

# Evaluation of Transversal Competences in the Final Year Project in Engineering

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**Abstract**— Transversal competences are usually forgotten and neglected. However, the competence in transversal skills is considered by employers thinking about hiring a university graduate as important as technical knowledge. In this paper, a procedure to ensure the evaluation of a subset of skills of high interest for entrepreneurs is presented. Since all engineering students must complete a final year project (FYP), this is the ideal subject for assessing these skills. On one hand, by being mandatory and on the other because it is done after all the other subjects, assessment of transversal skills to all the students is ensured. The first step was determining which skills needed to be assessed and then the descriptors for each one were defined. It was also fixed the manner in which evidences can be collected through the whole project. Finally, the results of this study will be used as a recommendation to future FYP in the ETSII (Escuela Técnica Superior de Ingeniería Informática de la Universidad de La Laguna) for its validation.

*Keywords-component; Final Year Project, Learning outcomes, Transversal competences assessment, e-portfolio.*

## I. INTRODUCTION

Generic skills are usually forgotten and neglected on the education system. Fortunately, the Bologna process has rescued them by giving a more important role. However, most efforts are still concentrated in the identification and assessment of professional skills or specific content. There is no clear idea of how to implement the teaching of these skills, so much less about assessing them.

The EHEA (European Higher Education Area) has been developed through various arrangements of the European countries education ministers, among which we mention the 1999 Bologna Declaration [1], the 2001 Prague Communiqué of [2], the 2003 Berlin Communiqué [3], the 2005 Bergen Communiqué [4], the 2007 London Communiqué [5] and the 2009 Leuven Communiqué [6]. The rules generated at European level were adopted by each country, developing its own standards. In the case of Spain, some of the relevant regulations are the RD1125/2003 [7] Royal Decree 1509/2005 [8], the 2514 order / 20071 [9] and the RD1393/2007 [10].

It was stated in Bergen Communiqué that the frame for European Higher Education must include generic descriptors for each cycle based in learning outcomes and competences. The Project Report [11], reflects that the general movement is

to give more importance to employment prospects and to the acquisition of transversal core skills. That makes necessary to redefine the curricula to take into account professional partners and to reach a minimum level for each principal component. It is a requirement that the degrees must be considered not only as a training for a particular and well defined profession, but also to include several skills needed for nearly any future professional activity. Moreover, grades must describe the realized job, the level of competence and the profile (2003 Berlin Communiqué [3]. A group of experts, in the context of the “Joint Quality Initiative (JQI)” developed the well known “Dublin Descriptors” [12]. Those were proposed as a base of the different national accreditation frames and state generic expectation regarding achievement and skills. They were approved in the 2005 Bergen Communiqué [4] and in 2009 Leuven Communiqué [6]. It was highlighted that regarding employability, labor market demand higher level of transversal competences and skills. Therefore, Higher Education must provide advanced knowledge, skills and competences that students need for their professional life.

In Spain, the 2003 MEC framework document states that official degrees must have, in general, a professional orientation. That is, they must provide a university level education in which basic general competences, transversal competences related with well-rounded development and specific professional competences will be integrated. It is also stated that generic, transversal and specific competences must be specifically mentioned in any title to be designed. In appendix I, the minimum competences that must be satisfied in each cycle are named. Royal Decree 1393/2005 [10] mention the following generic competence descriptors: 1) Have demonstrated a systematic understanding of a field of study and mastery of the skills and methods of research associated with that field; 2) Have demonstrated the ability to conceive, design, implement and adopt a substantial process of research with scholarly integrity; 3) Have made a contribution through original research that extends the frontier of knowledge by developing a substantial body of work, some of which merits national or international refereed publication; 4) are capable of critical analysis, evaluation and synthesis of new and complex ideas; 5) can communicate with their peers, the larger scholarly community and with society in general about their areas of expertise; 6) can be expected to be able to promote, within

academic and professional contexts, technological, social or cultural advancement in a knowledge based society.

As it can be observed there exists a legislative framework governing degrees and the competences that must be acquired by students in each one. Some research has been done about which competences are the most relevant and how to assess them. In this paper, we make a selection of transversal competences, based both in those previous studies and also in information from the local labor market, to be assessed in the Final Year Project in Computer Science Engineering.

