

Development of Competence Maps for Training Programs Based on the European Frameworks e-CF and ESCO

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Abstract—This work aims to develop a system capable of aligning different Information and Communication Technology (ICT) training programs (degrees, masters, courses, etc.) with the main European competence frameworks that are beginning to be implemented in Europe and the rest of the world. This alignment will be carried out through competence maps, which directly relate the contents taught in each training program with the competences included in the European standards.

Keywords- training; competence; European; framework.

I. INTRODUCTION

It is a fact that today's education systems must be modernized to ensure that young people have the right skills and are prepared for the jobs of the digital economy. Employers need access to more accurate and up-to-date information on skills and qualifications to better manage their workforce, and employment services should incorporate digital technologies to more efficiently assign job-seekers with job vacancies and improve their job opportunities. This is particularly important in a context of digital skills gaps, which are both a barrier to people's employment opportunities and a risk to economic growth. Despite the high levels of unemployment in Europe, especially among young people, 40% of employers do not find people with the right skills to fill their vacancies [1]. Guaranteeing a fair labor market and allowing citizens to adapt to the changes of an increasingly digital world are key priorities of the European Commission (EC), as established in the European Pillar of Social Rights [2].

European frameworks based on competences have been conceived as a tool to help mutual understanding and to provide a common language to articulate the competences required and acquired by ICT professionals. Through this semantic interoperability, an attempt is made to alleviate the communication gap that exists between different countries and between different sectors of employment, education and training. Transparency in these areas is also enhanced by agreeing on the definition of work profiles, qualifications, skills or abilities, and learning outcomes.

The e-Competence Framework (e-CF) [3], described in European standard EN16234-1:2016, and the European

Skills, Competences, Qualifications and Occupations (ESCO) [4] have been primarily discussed and from their study and the analysis of their possible convergences, the competences maps of each training program have been developed. It is important to point out that the European job classification ESCO, which was published in 2017, will be a mandatory reference for public employment services of the member states of the European Union (EU) in 2020, establishing a multi-language reference terminology reflecting the realities of both the labor market as well as the education and training sector.

In parallel, and given the need to adapt curricula, job offers, candidate profiles, etc., to the European competence frameworks, a training course on these standards has also been developed by the authors to make these frameworks known in the field of education as well as in the labor market. The training program shows the practical aspects of e-CF and ESCO through concrete examples in which its use can be seen in real cases. The audience to which this course is addressed would be formed by:

- ICT professionals who wish to assess and visualize their skills / abilities, identify their possible learning paths, or improve their ICT knowledge and correct their deficiencies.
- Managers and human resources departments involved in the administration of human resources.
- Organizations that provide ICT services, ICT users and ICT providers.
- Educational institutions and training organizations, including higher education, interested in promoting courses that are linked to digital skills and ICT work profiles.
- Certification providers, interested in certifying the digital skills of ICT professionals.
- Social agents, professional entities and accreditation bodies.
- Market analysts and regulators.
- Other organizations and stakeholders from the public and private sectors.

The paper is organized as follows. Section II describes the related work. Section III lists the benefits of the maps and finally, the concluding remarks are included in Section IV.

II. RELATED WORK

The authors have previously worked with the e-CF and ESCO standards in the European projects e-Skills Match [5]-[7] and e-CF Council [8]. The first was co-financed by the European Commission (EC) (The Directorate-General for Communications Networks, Content and Technology (DG CONNECT)) under the pilot program "Open Knowledge Technologies: Mapping and Validating Knowledge" related to the H2020 program [9]. The project began in September 2015, lasted 24 months and had a total budget of 1,112,787 euros. Among the project participants were partners from four European countries: Sweden, Italy, Spain and Greece. The objective of the project was to create a system for learning digital professional and user skills with dynamic adaptation to changes in job classification systems as part of the European Area of Skills and Qualifications (EASQ). The platform developed in the e-Skills Match project allows the self-assessment of competencies for specific positions, the connection with training modules that allow acquiring the skills of a given position and a qualification system for each competence. The system takes as reference the European models e-CF, ESCO and the European digital competence framework also known as DIGCOMP [10]. Regarding the e-CF Council project, included in the Erasmus + Skills Alliance program [11], it started in 2015 and had a funding of 871,000 euros. The members of the consortium, which was financed by the EC until 2018, were organizations that represent the reference groups in ICT professionalism in four member states of the EU: Italy, Spain, Bulgaria and the Netherlands. In addition, the e-CF Council had central associations recognized by the EU, such as Digital Europe, European Digital Small and Medium-sized Enterprises Alliance, e-Skills Association, etc. This project aimed to create an alliance of management of qualifications and certifications based on the e-CF standard to promote the professionalism of ICT at a European and international level. Its objective was to increase employability in order to reduce the gap of ICT competences in Europe by developing unified programs and certifications of professional training in ICT. On the other hand, since January 2018 the authors have been working on the European project "Support services for the development of version 4.0 of the e-Competence Framework", which lasts two years. The objective of this project is the development of the new version of the e-CF standard to update it and adapt it to the new changes introduced in the ICT sector.

