Mapping of tacit knowledge elements and critical skills to qualification definitions/matrixes

Intellectual Output 3

Author: Pietro Olson-Binelli (NTI-MMM)

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Author	Pietro Olson-Binelli (NTI-MMM)
Contributor	Michala Brokešová (SPSCH), Radek Matuška (SPSCH), Leif Erik Erikssøn (NTI-MMM)
Reviewer	Rolf Aslaksrud Kristiansen (EUROMASC)
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Introduction

The goal of IO3 was to conduct a mapping of “tacit knowledge elements” and “critical skills” and how to best incorporate them from the qualification matrix to the educational resources. This process was initially divided into five steps:

1. Step 3-1: Structuring the critical skills activities according to the qualification matrix.
2. Step 3-2: Structuring the tacit knowledge activities according to the qualification matrix.
3. Step 3-3: Adding the structured activities to the qualification matrix in Skillsbank (EN-version) as an extension of the defined learning outcomes and indicating the learning scenarios and the operational context in the workplace.
4. Step 3-4: Collect the translated language versions from the partners for uploading in Skillsbank.
5. Step 3-5: Documentation of the extended qualification matrix and progress report.

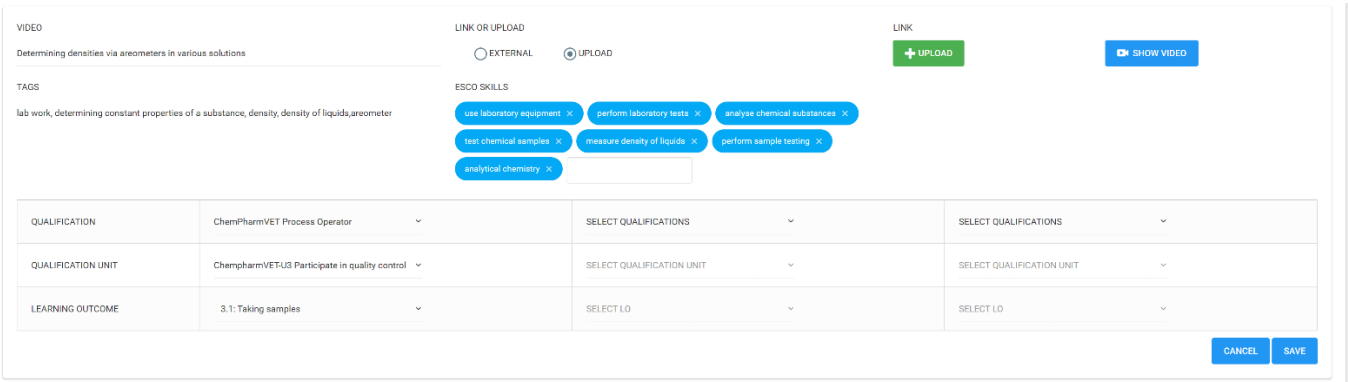
Steps 3-1 + 3-2

While this work was initially divided into two separate steps, it was quickly realised that it would be easier to combine the work into one step. This was because of the close connection between the learning outcomes defined as “tacit knowledge” and “critical skills”. The first step of this work was a thorough analysis was done of all the learning outcomes in the qualification matrices. The relevant learning outcomes were then, after careful deliberation, sorted. The main category was “tacit knowledge”, with two sub-categories: Common Competences (CC) and Specific Competences (SC). The Critical Skills (CS) made up a further sub-category within Specific Competences. This resulted in the structure attached as annex 1. This allowed us as a partnership to get a proper overview of all the relevant learning outcomes.

One of the main goals of the project was to create best practice videos, so the natural next step became how to sort these learning outcomes into video themes. After another longer discussion among the partners, a set of video titles were chosen. As one can see from annex 2, some videos cover the same learning outcomes. This is because different procedures will necessarily contain some of the same processes or steps. However, the totality of the videos would, according to our analysis, cover all of the learning outcomes.

Step 3-3

In Skillsbank the videos were uploaded and linked to the learning outcome(s). For easier retrieval and search, each video was tagged with keywords, given a short description and tagged with the ESCO skills terms.



Step 3-4

After the first three steps, all of the learning outcomes used in this project were translated into the relevant partner languages: Norwegian, German, Italian, Slovenian, Portuguese and Slovak. All of these translations were then uploaded to Skillsbank, to strengthen the multilingual option of this database.

