Comparative study between Professional Competences Developed in Engineering and Social degrees

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Abstract – After several studies that we have carried out on engineering about competences acquisition in Computing Engineering, we have developed a pilot experience analyzing science and social degrees competences acquisition. We have compared these data with previous results. The analysis offers a qualitative perspective, comparing the development of these competences in engineering students with other areas. The comparison of competences development among different degrees let us know the way they are developed taking into account the type of degree. The work tries to gather student opinions of different knowledge areas. Obtained results and conclusions will serve us to improve our processes as well as to implement the necessary changes involving the convergence towards the European Space for Higher Education (ESHE) in the best conditions.

Keywords: computer engineering curriculum, professional competences, pilot study, teaching methodologies, tuning project.

1 Introduction

The general directives to the adaptation to the European Space for Higher Education (ESHE) [1] are related to the competitiveness of the European Higher Education Area (EHEA), as well as to the incorporation of students in the industrial and business world. The vertiginous technological advance of our society entails continuous learning and this is generating a necessity of using educational models that allow students to "learn to learn". On the occasion of the transition to ESHE, the debate about the role of competences in university graduates has been reopened, especially concerning generic competences or transferrable skills.

The competence-based training approach provides a common language, at an international level, to define and express optimal academic and professional profiles, together with the configuration of the new educational programs in accordance with the principles of the construction of the European Space for Higher Education.

The incorporation of competences into educational programs is a basic element for student education, in the framework of a society that reformulates its demands in a constant way, aimed at bringing university formation closer to the labour market. For this reason, current and future educational programs must be designed from the point of view of professional competences acquisition, in such a way that graduates turn into competent people at their jobs. To perform that, we believe that the main change must take place in the teaching methodology.

The Teruel Polytechnic School of Engineering has been developing actions of innovation and educational improvement for several years. Actions carried out by the different management boards and by teaching committees of our university have tried to involve both lectures and students. These actions have achieved an improvement in students’ academic performance.

After several years of study we have developed a deep analysis about generic competences aimed at obtaining a valuation to the subsequent analysis and reflection. On this paper we go further and we try to compare the development of these competences in engineering students with other areas. We do it throw the participation and opinion of students and lecturers belonging to the different degrees. The present paper shows the global study fulfilled for the degrees: Fine Arts, Teacher Training, Labor Relations, Computing Engineering, and Telecommunication Engineering.

Several sources have propounded the advantages offered by considering different methodologies in order to acquire the skills and competences students will need in their future jobs. Interpersonal communication, teamwork, group problem-solving, leadership, negotiation and time management [2-5] are examples of the new competences. In addition, positive effects have been shown in students’ academic performance, in motivation and their attitudes towards learning [6].

Some of these advantages have also been underlined by students, who consider group activities and active methodologies to be more interesting and entertaining than traditional teaching [7].

This paper is presented as follows. Section 2 introduces generic competences. Section 3 analyzes the survey results, where we focus our attention on generic or transferrable competences and section 4 deals with the main conclusions.
2 Generic Competences in Engineering Education

The Spanish Organic Law of Universities [8], in its first article establishes "The creation, development, transmission and criticism of Science, Technology and Culture" as University first function. Consequently, students must develop intellectual, technical, artistic, social and personal abilities. These abilities or competences will encourage creativity, problem solving and autonomous learning through all their life.

Competences represent a dynamic combination of knowledge, understanding, skills and abilities. Fostering competences is the object of educational programs. Competences will be formed in various course units and assessed at different stages and can be distinguished between subject specific and generic ones. Tuning [9] project has highlighted the fact that time and attention should also be devoted to the development of generic competences or transferable skills. This last component is becoming more and more relevant for preparing students well for their future role in society in terms of employability and citizenship. Tuning [9] proposes a total of 30 generic competences classified into three types:

- Instrumental competences: cognitive abilities, methodological abilities, technological abilities and linguistic abilities.
- Interpersonal competences: individual abilities relating to the capacity to express one’s feelings, critical and self-critical abilities. Social skills relating to interpersonal skills or team-work or the expression of social or ethical commitment. These tend to facilitate processes of social interaction and of co-operation.
- Systemic competences: abilities and skills concerning whole systems (combination of understanding, sensibility and knowledge; prior acquisition of instrumental and interpersonal competences required).

We have considered these generic competences to develop our study. that were specified in the guide proposed by ANECA [10], where the importance of each of them was valued starting from the results analysis of surveys carried out to company communities, qualified people and lecturers.

2.1 Instrumental competences

Having an instrumental function, the main objective of these competences is to provide students with means and methods allowing them to use put knowledge in practice in the work environment. They include:

- Cognitive abilities, capacity to understand and manipulate ideas and thoughts.
- Methodological capacities to manipulate the environment: organizing time and strategies of learning, making decisions or solving problems.
- Technological skills related to use of technological devices, computing and information and management skills
- Linguistic skills such as oral and written communication, or second language knowledge.

According to Tuning, cognitive and methodological abilities are fundamental, as they will provide the student with the leadership nature.

Competences taking into account in our study include:

- Capacity for understanding and interpreting written information in a critical way (C1).
- Capacity for organization and planning (C2).
- Oral communication in your native language (C3).
- Ability to communicate ideas in different contexts (C4).
- Capacity for understanding and interpreting written information in a second language (C5).
- Written communication in your native language (C6).
- Knowledge of a second language (C7).
- Elementary computing skills (C8).
- Information management skills (ability to retrieve and analyze information form different sources) (C9).
- Capacity for analysis and synthesis (C10).
- Problem solving (C11).
- Decision-making (C12).