In addition, European authorities continue to promote projects similar to those mentioned above due to the high unemployment rates among young people and the growing employability in the ICT sector in Europe. One of these initiatives has been "Grand Coalition for Digital Jobs" [12], which was launched on March 4, 2013 in Brussels. The theme of the conference was "e-Skills and Education for Digital Jobs" and its main objective was to facilitate the adoption of measures to improve digital capabilities in the EU countries. The objectives of the EU for the period 2014-2020 are the promotion of the professionalization of ICT and the generation of a greater group of talents of entrepreneurs,

business leaders, managers and advanced users focused on the strategic use of new technologies of the information and communication. The EC is aware of the need to develop initiatives to ensure sufficient supply of adequately qualified ICT professionals and the need to encourage the younger population to pursue careers related to ICT. This fact is not unique to Europe, since the shortage of ICT vocations has also been identified in the United States and other developed countries. A report funded by the EC [13] estimates that up to 756,000 job vacancies by 2020 will not be filled due to the lack of qualified ICT professionals. This estimation, together with previous analyzes, has led the EU to launch specific initiatives related to eSkills and digital competences ("eSkills for Jobs", "Digital Agenda for Europe", "ICT Certification in Europe", "e-Leadership Digital Skills" for SMEs ", etc.) to help more people get jobs related to ICT throughout Europe.

On the other hand, the current analysis has shown that the level of interoperability of professional Web portals in Europe is very low. Although there is coverage for the development of e-Skills and professional support, individual portals provide only partial information. Users have to change from one service to another to find an integrated path for their professional development.

As it can be seen, the dynamics of the labor market both nationally and internationally depend entirely on the good communication of information related to profiles, skills, competences and knowledge. In the EU, having 24 official languages, everything points to the fact that common terminology should be used to guarantee the exchange of information between job-seekers and employers. However, despite local and global efforts, many stakeholders (job-seekers, employers, employment services, employment portals, educational institutions and training centers) do not know the European frameworks and standards and do not recognize them when they are asked about them. For this reason, we conducted a survey of 97 experts to analyze the perception of e-CF and other European initiatives. Surprisingly, more than half thought they lacked information and 77% admitted not knowing any curriculum mapped with e-CF or with ESCO. The survey also found that there are important differences between supply and demand in certain areas, such as software (30.3%), management (29.2%), cybersecurity (15.7%) or cloud computing (14.6%). These gaps give an idea of the need to apply the standards both in the field of training to detect those competences on which the new training courses should be based and also so that candidates who have a certain profile can self-assess their competences and verify if they meet the requirements of a certain job.

Although e-CF was confirmed as a European standard by the European Committee for Standardization in 2016, the Council of European Professional Informatics Societies (CEPIS) identified that there was a lack of information provided to employers and other potential users of e-CF. The promotion, provision of information and employment assistance to understand how e-CF can be used is a need that has not been identified either by the EC or by the European Standards Organization. As an organization whose mission is to improve and promote a high level among information and

technology professionals in recognition of the impact that information technology has on employment, business and society, CEPIS also advocates that e-CF should be established progressively in member states to promote the professionalization of ICT in Europe.

The present work aims to contribute to supply the deficiencies mentioned above through the implementation of competence maps of training courses that try to link the academic world with the labor world. This union constitutes a novel approach never before treated and represents the first step for a pioneering attempt to publicize European standards and adapt them definitively to the Spanish educational system.

III. BENEFITS OF THE MAPS

Considering the previous contributions to the scope of the present work, its innovative effect could be broken down into the following points:

- Understand the basic characteristics of the main European competence frameworks to subsequently be able to identify their relationship with the labor market and with the field of education.

- Provide a common European language for the ICT job market in terms of competences, skills and proficiency levels required by professionals in the sector. In this way, all stakeholders could have a common shared reference.

- Help to define:

- Jobs, offers and hiring needs, and other competence specifications.
- Training courses, qualifications, certifications and higher education programs.
- Career plans and professional development needs.
- Plans for formal and non-formal education.
- Analysis of competence improvements and training needs at an individual or global level.

- Allow mobility through the European job mobility service, improving the transparency and comparability of qualifications across Europe, as differences between the education systems of member states make it difficult for employers to identify the skills and qualifications that a person has obtained in another EU country.