## II. PREVIOUS WORKS

Some research has been done about the process of assessment for the Final Year Project. In that sense, Valderrama et al [4] propose a 6 stages procedure. Those stages together with some recommendations are:

a) *Learning outcomes definition for the FYP and assignment of a set of objective descriptors to each one.* From the set of 28 competences suggested in the Tuning Project [13], they did a poll and obtained 135 replies of Universities, 107 from Spain and 28 from the rest of Europe. The top five scored abilities were: 1) To put into practice the acquired knowledge, 2) Written and oral communication skills in their native language, 3) Inception, design and implementation of projects using engineering tools, 4) Organization and planning, 5) Knowledge about their study field.

b) *Definition of assessment milestones: Who and what will assess each descriptor.* Valderrama [14] recommends to make a soon assessment in the first weeks of the Project to check that the student has analyzed the state of the art and has a clear approximation to it. Moreover, it is necessary to make several assessments through the project development and a final assessment at the end.

c) *Descriptors assignment to each assessment action.* The descriptors assigned in that case were:

-Descriptor 1: Student presents a diagram of the Project planning.

-Descriptor 2: Student is able to monitor the level of compliance regarding the initial plan and take into account deviations from it.

-Descriptor 3: The student analyzes the level of compliance regarding the initial plan, the causes of deviations from the original plan and their consequences.

d) *Definition of level of compliance for each descriptor establishing a clear and objective level of compliance to be satisfied by the student. The levels of compliance are: 0- Student do not comply, 1- superficial compliance, 2- proper compliance, 3- Excellent compliance*

e) *Assessment report.* The assessment report must include descriptors, the level of compliance and the level of demand for each descriptor. They also propose an overall assessment report organized by skills.

f) *Qualification.* The faculty or college must define the criteria to be followed in order to provide the students with qualifications.

On the other hand, Cruz [15] proposes a take-home exam, within a subject, to assess competences which are very difficult to evaluate in a normal exam. Students solve this exam in a long period of time (e.g. one week) so they are not bounded by time or lack of information resources. The competences under evaluation are: 1) Entrepreneurial spirit, 2) Sustainability and Social Commitment, 3) Effective written and oral communication skills, 4) Team working, 5) Efficient use of information resources, 6) Autonomous learning, 7) Work attitude, 8) Way of thinking.

Regarding how to assess the final year project, Kim [16] proposes a qualification based in a weighted sum of each one of the evaluated items.

$$M = \sum_{i=1}^N F_i * X_i \quad (1)$$

Where  $F_i$ =weight and  $X_i$ =Qualification of descriptor i.

On the other hand, Teo [17] introduces five assessment components: 1) Interim assessment with a weight of 15%, named S1, 2) Report and final assessment with a weight of 50%, named S2, 3) Oral presentation with a weight of 5%, named S3, 4) Report and demonstration with a weight of 25%, named M1 and 5) Oral presentation with a weight of 5%, named M2. Each one of the 5 components is divided in topics. For example: Final report is divided in 1) Introduction, 2) Structure, 3) Theory, design and implementation 4) Results, 5) Conclusions and 6) Presentation.

Those previous works will serve us as a frame of reference to elaborate our own assessment procedure for the final year project. Moreover, it is necessary to know what local business in computer science demand from the students to adapt our procedure to assess such competences.

## III. RECCOMENDATIONS REGARDING TRANSVERSAL COMPETENCES (OPSIL AND ENTREPENEURS).

A survey among managers of software companies was carried out in order to establish the transversal competences of interest for the software companies. The survey was done through 3 clusters which represent 60 software companies in the island. As a result, the most important transversal competences for the Canarian software business are: 1) Written and oral communication skills in foreign language (English), 2) Capacity for drafting documentation and reports in native language (Spanish), 3) Effective oral communication in native language (Spanish), 4) Interpersonal skills and 5) Basic entrepreneurial culture. On the other hand, OPSIL (Observatorio Permanente para el Seguimiento de la Inserción Laboral) has carried out an exhaustive study [18] about seeking employment of Universidad de La Laguna students. From both studies, some recommendations about the competences of interest for Canarian software business were extracted.

Mastering in foreign languages has become an institutional primary objective (The Commission of the European

Community 2003). The relative importance associated with mastering in foreign languages by university graduates is growing. Additionally, this competence is the one that shows the biggest perceived deficit in university graduates. Most of the businesses in Canary Islands are SME that do not demand high levels of foreign language to their employees. However, English language knowledge has a great impact on software companies due both to that the manuals and documentation are usually written in English and to that software companies has stronger links to other business at European level.

A very similar situation happens regarding basic entrepreneurial culture. It is often not taken seriously enough, so that perceived deficit level is big. Although this knowledge is usually acquired once joined to the company and it can vary depending on the business organization, there is a lack of a minimum level of knowledge about that topic before entering in the labor market.

The next competence with bigger perceived deficit is oral communication. Although needing for oral communication differs significantly between academic and working environments, a fluent oral communication in academic environment could help both the entrance in the labor market and in career progression.

