COMPETENCE MATRIX IN PROFESSIONAL DEVELOPMENT OF WELDING TEACHERS/TRAINERS

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Abstract

Rapid and dynamic changes in technology in this digital era require teachers/trainers to guide their trainees to learn how to cope and reply to those changes. This relies on a paradigm shift in Education and Training, one that allows them to be facilitators of the learning process. Teachers/trainers must be able to understand their trainees, learn to communicate using their language and style and be familiar with their needs and behaviours, which includes the acquisition of new skills/competences and knowledge.

WELDONE (funded by Erasmus+ programme) partners identified the skills and knowledge to be addressed by the Competence Units that comprise the Training of Trainers curriculum developed in the scope of the project by using a specific tool of the Learning Outcomes approach – the Competence Matrix.

This paper will present the importance of the Competence Matrices developed by each WELDONE partner in the identification of skills and knowledge that are addressed by the Learning Outcomes of each Competence Unit, as well as their respective subject matters, towards the professional development of teachers/trainers from EWF Qualification System and STEM Educators in terms of using new pedagogical approaches and methodologies for a new and better learning system, and for the development of key and vocational competencies that are already needed globally in the labour market, especially in the fields of Welding and STEM.

Keywords: Welding, Competence Matrix, Learning Outcomes, Education of Welders, Teacher, Trainer, Trainee, VET, STEM, Paradigm Shift

1. Introduction

Innovation, globalisation and rapid technological changes, and more recently the global pandemic that accelerated the digital transition, have been posing challenges to education and training systems. Thus, their flexibility and high quality level are crucial to ensure that learners (both youngsters and adults) have an effective learning experience that allows them to develop the required skills and competences for successful integration (or progression) in the labour markets, in all industrial ecosystems across Europe.

Teachers and trainers play an important role in achieving these goals. The Bruges Communiqué (2010)[1] considered them "as key agents for high quality initial and continuous" Vocational Education and Training (VET), hence the relevance of ensuring teachers and trainers have access to continuous professional development to acquire the needed competences to implement new education and training curricula, implement innovative pedagogical approaches and training tools, deal with an increasing heterogeneity of learners, apply new technologies to training and apply common European transparency tools and contribute to tackle emerging needs such as the ones imposed by COVID-19, in line with European policies and strategies.

EU launched the European Skills Agenda (2020)[2], a new strategy comprised of a number of building blocks and key actions to promote cooperation between different stakeholders towards a paradigm-shift on skills to cope with the current challenges the European Union (EU) is facing (e.g. twin green and digital transitions). The key actions refer, among other relevant issues, the need to train teachers and trainers and the need to encourage cross-disciplinary and innovative teaching and learning approaches in schools, VET and Higher Education.

In light of these circumstances, *WELDONE – Boosting Innovation in Welding* Training project, funded by Erasmus+ programme, acquired an additional relevance towards achieving the above-mentioned purposes. Launched in 2019 (i.e. previous to the global pandemic), it supports the creation of a Training of Trainers (ToT) curriculum aimed to capacitate teachers and trainers from EWF Qualification System and educators from Science, Technology, Engineering and Mathematics (STEM) fields to deliver technical training using innovative pedagogical approaches and embedding the development of key competences in technical training, as part of their professional development.

The course is rooted in a modular approach, meaning that it is comprised of Competence Units (CUs) organised in Learning Outcomes (LOs), written in terms of skills and knowledge to be developed by participants. Each CU addresses the use of innovative pedagogical approaches such as Problem-Based Learning (PBL) and digital resources, social media and specific games in learning. In addition, key and transversal competences such as entrepreneurship have

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[1] Source https://www.cedefop.europa.eu/en/content/bruges-communique
[2] Source https://ec.europa.eu/social/main.jsp?langId=en&catId=1223&moreDocuments=yes

dedicated CUs in the course. The purpose is that, by successfully accomplishing the ToT course, teachers and trainers are able to use those innovative pedagogical approaches with their own learners, improving their learning experience and the acquisition of relevant skills and competences for a smoother and successful transition into the labour market.