Step 3-5

The last step of this IO was to present the extended matrix with the main categories of “tacit knowledge”, including the two sub-categories: Common Competences (CC) and Specific Competences (SC). The Critical Skills (CS) made up a further sub-category within Specific Competences. To document the work process of the IO was not a particularly easy process, as the work was mostly done through discussions in-person, via e-mail and through virtual meetings. The actual results are mostly as Excel files, or shown as results in other IOs. However, this document shows the most important steps in reaching our results. The most important aspect of IO3 is that is works as a foundation for the rest of the project. That means that while there are fewer tangible results, the project as such would not have been possible without the work put into IO3. The whole structure of videos (a total of 93 videos) would not have been possible. The same goes for the translations of learning outcomes. In any case, this document functions as both a report of the work done, and as a template for how such work can be done in the future.

Annex 1: Sorting of learning outcomes

Tacit knowledge		
Common Competences	**Specific Competences**	**Critical Skills**
	1.1.3: Production planning Competence: Is able to coordinate his/her own work schedule with the schedule of a team Knowledge: Understand the planning of introduction of new products Skills: Read and understand the plan of production schedules in relation to customer demand Understand /compare the required specification for supplies and products Liaise with suppliers to ensure supplier has adequate back up of stock levels Consult others where necessary (colleagues, supervisor)	
	1.2.2: Process control Competence: Is able to autonomously instruct a team on all necessary work steps needed to provide raw material of the right quality Knowledge: Explain process diagrams and planning charts (P&ID) Explain working instructions Skills: Maintain accurate records and documentation of the procedures Manage hazards in the production process Report deviations correctly and inform the involved	

	departments, colleagues and/or customers Deal cost- consciously with materials and products Optimise work processes through open communication with operators, maintenance team members, contractor team members, management, suppliers and customers (internal and/or external)	
2.1.1.2: Equipment <u>Competence:</u> Take responsibility for the correct installation of the equipment used by the team <u>Knowledge:</u> Name equipment that is needed to conduct the process Explain the operation mode of the respective equipment <u>Skills:</u> Clarify equipment parts and describe their function correctly	**2.1.1.2 Equipment** <u>Competence:</u> Take responsibility for the correct installation of the equipment used by the team <u>Knowledge:</u> Name equipment that is needed to conduct the process Explain the operation mode of the respective equipment <u>Skills:</u> Clarify equipment parts and describe their function correctly	
2.1: Process preparation <u>Competence:</u> Autonomously execute all steps of the adapted work plan/ task schedule <u>Knowledge:</u> Outline fundamental basics of production planning (including process optimization, work safety, quality management and GMP) <u>Skills:</u> Evaluate the task schedule/work plan according to the current situation of the plant	**2.1.1.3 Equipment setup** <u>Competence:</u> Take responsibility for the correct installation of the equipment used by his team <u>Knowledge:</u> Describe the equipment set up correctly <u>Skills:</u> Install the respective equipment correctly	**2.1.1.3: Equipment setup** <u>Competence:</u> Take responsibility for the correct installation of the equipment used by his team <u>Knowledge:</u> Describe the equipment set up correctly <u>Skills:</u> Install the respective equipment correctly
	2.1.2 Instrumentation and control <u>Competence:</u>	

	Assume responsibility for fellow workers and their safety during the processing <u>Knowledge:</u> Describe fundamentals of process control and instrumentation technologies Explain the operation mode of scales <u>Skills:</u> Recognize the hazard potential of the process	
	2.1.2.2 Instrumentation diagrams <u>Competence:</u> Take responsibility for the proper presentation and documentation of piping and instrumentation diagrams <u>Knowledge:</u> Identify symbols and their meaning in a piping and instrumentation diagram Name rules concerning the compilation of a piping and instrumentation diagram Identify points of measurement in a given piping and instrumentation diagram Name regulations on marking E/I & C technology in a piping and instrumentation diagram <u>Skills:</u> Read the piping and instrumentation diagram Compile an instrumentation and piping diagram abiding by the used standards into a given matrix Marks points of measurement in a piping and instrumentation diagram abiding the used standards Enter standardized points of measurement into a piping and instrumentation diagram correctly	

