and knowledge of the training. In red, skills and knowledge actually provided by the course but missing from the ESCO database.

3. The mass spectrometry example

LLL courses are already available at our universities. As a working example, we took two existing offers in the field of mass spectrometry. These can be introductory (level 1) or more advanced courses (level 2) made over 2 or 3 days, with both “theory” and “practical” included (typically 14 hours). (for 1 ECTS = 25 hours, it is typically 0.5 ECTS). Mass spectrometry is inescapable in the training of an analytical chemist, and it exists in the ESCO base as “the analytical technique that makes use of the measurements performed at gas-phase ions and the ratio mass-to-charge”. It follows the hierarchy: knowledge >natural sciences> mathematics and statistics>physical sciences>physics>mass spectrometry. It is declared as optional for a chemical technician, but is absent in the optional skills/competences and knowledge of the targeted analytical chemist, while chromatography is!

	IN ESCO/ NOT IN ESCO	skill/kw	Industry Ready skill proficiency level for **Analitycal Chemist**	LA SPECTROMÉTRIE DE MASSE COMME OUTIL ANALYTIQUE **Lev1**	LA SPECTROMÉTRIE DE MASSE COMME OUTIL ANALYTIQUE **Lev2**
use chromatography software	Available	skill	3	0	2
gas chromatography	Available	kw	3	0	3
apply liquid chromatography	Available	skill	3	0	3
gel permeation chromatography	Available	kw	2	0	0
high-performance liquid chromatography	Available	kw	2	0	3
laboratory techniques	Available	kw	3	1	3
conduct soil sample tests	Available	skill	3	1	3
mass spectrometry (fundamental principles)	Available	kw	4	3	4
prepare chemical samples	Available	skill	2	1	3
ionization methods	N/A	kw	3	3	4
vibrationnal spectroscopies (RAMAN, Infra Red..) (fundamental principles	N/A	kw	3	0	0
apply vibrational spectroscopies methods	N/A	skill	3		
nuclear magnetic resonance	N/A	kw	2	0	0
UV-Visible spectroscopy	N/A	kw	3	0	0
XPS	N/A	kw	2	0	0
Photo luminescence	N/A	kw	2	0	0
solid NMR	N/A	kw	3	0	0
X-rays diffraction	N/A	kw	2	0	0
x-rays photo electron spectroscopy	N/A	kw	2	0	0
electronic microscopies	N/A	kw	2	0	0

Figure #: This figure shows in the same table, a column with the proficiency levels required of a specific occupation (should be filled by industry experts) and two columns with the proficiency levels of skills and knowledge provided by trainings (should be filled by teachers).

The industry-ready skill proficiency for Analytical Chemist has been chosen only by the sake of didactical explanation of the feature. The skills in red are not present in the ESCO base.

The column lists all the skills/competences and knowledge our SU team deems necessary to train an analytical chemist. Among these skills some are already in the ESCO base (ESCO primitive skills). Many other competences are not listed in ESCO, and have been added by the experts. The “salmon column” indicates the proficiency levels, as they could be envisaged in the industry and in university (two columns) with levels between 1 and 4. This matrix allows one to determine how a given class (spectrometry) contributes to the skills/competences and knowledge that are needed to train an analytical chemist. The same can be done for any other class.

Therefore, by adding their classes and projecting them on the “bases” of ESCO and NON ESCO (ESCO-like) ontologies, the software is able to determine whether an ESCO occupation can be completed by different LLL classes in SU, or in any network of European universities. More work must be done

1) to give a better description of how the software will help the faculty to determine what classes should be proposed to fulfil the requirements of a given occupation
2) to specify which actor(s)/role(s) will be able to use these functionality(-ies)?
3) to better consider the role of the local university in the software.[6]

[6] Until now we did everything without explicitly taking into consideration the subdomain (specialisation) of a university. The university name appears only in a training offer, with the role of training provider.

V. Enhancing the ESCO database.

Some questions were raised after a zoom contact with ESCO:

There are domains which are well covered (chromatography)

Mass spectrometry (unescapable to the SU team) is a cited skill (for chemistry technician!) but highly incomplete

There are many “missing skills” in ESCO to qualify an analytical chemist (e.g. infrared spectroscopy, and other techniques like NMR):

- ESCO seems unbalanced (chromatography is overemphasized with respect to “mass spectrometry”, NMR or vibrational spectroscopies
- The issue of complex skills. For instance, “analyze chemical substances” is a typical complex skill, ESCO seems to have no way to represent how a complex skill is composed of elementary/simple skills