- Help the training centers by describing the learning outcomes, as these are defined in terms of knowledge, skills and competences. This shared terminology facilitates dialogue between the labor market and stakeholders through different sectors and borders. In addition, it allows to understand the development of emerging skills in an international context, and to be able to communicate in the same language as employers:

- Employers will verify the suitability of a candidate for a job based on their qualifications.
- Educational systems will be able to obtain feedback on the needs of the labor market, identify skills gaps and adapt their qualifications accordingly to meet employment needs.

- Improve the efficiency of human resources departments, providing a connection between jobs, skills and qualifications:

- The competences can be used to describe jobs, competence specifications and descriptions of professional development needs.
- Competence levels can be used to provide detailed profile specifications.
- The competences are related to jobs, which allows to focus efficiently on the selection of personnel, hiring, and collaborations.
- It makes it possible to measure the skills deficit and the short and long-term planning, to evaluate and budget the educational and training needs of the staff.

- Help employers to:

- Understand the knowledge, skills and competencies that people have to obtain through education, training or work experience.
- Express what they expect from their employees with knowledge, skills, competences and qualifications.
- Find the right person for a job.

- Help job seekers to:

- Understand what employers need.
- Understand how they can develop their careers through lifelong learning.
- Describe their knowledge, skills and competences in order to find the right job.
- Self-evaluate to know what competencies have been acquired and which have not.

- Help employment services to:

- Provide better online services to their users by improving the mapping of job seekers with jobs.
- Communicate with their users in several languages.
- Partner with other service providers and exchange information with them, to strengthen cooperation between public and private employment services, as well as training centers.

Table I shows an example of a competence map. The training course that has been analyzed is called “Master in software engineering for the Web”. It is offered by the University of Alcalá (Spain) and its duration is one year. The 80% of the course can be studied online. According to the table, the e-CF competences covered with the course are listed together with their correspondent proficiency level (from 1 to 5). If the competences from the ICT profiles are considered, we can see that the certificate covers different competences with different levels. Finally, the related ESCO occupations are also included at the bottom of the map. Note that sometimes the names of the e-CF job profiles are different from the names of the ESCO occupations.

TABLE I. EXAMPLE OF COMPETENCE MAP.

Competence covered with this certificate		Competence from the ICT Profiles			
e-CF competency	Level	SYSTEMS ANALYST	DIGITAL MEDIA SPECIALIST	DEVELOPER	SYSTEM ARCHITECT
A.5. Architecture Design	4	3			4
A.6. Technology Trend Monitoring	3		2		
B.1. Application Development	3	3	3	3	4
B.2. Component Integration	2			2	4
B.3. Testing	3		2	2	
B.5. Documentation Production	2		3	3	
B.6. Systems Engineering	4				
C.3. Service Delivery	3				
D.11. Needs Identification	2				
D.12. Digital Marketing	1				
E.5. Process Improvement	3	3			
E.8. Information Security Management	4				
ESCO Occupations		ICT system analyst	Digital media designer	Software developer	ICT system architect

IV. CONCLUSION AND FUTURE WORK

It is expected that this work will have a significant impact in its field, due to the development of competence maps, starting with higher education, and due to the implementation of the training course that will reveal the main competence European frameworks to the main stakeholders. The use of these standards will improve the relevance of the mapped training programs at the international level, since they will follow the same reference that is beginning to be established in the rest of the world.

The results of the project will make possible to address technological transfer actions towards companies and external entities in which work connections already exist in the following areas:

- Competence analysis guide for personnel, adaptation to the professional profile and organization of support for the internal career plan and training in human resources related to ICT: collaboration and contacts with Exin Consulting [14], Human Resources Department of MadridDigital [15], etc.
- Specialized training for consulting services, public entities and training centers, with existing contacts with the computer services department of the University of Seville (Spain).

The proposed work will implement a social innovation process to engage people in the learning activities. In this regard, the authors will devote significant effort in engagement and dissemination activities, consulting with all relevant EU stakeholders in the research community, institutional actors in the member states, the industry, and public employment services, businesses and job-seekers representing end users.

The communication and dissemination strategy includes the following items:

- Developing courses
- Developing promotional materials: presentations, press releases, factsheets, posters, brochures, etc.
- Disseminating the results via online and offline communication channels.
- Feeding updates of the results on social networks
- Developing a website.

A possible future line of research deals with the development of certification competence maps. There are currently 2313 ICT certifications [16] from 161 different entities. This mapping would represent a very novel contribution because it would connect another fundamental

pillar of the ICT sector with the European reference frameworks.

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