	2.1.3 Equipment operation Competence: Execute specific operational needs according to the process that is to be conducted Knowledge: Describe the setup of the equipment Have knowledge of the operation mode and set up of the equipment Relate specific operational needs that have to be kept in mind when preparing the equipment Skills: Handle equipment correctly Instruct the team on the correct preparation of the equipment	**2.1.3: Equipment operation** Competence: Execute specific operational needs according to the process that is to be conducted Knowledge: Describe the setup of the equipment Have knowledge of the operation mode and set up of the equipment Relate specific operational needs that have to be kept in mind when preparing the equipment Skills: Handle equipment correctly Instruct the team on the correct preparation of the equipment
	2.1.4 Software Competence: Take responsibility for the processes and the operating software systems Knowledge: Describe processes and explain operating software systems Skills: Describe and explain processes and their visualization on the screen	
	2.1.5 Procedures Competence: Executes and controls respective process preparation autonomously and verifies quality and safety of the process Knowledge: Relate standard operating procedures (sop) Skills: Work accurately and precisely	
	2.2.1.2 Starting production	

	Competence: Autonomously decide on ramifications to start and stop the process safely Knowledge: Identify basic operations and basic functions of the software Identify specific conditions of the start process according to current situation Skills: Instruct fellow workers on the ramifications Use correct materials and hardware according to situation Assume responsibility for his and his colleagues' safety Handle machinery manually (and via screen) according to process specifications	
	2.2.1.3 Closing down Competence: Take responsibility for the closing and the required documentation Knowledge: Explain the operation mode of the equipment and know how to shut it down appropriately Skills: Write an appropriate protocol containing all results	
	2.2.2.1 Purification and contamination Competence: Take responsibility for the correct and accurate purification of products and the resulting quality Knowledge:	

	Explain how to safely transfer and add raw material into the equipment Explain how and why to purify/ finish the product Name possible by-products and contaminants of specific reactions <u>Skills:</u> Handle chemicals and equipment according to safety regulations Instruct his team on the correct handling of chemicals Transfer/ add the raw material into the equipment correctly, taking specific safety regulations into account Purify/ finish the product correctly Instruct team on how to purify the products correctly	
	2.2.3.2 Experimental setups <u>Competence:</u> Autonomously determine the ideal parameters for the experiment Take safety regulations into account and instruct team on the respective parameters <u>Knowledge:</u> Describe experimental setups that are to be tested Explain the influence of experiment specific factors on the experimental process <u>Skills:</u> Adjust experiment specific parameters Take safety measures into account Evaluate the respective data and compile a characteristic curve in form of a graph using calculation software	
	2.3.3.3 Test series in process control	

	Competence: Autonomously use methods for process control Knowledge: Define the respective values and means of their determination correctly Explain the use of the values in quality control Explain mode of operation of e/i & c technology Specify the importance of test series at the set value and explain how to conduct it Explain how to evaluate data by help of reference data Skills: Determine the respective value correctly Operate the laboratory techniques correctly Check the e/i & c technology correctly and evaluate their functioning Conduct test series at the set value as to determine the state of parameter settings Compile trend graphs of respective values and evaluate them keeping in mind the optimal parameter setting	
	3.1.2.1: Sampling and offloading of samples from equipment Competence: Autonomously take samples from the process correctly Knowledge: Have knowledge of the kind of samples taken Skills: Take samples correctly	
	3.1.3: Implementation of sampling Competence:	

	Manage the sampling process <u>Knowledge:</u> Identify possibilities for taking samples suitable for the respective equipment and tested materials <u>Skills:</u> Explain methods for sample preparation taking and storing of samples Take responsibility for abiding safety regulations Prepare samples and sampling devices as well as pay attention to specifics of the equipment and safety regulations	
	3.1.3: Implementation of sampling <u>Competence:</u> Manage the sampling process <u>Knowledge:</u> Identify possibilities for taking samples suitable for the respective equipment and tested materials <u>Skills:</u> Explain methods for sample preparation taking and storing of samples Take responsibility for abiding safety regulations Prepare samples and sampling devices as well as pay attention to specifics of the equipment and safety regulations	
	3.1: Taking samples <u>Competence:</u> Is able to perform sampling according to quality and safety prescriptions <u>Knowledge:</u> Knows the methods and principles of sampling	