To structure each CU, WELDONE partners used a Competence Matrix as baseline to write the respective Learning Outcomes in terms of skills and knowledge, aligned with specific European Qualifications Framework (EQF) levels. The process of designing the CUs of the ToT course using this tool, connected to the Learning Outcomes approach, is described moreover.

2. Learning Outcomes Approach

Traditional methods of training placed teachers/trainers in the center of the learning process. The approach used was content-based, providing information on the aims and matters the teacher/trainer intended to teach in a specific teaching block. Thus, the training was organised in terms of general and specific objectives and delivered taking in consideration the contents to be taught to learners, who had a passive role in the learning process.

However, with time, there was the need to redesign learning procedures, strategies, environments and approaches to match a new paradigm not so much focused on the contents to teach, but on the outcomes of the learning process, on what the learners would be able to know and do at the end of the learning process. This approach places learners at the center of the learning process, with an active role to play, whilst teachers/trainers guide them through that process.

The Learning Outcomes approach is aligned with current education and training policies and practices. It was indeed a shift in the way training is provided, improving the quality of education and training systems and increasing relevance of training courses and Qualifications, as well as their transparency and recognition, across the European Union (EU).

According to Cedefop (2014)[3], Learning Outcomes (LOs) are "statements of what a learner knows, understands and is able to do on completion of a learning process [either formal, non-formal or informal], which are defined in terms of knowledge, skills and competence". LOs and the way they are written are crucial for the definition of training and learning methods and activities, learning environments and assessment practices, not to mention their impact on the definition of qualifications framework (which define and classify qualifications according to specific criteria).

Writing LOs is not an easy task to perform as they can be written in many different ways. They must promote transparency and clarify the intentions of the learning

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[3] Cedefop (2014). *Terminology of European education and training policy*. Luxembourg: Publications Office of the European Union

process. Thus, there are specific rules that must be followed to ensure these relevant aspects are covered.

According to Cedefop (2017)[4], there is a set of rules of thumb that must be complied with when writing LO statements. Some of those rules are:

- When writing LOs, the learner must always be at the center, irrespectively of their purpose and level of detail;
- LOs should reflect the particular context being addressed, evolving based on an iterative process that involves all stakeholders/team members;
- There is a difference between intended LOs (statements of intentions and expectations) and achieved LOs (which can only be identified following the learning process, through assessment and demonstration);
- LOs must be "fit-to-purpose", hence the difference of detail when they are written for National/European Qualification Frameworks, programme description, curriculum or assessment standard.

Moreover, each LO statement must combine an action verb (connected to Bloom's Taxonomy, used to stimulate a more comprehensive approach to education, more specifically its cognitive dimension of learning), with an object and scope (connected to the depth of the LO statement) and context. LO statements must also be written in a way that they can be assessed, which is aligned with the identification of achieved LOs previously mentioned.

These criteria are articulated along a vertical dimension (i.e. level and complexity of learning, connected to the EQF level descriptor to which the CU or Qualification addresses) and a horizontal dimension (i.e. learning domains in terms of knowledge and skills).

Figure 1 Basic structure of LOs statements (Cedefop, 2017) illustrates the basic structure of LO statements following these criteria, as referred to by Cedefop[5]:

The basic structure of learning outcomes statements…			
… should address the learner.	… should use an action verb to signal the level of learning expected.	… should indicate the object and scope (the depth and breadth) of the expected learning.	… should clarify the occupational and/or social context in which the qualification is relevant.
Examples			
The student…	…is expected to present …	…in writing the results of the risk analysis	….allowing others to follow the process replicate the results.
The learner…	…is expected to distinguish between…	…the environmental effects…	…of cooling gases used in refrigeration systems.

Figure 1 Basic structure of LOs statements (Cedefop, 2017)

WELDONE partners were reminded of these and other relevant rules and criteria in order to start writing the LOs for each CU that comprise the ToT curriculum, which led to the next step of WELDONE project: the use of Competence Matrices by partners for designing the CUs.