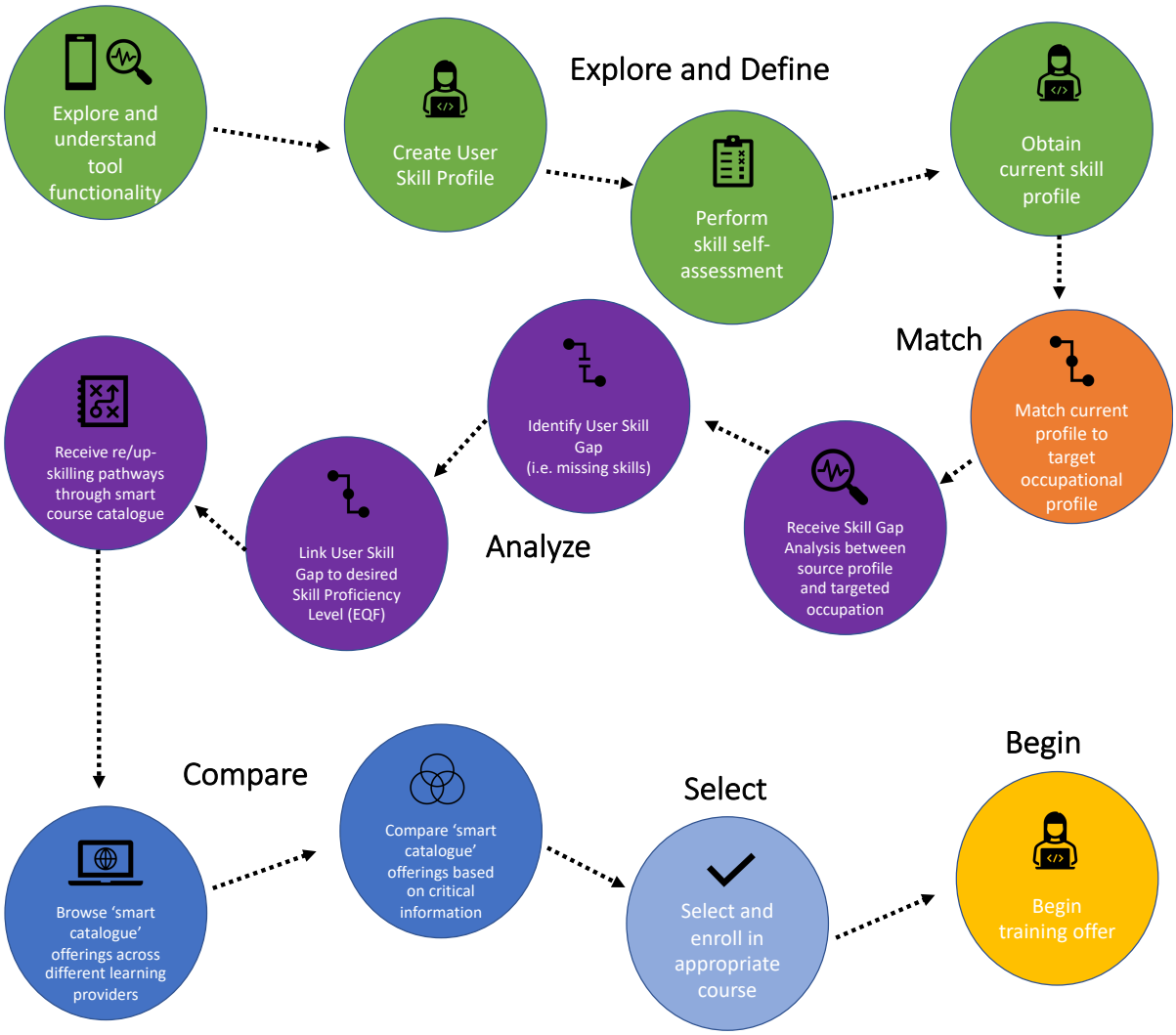
Independently of the present status of the ESCO database and its lacunary aspects, the SU experts consider that skills and knowledge that are lacking must be added.

The team contacted an ESCO officer who sent us an EXCEL table. We filled the cells in the case of infrared/Raman spectroscopy, a spectroscopy that is deemed necessary for any analytical chemist.

5. User Centered Design

A User Experience Approach

In line with the goal of PR1 to create a set of guidelines for mapping career guidance to upskilling and reskilling pathways using a Skills Gap Analysis, we have followed a user-centered design approach. Thus, we have incorporated some generative user-experience research techniques, including a User Experience mapping technique. This was done to visualize the steps that a learner goes through in order to accomplish the overall goal of using the D-Reskill@U tool for receiving virtual career guidance by identifying new learning pathways based on ESCO-compatible occupations using a skill gap analysis.


Explore and understand tool functionality
Create User Skill Profile
Explore and Define
Perform skill self-assessment
Obtain current skill profile
Match
Match current profile to target occupational profile
Receive Skill Gap Analysis between source profile and targeted occupation
Identify User Skill Gap (i.e. missing skills)
Analyze
Link User Skill Gap to desired Skill Proficiency Level (EQF)
Receive re/up-skilling pathways through smart course catalogue
Compare
Browse 'smart catalogue' offerings across different learning providers
Compare 'smart catalogue' offerings based on critical information
Select
Select and enroll in appropriate course
Begin
Begin training offer

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