	according to internal and external requirements Skills: Apply the methods and prescriptions of sampling according to quality and safety prescriptions Explain methods for sample preparation, taking and storage	
3.2.1: Procedure and process Competence: Autonomously execute analyses and supervise the working process Knowledge: Describe methods of analysis for determining parameters Skills: Execute analysis at production process level Autonomously execute task Take responsibility for the evaluation of the results Evaluate results of the analyses	**3.2.1: Procedure and process** Competence: Autonomously execute analyses and supervise the working process Knowledge: Describe methods of analysis for determining parameters Skills: Execute analysis at production process level Autonomously execute task Take responsibility for the evaluation of the results Evaluate results of the analyses	
	3.2.3: Result Competence: Take responsibility for the documentation of results Knowledge: Describe results of analyses Determine the results of the analysis Skills: Present and evaluate results of an analysis Report on the results and the respective conclusions Take responsibility for passing on information	
	3.2: Sample analysis Competence: Organise and manage the sample analysis Know the plant	

	internal guidelines for analysis of samples <u>Knowledge:</u> Identify chemical, physical and/or microbiological parameters that are needed for quality assessment according to guidelines <u>Skills:</u> Supervise the working process	
4.3.1: Specific conditions <u>Competence:</u> Perform and monitor minor repair and maintenance work according audited procedures on mechanical, electrical and instrument field <u>Knowledge:</u> Understand the principles of electricity in relation to safety Understand and explain the working principles of equipment (like pumps, valves, measure & control equipment, seals, piping). Recognise unsafe or critical situations and explain appropriate measures <u>Skills:</u> Monitor the use of reliable equipment and working methods during maintenance work Organise and use tools, machinery, equipment, chemicals and energy for doing proper and safe maintenance work Support and cooperate with maintenance personnel		

Annex 2: Video clips and corresponding learning outcomes

Content of videoclip	**CC/SC/CS**	**Learning outcome**
Determining densities via areometers in various solutions	CC	3.2.1: Procedure and process
Determining densities of solids via pycnometer	CC	3.2.1: Procedure and process
Bacteriological examination of water in the technical centre	CC	3.2.1: Procedure and process
Changing a flanged valve	CC	4.3.1: Specific conditions
Taking samples from vessels with Bürkle MiniSampler	SC	3.1.2.1: Sampling and offloading of samples from equipment
Commissioning practice of the Ultra Centrifugal Mill ZM200	SC	2.1.1.2 Equipment
Commissioning of the twin-screw extruder Brabender TSE20 x 40D	CS	2.1.1.3 Equipment setup
Starting process of the semi-technical distillation DN 80	CS	2.1.1.3 Equipment setup
Low pressure in DP-cell	SC	2.1.1.2 Equipment
Air trapped in centrifugal pump	SC	2.1.1.2 Equipment
Pressure release for maintenance	SC	2.1.2 Instrumentation and control
Pressure release for start-up and shutdown of the plant	SC	2.1.2 Instrumentation and control
DB&B of valves and pumps	SC	2.1.2 Instrumentation and control
Use and understand of P&ID	SC	2.1.2.2 Instrumentation diagrams
Use and understand of P&ID legend	SC	2.1.2.2 Instrumentation diagrams
Use and understand of PFD	SC	2.1.2.2 Instrumentation diagrams
Use and understand of block form	SC	2.1.2.2 Instrumentation diagrams
How to communicate with other operator	SC	2.1.4 Software
How to orientate on the screen	SC	2.1.4 Software
Understand the process medium	SC	2.1.4 Software
Understand what comes in and out of the plant	SC	2.1.4 Software
Understand the main components of the plant	SC	2.1.4 Software
Understand physical and chemical changes	SC	2.1.4 Software
Understand the regulation and regulatory principles	SC	2.1.4 Software
Understand alarms levels, security systems and interlocking systems	SC	2.1.4 Software