Interpersonal skills are often neglected by students in general, but highly appreciated by employers. The employee must communicate at three different levels. Firstly, he must maintain a close contact with his colleagues as a member of a team. Secondly, he must convince to his supervisors about the suitability of his proposals. Thirdly, he must be friendly enough to attract customer's interest.

Finally, the capacity for drafting documentation and reports in native language (Spanish) is not perceived as a deficit by student or teachers at University level, due to that students use to write reports for their practical work. However, producing reports, drafting research proposals and responding to tenders require a mastering in written language.

#### IV. METHODOLOGY

Working methodology starts by establishing a joint framework of communication among software companies, Computer Science Faculty at ULL (Universidad de la Laguna) and students in their last two years of studies. Within this framework, business can transmit to the faculty, in real time, the shortcomings identified in their employees with university degree. So, training needs in transversal and professional competences are evidenced. At the same time, job offers can be seen directly by our students as soon as they are produced. They will also be able to send their curriculum digitally what improves their access to the labor market.

OPSIL and some other institutions will belong also to this framework of communication, advising the head of the faculty and reporting figures about the degree of insertion in labor market.

Taking into account suggestions from employers, the head of the faculty and the management team can determine the subjects best suited to meet the competences demanded and

contact with the responsible teacher to ensure the correct training and evaluation of such competences.

The final year project is particularly well suited to evaluate transversal competences. We develop a methodology based in the electronic portfolio in order students follow a richer and more flexible assessment process [19], become aware of those things which constitute evidence of their competences and to which level they have developed and, together with the teacher, set the path to improve on them.

#### V. COMPETENCES ASSESSMENT IN FYP FOR COMPUTER SCIENCE ENGINEERING

A mixed model that agglutinates the previously discussed models is proposed. Taking into account that the weight traditionally assigned to practical jobs is around 30% the total qualification, we decided to assign a 28% to the transversal competences in the FYP.

From the set of the most valued transversal skills for the Canary software companies mentioned before (section III), regarding the learning outcomes, the latter is not consider. Therefore the four competences to be used for assessment are: 1) Written and oral communication skills in foreign language (English), 2) Capacity for drafting documentation and reports in native language (Spanish), 3) Effective oral communication in native language (Spanish) and 4) Interpersonal skills. In addition it is necessary to add some technical competences which include: 5) Theoretical knowledge, 6) Practical knowledge, 7) Information search and management, 8) The use of advanced software for document processing, 9) The use of advanced software presentation tools.

Regarding milestones for assessment we do consider not only the frequency but also the assessor and the object for assessment. Although the final score is an exclusive competency of the evaluation panel that judge the project the day of presentation, some evidences must be collected by the project supervisor during the whole project to be evaluated by the evaluation panel. Regarding the competences which are evaluated the day of the presentation, some of them are related to the written project and some related to the oral presentation.

Four levels of compliance are considered: Fail, Pass, Good and Excellent. In order to be objective requirements to be satisfied in each level must be clearly specified. Those basic objectives are qualified and the overall score will be obtained as a weighted sum of these factors.

Additionally, we consider three different kinds of reports (see tables I to III). The first set of reports (Table I) is done by the supervisor to provide evidence, throughout the life of the project, about long term skills to the evaluation panel. It includes mastering in foreign languages (S1), interpersonal skills (S2) and competence in the use of information resources (S3). Regarding foreign languages, it will be evaluated only the writing and reading capacity as the project must be defended in Spanish, by law. Interpersonal skills will be evaluated in the basis of the relation with the supervisor and with a peer, in case a team approach is used.

TABLE I. SUPERVISOR REPORTS S1, S2 & S3, PROVIDING EVIDENCES THROUGHOUT THE LIFE OF THE PROJECT.

Report	Competence	Descriptor
S1	1) Written communication skills in foreign language.	<ul style="list-style-type: none"> <li>• Capacity to look for information in foreign language (English) sources.</li> <li>• Capacity to extract information from those sources.</li> <li>• Capacity to write reports in foreign language (English) about those sources</li> <li>• Capacity to explain some parts in foreign language (English)</li> </ul>
S2	4) Interpersonal Skills	<ul style="list-style-type: none"> <li>• Social Skills</li> <li>• Emotional intelligence</li> <li>• Empathy</li> </ul>
S3	7) Information search and management	<ul style="list-style-type: none"> <li>• Capacity to look for information by itself</li> <li>• Capacity to determine the importance of each piece of information.</li> <li>• Classification and organization of information</li> <li>• Relevant information extraction from the search results</li> </ul>

The second set of reports (Table II) must be filled by the evaluation panel taking into account the written report done. They have to inform about the capacity for drafting reports and documentation in native language (Spanish) (M1), the use of advanced software for written documents (Latex, graphics, etc...) (M2), Theoretical knowledge (M3) and practical knowledge (M4). Altogether, those four reports account for 70% of the overall score.

