EVALUATION OF SOCIAL COMPETENCIES IN CHEMICAL ENGINEERING: APPLICATION AND RESULTS OF THE PILOT TEST (ACADEMIC YEAR 2012-2013)

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Abstract

The Escola Tècnica Superior d'Enginyeria Química has a long tradition in the deployment of social competencies in engineering curricula through Integrated Projects (IP) carried out in structured teams. Social competencies are taught and practiced during the development of the IPs. We conceptually introduce a methodology for a 360° assessment of the students' social competencies, as a tool to foster the improvement of their competency levels. In this article we analyze the results of the pilot test where the aforementioned methodology has been implemented in the Bachelor studies of Chemical Engineering. The results indicate that it is possible to objectively obtain the student's competency level discriminating among different social competencies, as well as among different students in the same team. The application of this tool fosters the development of specific educative actions to help the students with low competency profile, to reach acceptable levels for a successful insertion in the labor market.

Keywords – Social competencies, assessment, chemical engineering education.

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1 INTRODUCTION

The new challenges of the global society demand from higher education graduates capable of leading and fostering the progress of the world. The new paradigm aiming at meeting these challenges focuses on developing competencies rather than only knowledge and practical skills in the students during their way through higher education (ABET, 2012; Spencer & Spencer, 1993; McClelland, 1998; AQU, 2012).

The idea of competency first appeared from the observation of what makes the difference between average and outstanding professionals in different jobs. The birth of the concept can be attributed to David C. McClelland (McClelland, 1973), who published the article *Testing for Competence Rather Than Intelligence*, in 1973. In that article the author indicates how traditional tests, based on academic aptitude and knowledge, are unable to predict job performance or success in life. It is interesting to read the detailed example of the recruitment of the U.S. State Department Foreign Service Information Officers (Spencer & Spencer, 1993), as a case where these ideas are clearly explained.

Spencer and Spencer (1993) define competency as (sic):

> *A competency is an underlying characteristic of an individual that is causally related to criterion-referenced effective and/or superior performance in a job or situation.*

Notice that we use the word competency in the sense of "an important skill that is needed to do a job". It should be differentiated from competence, which is "the ability to do something well".

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Although Spencer's definition is neither unique nor probably the best, it indicates that the individuals that excel in their function are not distinguished from the average only by their knowledge or their experience. Other capacities, many of them of social nature, also play a very important role.

Hence, in order to respond to the new paradigm, one has to incorporate social competencies in the engineering curricula. A consequence of this fact is the need of providing an adequate feedback to the students. Therefore, it is essential to objectively evaluate their competency level during the studies, to push them towards becoming outstanding professionals in their future jobs.

The educational model of the Escola Tècnica Superior d'Enginyeria Química (ETSEQ) is based on Integrated Projects (IP) in which the students work in structured teams on open design projects related to Chemical Engineering and Food Engineering (Witt, Alabart, Giralt, Herrero, Vernís & Medir, 2006). In this context, students receive specific training about social competencies and interact in an adequate environment to practice them. Social competencies are reflected to the individual behavior (Suñé & Bonet Avalos, 2012). The most significant behaviors will take place in quasi professional situations that occur during the IP. Hence, it is essential to observe the behavior of the individuals while they are acting in their roles, in order to determine the competency level. Therefore, the intrinsic difficulty of assessing social competencies lies in the need of an objective and reliable procedure based on direct observations of the behaviors.

In this article we discuss the procedure implemented in the ETSEQ to observe and assess these social competencies among the students. We also discuss the results of the pilot test carried out in the ETSEQ during the second semester of the academic year 2012-2013 of the Bachelor studies of Chemical Engineering (GEQ) and Food Engineering (GEA), which show that an objective assessment of social competencies is possible.

2 METHODOLOGY

2.1 Background

From the beginning of 2012, the ETSEQ has developed and implemented an evaluation methodology to assess the five social competencies included in its competency dictionary. These five social competencies are described in the memoranda of the Bachelor studies (GEQ, 2009; GEA, 2009), and are listed in Table 1.

Classification	Competency
Technical Competencies	A1. Technical
	A2. Professional
Social Competencies	B1. Human Interaction & Versatility
	B2. Facilitative Leadership
	B3. Teamwork
	B4. Active Learning & Responsibility
	B5. Initiative & Innovation
Nuclear Competencies	C1. Communication
	C2. Social

Table 1. Competency dictionary of the ETSEQ

However, these competencies, as they stand, are meaningless if no additional explanation is provided. In Table 2 we give the definition of competency B1 in terms of behavioral descriptors, which are further deployed through a list of observable elementary behaviors related to the latter. We will return to this point in section 2.3. In summary, the set of social competencies B1-B5 need 22 behavioral descriptors, with 37 elementary behaviors, which are ultimately evaluated one by one.