Understand C&E	SC	2.1.4 Software
How to communicate with other operator	SC	2.2.1.2 Starting production
How to communicate with other operator	SC	2.2.1.3 Closing down
Filtration at atmospheric pressure	SC	2.1.1.3 Equipment setup
Filtration at reduced pressure	SC	2.1.1.3 Equipment setup
Proper handling of centrifuge	SC	2.1.3 Equipment operation
Determination of boiling point by capillary method	SC	2.1.3 Equipment operation
Determination of density by pycnometer	SC	2.1.3 Equipment operation
Determination of refractive index using refractometer	SC	2.1.3 Equipment operation
General skills for volumetric analysis	CC	2.1 Process preparation
Examples of volumetric assays	SC	2.3.3.3 Test series in process control
Volumetric measurements	SC	2.1.3 Equipment operation
Acidimetric titration	SC	2.1.5 Procedures
Iodometric titration	SC	2.1.5 Procedures
Preparation of solution of solid in liquid with approximate composition	SC	2.1.5 Procedures
Preparation of solution of two liquids with approximate composition	SC	2.1.5 Procedures
Preparation of solution of solid in liquid with exact composition	SC	2.1.5 Procedures
Preparation of solution of two liquids with exact composition	SC	2.1.5 Procedures
Simple synthesis with fast run in a beaker - precipitation	SC	2.1.5 Procedures
Organic single-dose reactant synthesis	SC	2.1.5 Procedures
Working with rotary vacuum evaporator	SC	2.1.3 Equipment operation
Candles in a container - how to make a proper choice for a suitable wick	SC	1.1.3: Production planning
Candles in a container - how to prepare a wick for a candle	SC	1.2.2: Process control
Candles in a container - how to place a wick in a candle	SC	1.2.2: Process control
Candles in a container - how to straighten a wick in a candle.	SC	1.2.2: Process control
Candles in a containers- weighing anti-cracking component	CC	Process preparation
Candles in a containers - addition of anti-cracking and mixing components	CC	Procedure and process

Candles in a containers - weighing of perfume and dispersant	CC	Process preparation
Candles in a containers- addition of perfume and dispersant in the mixture of melted wax and mixing	CC	Procedure and process
Fat liquering agents - how to prepare samples of leather	SC	3.1: Taking samples
Fat liquering agents - how to set up necessary equipment (barrel)	SC	3.1.3: Implementation of sampling
Fat liquering agents - how to prepare test solution	SC	3.2: Sample analysis
Fat liquering agents - how to carry out the test on samples	SC	3.2.1: Procedure and process
Fat liquering agents - how to evaluate the result	SC	3.2.3: Result
Weighing (laboratory balance vs. analytical balance)	CS	2.1.3 Equipment operation
Preparation of solutions in a volumetric flask	SC	2.1.5 Procedures
Heating in water / oil bath	SC	2.2.3.2 Experimental setups
Checking the bath temperature	SC	2.2.3.2 Experimental setups
Heating with magnetic stirrer	SC	2.2.3.2 Experimental setups
Stirring with magnetic stirrer	SC	2.2.3.2 Experimental setups
Setting up a reaction apparatus with a paddle-wheel stirrer	SC	2.2.3.2 Experimental setups
Drying in a desiccator	SC	2.2.2.1 Purification and contamination
Drying liquid products of organic synthesis	SC	2.2.2.1 Purification and contamination
Drying gases	SC	2.2.2.1 Purification and contamination
Working with a pressure bottle (gas withdrawal)	SC	2.1.5 Procedures
Working with cryogenic liquids and solid matters (dry ice, liquid nitrogen)	SC	2.1.5 Procedures
Simple filtration	SC	2.2.3.2 Experimental setups
Low-pressure filtration (glass filter / Büchner funnel)	SC	2.2.3.2 Experimental setups
Decantation	SC	2.2.3.2 Experimental setups
Recrystallization (complex)	SC	2.1.5 Procedures
Working with a rotary evaporator	SC	2.1.3 Equipment operation
Simple distillation (complex)	SC	2.1.5 Procedures
Low pressure distillation (complex)	SC	2.1.5 Procedures
Liquid-liquid phase extraction	SC	2.1.5 Procedures
Setting up an apparatus for a Soxhlet extraction (percolation)	SC	2.2.3.2 Experimental setups
Determination of the melting point	SC	3.2.1: Procedure and process
Determination of the boiling point	SC	3.2.1: Procedure and process
Measurement of the refractive index	SC	3.2.1: Procedure and process

Thin layer chromatography	SC	3.2.1: Procedure and process
Preparation of a sample for GC/LC	SC	3.1.3: Implementation of sampling
Mineralization of a sample (complex)	SC	2.1.5 Procedures
Dismantle the valve	CC	2.1.1.2 Equipment
Repack the valve	CC	2.1.1.2 Equipment
Mount the valve	CC	2.1.1.2 Equipment
Change of drum at the vacuum distillation with Anschütz-Thiele adapter	CS	2.1.1.3 Equipment setup

Annex 3: Excel file with all video clips titles, learning outcomes and learning outcome descriptions.

See attached file: “ChemTube Video and learning outcome overview IO3”