TABLE II. EVALUATION PANEL REPORTS M1, M2, M3 AND M4, BASED IN THE WRITTEN REPORT.

Report	Competence	Descriptor
M1	2) Capacity for drafting written reports and documentation in native language	<ul style="list-style-type: none"> <li>▪ Absence of spelling errors.</li> <li>▪ Document organization</li> <li>▪ Clear and impersonal explanations.</li> <li>▪ Document format.</li> </ul>
M2	8) The use of advanced software for document processing	<ul style="list-style-type: none"> <li>▪ Document processor for editing (Latex or other publishing software)</li> <li>▪ Graphics resources (Graphics, figures, tables, schemes,)</li> <li>▪ Level of compliance with an author style guide.</li> </ul>
M3	5) Theoretical knowledge	<ul style="list-style-type: none"> <li>▪ Well structured theoretical knowledge.</li> <li>▪ Clear explanations about theoretical concepts.</li> <li>▪ Large bibliography</li> </ul>
M4	6) Practical knowledge	<ul style="list-style-type: none"> <li>▪ The object of the FYP works properly.</li> <li>▪ Current programming technology.</li> <li>▪ Well documented program.</li> <li>▪ Well structured program</li> </ul>

TABLE III. EVALUATION PANEL REPORTS P1 & P2, BASED IN THE ORAL PRESENTATION.

Report	Competence	Descriptor
P1	9) The use of advanced software presentation tools	<ul style="list-style-type: none"> <li>▪ Document processor for presentation (Latex+Beamer, etc...)</li> <li>▪ Advanced software as HTML 5, concept maps, flash, etc.</li> <li>▪ Organization of presentation</li> <li>▪ Multimedia resources in the presentation</li> </ul>
P2	3) Effective oral communication in native language.	<ul style="list-style-type: none"> <li>▪ Not weaver.</li> <li>▪ No use of fillers.</li> <li>▪ Clear explanation.</li> <li>▪ Capacity to defend his arguments.</li> </ul>

Finally, the third set of reports must also be filled by the evaluation panel based on the oral presentation basis. It has to be informed about the use of advanced software for presentations (Beamer + latex, multimedia, etc...) (P1) and the effective oral communication in native language (Spanish). Each assessment report must include the objectives, descriptors and competences evaluated together with the evidences in which they are based. The overall score is a weighted sum of each one of the competences.

Each one of the descriptors is assessed according to its level of compliance: Not compliance, Pass, Good and Excellent. Qualification for each competence is obtained as an average of its descriptors. The overall score is obtained as:

$$Marca = A * (S1 + S2 + S3 + M1 + M2 + P1 + P2) + C * M3 + D * M4 \quad (2)$$

$$A = 0.04, \quad C = 0.22, \quad D = 0.50$$

It must be remarked that theoretical knowledge account for a 22% of the overall score and practical knowledge for a 50%, remaining a 28% for transversal competences.

The evaluation panel must provide the overall score and the evidences and acquired level for each one.

The process to put in practice this experience consists in providing a virtual subject in Moodle and in Mahara (e-portfolio) where the project will be registered. The student portfolio must contain all the information and evidences required by the supervisor must be sended to a Moodle task. Supervisor must upload all his reports in this Moodle subject for being evaluated by the evaluation panel. The presentation day, the evaluation panel is provided with an electronic version of all the needed documents and previous reports. Any document will be filled in a digital platform. The overall score will be automatically calculated from the evaluation of each one of the descriptors in order to avoid subjectivities.

This working scheme has been sent to the Commission to examine FYP to be considered as a rule for future FYP at Computer Science Faculty (ETSII). After one course experience, the results will be sent to the academic governing authorities in order to be applied to the rest of degrees.

## I. CONCLUSIONS

A joint framework of communication among software companies, Computer Science Faculty at ULL and students in their last two years of studies was established in this job.

A model for assessing transversal competences through the Final Year Project is presented. Learning outcomes, descriptors and milestones for assessment have been defined. Moreover, descriptors assignment to competences, their level of compliance, reports for assessment and evaluation criteria has also been clarified.

As methodology we make use of e-portfolio and e-learning software to collect the evidences that allow the assessment of competences.

Finally, during the present scholar course, the whole process will be implemented in order all the FYP at our faculty will be assessed according to these guidelines.

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