The methodology proposed here is based on two postulates (Suñé & Bonet Avalos, 2012) that set its conceptual epistemological basis:

Postulate 1. The object accessible to the observer is the so-called observable. Hence, for our purposes, the observable is:

> *The behavior of an individual in a given moment, in a concrete environment, and exerting a given role related to her/his current studies (and the future profession).*

One can not have access to what a person is or to what in psychology is known as a mental state. Instead, one can observe what a person is doing as the only indicator of his/her capabilities.

Postulate 2. The measure is a comparison process. The objectivity of the measure is hence based on the existence of a standard, in the first place, which will be the same for all the observers. Secondly, considering that human behavior depends on the circumstances and the states of mind (which exist as facts of the inner individual experience but are not directly accessible to others), the final objective is, hence, to determine what the person does in general, not in a specific moment, a particular day, or under concrete circumstances. Therefore, to guarantee the objectivity of the assessment of the competency level, it has to be determined from an average of observations obtained from different observers, at different moments, under different circumstances, but always while the individual is exerting her/his role, which the standard refers to.

According to this postulate, it is very important that the students perform quasi-professional roles during their education, since this is the only context in which the behaviors related to the social competencies can be observed. In the next section we introduce the context in which the assessment methodology has been implemented.

2.2 Context

The competency assessment has been implemented in the subjects where the IP's, mentioned in the Introduction, are carried out. The IP implies building balanced teams using the principal profiles of the students. Such profiles can be obtained from questionnaires of the type of Belbin (Belbin, 2014), together with relevant information about them like grades, geographic constraints, etc. Within these teams, we differentiate two roles: leader and team member. Professors of the first year play different roles. On the one hand, a professor can be a consultant and address the questions posed by the students on a given subject. On the other hand, the same professor acts as a client because he/she will grade the final report at the end of the IP. Another professor plays the role of coach to support the team during the development of the IP, without intervention in the evaluation. The goal of the IP is proposed by the coordinators, which act as sponsors.

The IP of the first academic year involve students of the first year and students of the fourth year, enrolled in the elective subject Team Leadership Practice (PLE). In this particular IP, the leader of the team is one of these PLE students. He/she should lead from 5 to 7 students of the first year who act as team members (Witt et al., 2006). The professors of PLE coach the leaders during the IP, grade their performance in the subject, and also assess their social competencies. A scheme of the organization of the IP of the first year is shown in Figure 1. In the IP of the second and third year, the leader is a student belonging to the same academic year, who also plays a significant role as a team member.

The team has to set a Team Charter in order to determine the objectives, the team rules, the planning of the tasks, the deadlines, the deliverables, etc. The leader and team members have to meet at least once a week according to a schedule established at the beginning of the academic year.
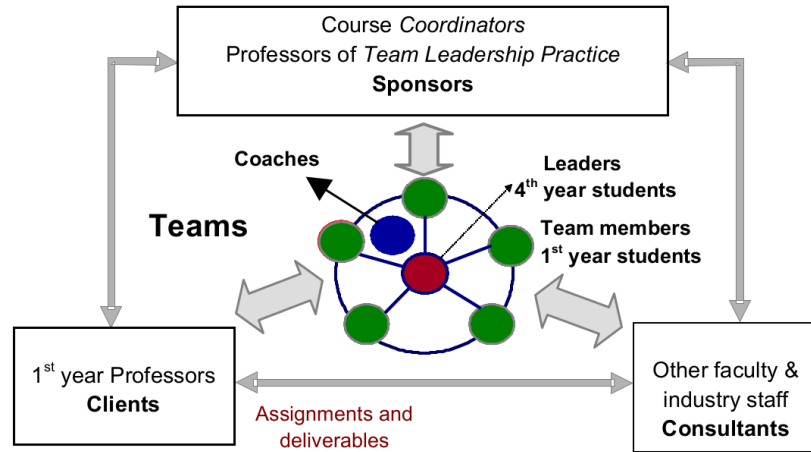
Figure 1. Structure of the teams involved in the IP of the first academic year

2.3 Implementation of the methodology of evaluation of competencies

According to Postulate 2, one has to define a standard for each role. The standard has to be related to the competency dictionary given in Table 1. Such a standard is deployed as a collection of rubrics, bound to the behavioral descriptors, which define each competency, as in Table 2. Hence, the standard materializes in a questionnaire to be used for all the observers to assess all the individuals acting within the same role. In our case, we have chosen these rubrics to be descriptions of elementary behaviors, also known as *pinpointed behaviors*, easily identifiable in the student's behavior during the IP.