3. The Competence Matrix and its relevance for the professional development of teachers and trainers from EWF Qualification System and STEM educators

3.1 Teachers' and Trainers' profile and expected previous levels of expertise

It is important to mention that, to fill in the Competence Matrix related to each CU, WELDONE partners had in consideration the role of teachers and trainers as facilitators of learning. They stimulate the creation of new behaviour and, as such, they must be able to adapt to the heterogeneity of learners, be innovative, creative and diverse.

Moreover, depending on the countries of the partnership, teachers and trainers have specific qualifications to conduct training, meaning that, to design the CUs, partners also considered the possibility that these teachers and trainers already have a certain level of skills and knowledge in some of the matters addressed by some of the CUs of the curriculum. Thus, each CU addresses a specific EQF level (4 or 5, depending on the scope of the CU), not as entry requirement, but as expected level of expertise teachers and trainers enrolled in the CU/ToT course will acquire at the end of the learning process/course.

Table 1 List of CUs of WELDONE ToT Curriculum and the EQF levels addressed by each CU

ToT Curriculum CUs	EQF level addressed by the CU
CU 1 – Multiple intelligences and learning styles	EQF 4
CU2 – Learner Centred didactics: Problem based learning, Critical thinking and Collaborative learning	EQF 5
CU3 – Gamification	EQF 5
CU4 – Digital competences and using digital resources	EQF 4
CU5 – New media didactics: the use of social media and micro-learning	EQF 5
CU6 – Personal, social and learning competences	EQF 4
CU7 – Entrepreneurship competence	EQF 4

As explained moreover, there is a connection between the EQF level's descriptors and the process of writing the CU's Learning Outcomes. Hence, it is important to know the respective descriptors of the EQF levels addressed by the ToT curriculum Competence Units:

Table 2 Descriptors[6] of EQF level 4 and EQF level 5 considered for designing the ToT curriculum CUs

EQF Level	Knowledge	Skills	Responsibility and Autonomy
The learning outcomes relevant to **Level 4** are:	Factual and theoretical knowledge in broad contexts within a field of work or study	A range of cognitive and practical skills required to generate solutions to specific problems in a field of work or study	Exercise self-management within the guidelines of work or study contexts that are usually predictable, but are subject to change; supervise the routine work of others, taking some responsibility for the evaluation and improvement of work or study activities
The learning outcomes relevant to **Level 5** are:	Comprehensive, specialised, 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

3.2 The role of the Competence Matrix for designing the ToT curriculum CUs

The process of designing and developing the CUs of the ToT curriculum started with the use of a common tool: the Competence Matrix. This tool was crucial to organise the LOs to be addressed by the respective CUs and to write the LO statements, in line with the specific rules and criteria previously mentioned, and to organise their respective contents towards their development.

A Competence Matrix template was prepared with specific fields to be filled in by the partner responsible for designing and developing a given CU.

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[6] Source https://europa.eu/europass/en/description-eight-eqf-levels

Competence Matrix	Name of the CU		
SUBJECT TITLE (S)			
…			
…			
…			
	CONTACT HOURS (Total)	…	
	WORKLOAD	…	
LEARNING OUTCOMES **(name of the CU)**			
KNOWLEDGE	(Descriptor of the EQF level addressed by the CU/Qualification) • (…) • (…)		
SKILLS	• (…) • (…)		

Figure 2 Competence Matrix template used by WELDONE partners to write LOs for the CUs that comprise the ToT curriculum

The field referring to Subject title(s) (i.e., topic(s)/content(s) of the CU), is connected to the Knowledge defined in the LOs' field of the template. The level of knowledge is directly connected to the descriptor of the EQF level addressed by the CU, as illustrated in the following tables:

Table 3 Alignment between each "knowledge" to be acquired by learners, aligned with the EQF level 4 descriptor (EQF level 4 CU)

LEARNING OUTCOMES **(name of the CU)**	
KNOWLEDGE	*Factual and theoretical knowledge of the principles and applicability of:* • (…) • (…)

Table 4 Alignment between each "knowledge" to be acquired by learners, aligned with EQF level 5 descriptors (EQF level 5 CU)

LEARNING OUTCOMES (name of the CU)	
KNOWLEDGE	***Specialized factual and theoretical knowledge of the principles and applicability** of*: • (…) • (…)

Each <u>Skill</u> is written in accordance with the rule set for LO statements, i.e., action verb (connected to Bloom's Taxonomy cognitive dimension), object and scope of the LO (depth), followed by the context.