2.2 Interpersonal competences

Abilities to communicate and teamwork are fundamental in the success, increasing possibilities of promotion. Communicating solutions to workgroups (social competences) is one of the main goals demanded nowadays.

We may remark ethical commitment and interpersonal skills as essential to manage groups of heterogeneous people. The competences considered are the following:

- Ability to work in a team with responsibility and flexibility (teamwork) (C13).
- Ability to work in an interdisciplinary team (C14).
- Ability to work in an international context (C15).
- Interpersonal skills (C16).
- Appreciation of diversity and multiculturality (C17).
- Ethical commitment (C18).
- Critical and self-critical abilities (C19).

2.3 Systemic competences

Students should have the ability to understand the social and economic context belonging to the sector in which they develop theirs activities. For this reason, it is...
necessary for them to show an enterprising attitude to find possibilities and to define objectives, together with the managing and teamwork abilities. We consider the following systemic competences:

- Ability to work autonomously (C20).
- Capacity to adapt to new situations (C21).
- Capacity for generating new ideas (creativity) (C22).
- Leadership (C23).
- Understanding of cultures and customs of other countries (C24).
- Initiative and enterprising spirit (C25).
- Concern for quality (C26).
- Sensibility to environmental matters (C27).

3 Practical Experience. Results

During the academic year 2010/11 we designed a survey to be completed by students belonging to the degrees previously presented. We have centred our study on the analysis of generic competences. They survey was completed by more than six hundred students belonging to the aforementioned degrees. We show in this section several comparative analyses with the collected data at the end of the second term.

In order to gather opinions we decided to carry out a quantitative analysis. The so chosen type of survey in this case was delivered to the different classrooms belonging to the aforementioned degrees.

The questions are shared by all the degrees, since we have seen there are 27 questions related to competences (1 to 12 instrumental, 13 to 19 personal, and the rest belong to systemic competences.

In addition, to be able to value the mentioned aspects in the purpose of the survey, it is divided in three columns related to the importance that every student/professor gives to each competence. In this point, the importance in the labour market and the way they have been developed at classroom are taking into account. On the other hand, we have to remark that the scale of valuations varies from 1 to 5, in order to get data having enough meaning.

Fig. 1 shows the development of generic competences within the current year for the aforementioned five degrees, having marks above 3. Social degrees focus on the development of generic competences (to a greater extent) whereas engineering degrees focus on the development of professional competences. We separately analyze every type of competence to guess which are more developed taking into account the degree. We will begin our analysis with instrumental competences, after them, personal ones and finally the systemic ones.

Fig. 2 shows the existing discrepancy among the importance given by students at both personal level and labour market in comparison with the way they have been developed in the current year (according to students’ perception). The same conclusion will be observed in the following figures.

On the other hand, if we focus the analysis on the current year, we also observe that in spite of the fact that engineering degrees develop to a lesser extent generic competences (in general), these technical degrees instrumental competences develop to a greater extent, such us: Information management skills (ability to retrieve and analyze information form different sources) (C9), Capacity for analysis and synthesis (C10), Problem solving (C11), among others.

Fig. 3 shows that personal competences are developed to a greater extent in social degrees, in comparison with engineering degrees. Remarkable are the following: Ability to work in an interdisciplinary team (C14), Appreciation of diversity and multiculturality (C17), Critical and self-critical abilities (C19) among others.
The development of instrumental competences is remarkable, especially 9 and 11 competences: Information management skills (ability to retrieve and analyze information from different sources) (C9) and Problem solving (C11).

Fig. 6 shows competence development in the Fine Arts degree. Development of systemic competences is remarkable, especially: Capacity for generating new ideas (creativity) (C22), Concern for quality (C26), as well as Instrumental Problem solving (C11).

Fig. 7 shows that the most developed competences in the Telecommunication degree are instrumental: Elementary computing skills (C8), Information management skills (ability to retrieve and analyze information from different sources) (C9), Capacity for analysis and synthesis (C10) and Problem solving (C11).
According to the Labour Relations degree (see fig. 8), systemic competence ‘Concern for quality (C26)’ and instrumental competence ‘Information management skills (C9)’ are valued above others.

Within the Teacher Training degree (see fig. 10), the most valued competence is a systemic one (Concern for quality (C26)), followed of Information management skills (ability to retrieve and analyze information form different sources) (C9), Capacity for analysis and synthesis (C10) and Ability to work in an interdisciplinary team (C14).

An overall view of the situation (fig. 10) shows that instrumental competences are most valued on average. Nevertheless, values are closer each other.

4 Conclusions

In this work, we have dealt with the importance of competences acquisition; in particular, we have focused our analysis in the degrees taught on Teruel Campus. Due to the forthcoming implementation of the new educational model focused on the student, teaching/learning activities should be carefully designed and schedule to reach the educational goals as far as competence acquisition is concerned. Results obtained in practice will let us correct the tested methodological strategies and work on their improvement. Taking into account competences demanded by companies, we may conclude that, in general, competences most valued by students are really useful in the labour market.

A general lack has been observed in the valuation of competences such us aptitude to communicate (oral and written) in another language, or the knowledge of foreign cultures, for instance. In this respect, lecturers will have to emphasize their importance, trying to develop them at the classroom.

They are slightly differences among valuations, pointing out that mean values are above 3 (out of 5), showing a suitable interest in all the areas. Nevertheless, competences development in the current year is below expectative of importance. Getting the right balance between both aspects is crucial.

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6 References