Table 5 Example of a LO statement aligned with the rules for writing LOs

Develop assessment strategies using gamification to assess the learning outcomes achieved by learners		
Action verb	**Object and scope of the LO**	**Context**

Also, as previously explained, each LO statement must be written in a way it can be assessed. In this case, what will be assessed is the ability of the trainee (i.e. teacher or trainer enrolled in the ToT course/CU) to develop assessment strategies using gamification, and for that a specific training activity and assessment tool must be developed, hence the connection between the LOs, the training environment/activities and assessment methods and criteria.

In addition to the fields dedicated to the Learning Outcomes (knowledge and skills) and to Subject Title(s), the Competence Matrix also has a specific field for:

a. Contact hours: total number of hours needed to implement the CU in terms of theoretical and practical training in classroom context;
b. Workload: An estimation of the time learners typically need to achieve the defined learning outcomes. It covers theoretical training and self-study, as well as the time devoted to practical training and examination.
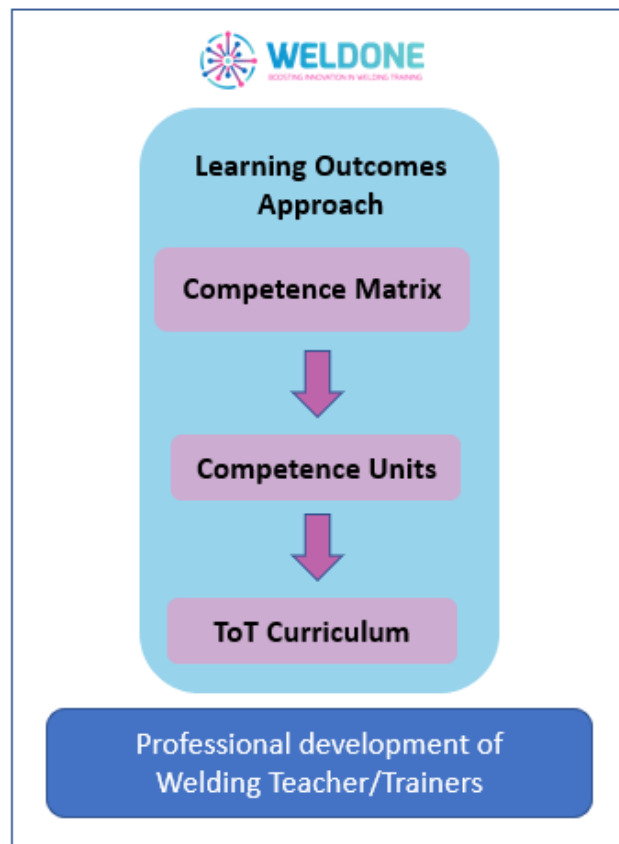
4. Conclusion

WELDONE project approach to the professional development of teachers and trainers from EWF Qualification System and educators from STEM fields is based on the Learning Outcomes approach in which the learner is at the center of the training activities, playing an active role in its learning process.

In the case of WELDONE ToT curriculum, to be implemented through a series of Workshop sessions, the learners are the teachers/trainers/educators who, by enrolling in the ToT course, will be capacitated to use with their own learners the innovative pedagogical approaches addressed by the CUs that comprise the ToT curriculum.

In order to design and develop each CU, WELDONE partners used a Competence Matrix that assisted them to write LO statements in line with a specific set of rules and criteria, to define the topics of each CU, based on those LOs, and set the duration of training in terms of contact hours and workload, expected to be required to implement the CU. Thus, the Competence Matrix is an important tool to use for designing training courses/qualifications as it is a useful resource for the development of the contents of the CUs, or modules of learning, part of those courses/qualifications.

In the case of WELDONE ToT curriculum, it was crucial to develop each CU, hence its connection to the professional development of teachers and trainers from EWF Qualification System and educators from STEM fields.

Table 6 The Competence Matrix in the process of achieving WELDONE ToT Curriculum for the professional development of Welding Teachers/Trainers

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