Competency	Behavioral descriptors	Elementary behaviors
B1. Human Interaction & Versatility	1.1 Communicates effectively in interpersonal and group situations.	Looks for the best in team members, irrespective of personal opinion and judgment.
		Expresses her/himself clearly, taking care of being understood (for example, expressing ideas, giving feedback, addressing tasks to the team).
		Builds effective relationships in and outside the team to improve performance.
		Updates team members and stakeholders on progress.
	1.2 Able to translate thoughts into oral and written communication.	Clearly explains to the team members what her/his expectations are.
	1.3 Adapts behavior and work method in response to changing conditions.	Increases her/his leadership in front of difficulties and challenges.
		Encourages others to contribute and come forward with own ideas.
		In the moments of high workload, with a positive attitude, encourages the team members by acting as a role model.
	1.4 Deals effectively with high workloads.	When the workload is high she/he reviews the work plan with the team and resets priorities.
	1.5 Displays resilience.	Is able to cope with setbacks and disappointments while focusing on moving the team forward.
	1.6 Resolves conflict constructively.	In the case of a conflict, she/he faces the situation by finding a solution with win-win scenarios.
		Understand conflict resolution methods and applies them effectively.

Table 2. Rubrics of the B1 competency for the leaders. The table shows the competency, the behavioral descriptors and the elementary behaviors

The students are provided with forms containing the questionnaires with the complete list of competencies, behavioral descriptors, and the associated pinpointed behaviors for each role. In these questionnaires the pinpointed behaviors have to be evaluated one by one by the observer, using a scale with three values: 0, 1, 2, depending on whether a given elementary behavior has been seldom observed (0), sometimes (1), or often (2), if it denotes frequency, or low (0), medium (1) or high (2) if it denotes intensity. If circumstances are not appropriate for the observation of a specific elementary behavior, the observer leaves the evaluation of the item blank. At the end of the year, the average of the observations for each elementary behavior is determined. Collecting these average values of the elementary behaviors for a given competency one obtains the competency level from their mean on a scale from 0 to 2. The level is finally scaled up to a range between 0 and 10 for the ease of interpretation. The student finally receives a qualitative assessment of her/his competency profile in terms of *superior performance* (8.25-10), *average performance* (6-8.25), *needs improvement* (4-6), and *needs serious improvement* (0-4).

The process of evaluation starts with a training session with the students in order to explain to them the methodology step by step. From this moment on, the students have access to the rubrics and a detailed guide with all the information required.

The dynamics of the evaluation then proceeds as follows. The team members have to evaluate once a week his/her teammates (cross-evaluation), perform the self-evaluation, and also evaluate the leader. To reduce the evaluation burden, however, the competencies to be evaluated are distributed among the team members so that each team member evaluates all the other team members with respect to one single competency (maybe two, depending on the size of the team), while another team member evaluates the leader. These roles rotate among the team members according to a calendar that the leader establishes at the beginning of the project. The leader has to evaluate individually her/his team members once a week, and do the self-evaluation with the same periodicity. The leader is furthermore evaluated twice a month by the PLE professor. In the example of the team member, the relative weight of each type of evaluation is approximately the same (1/3).

3 RESULTS

To check the feasibility of the procedure, we conducted a pilot test during the 2nd semester of the academic year 2012-2013. The pilot test involved one team of the integrated project (GEQ/GEA) of the first year (the leader was a student of the fourth year), one team of the fourth year (involving several students of PLE of the GEQ) and one team of the second year (GEA). A total of 17 students, 3 of them as leaders, and the rest as team members, were involved. The procedure allowed us to collect 70 observations related to the role of leaders and 232 observations for the role of team members; that is, 23 observations/leader and 17 observations/team member.

Using the data collected we did an analysis to validate the methodology and the rubrics, namely, what we refer to as *the instrument*. The objective was to determine whether the instrument is a) statistically significant, b) consistent with the ability to identify the superior performance, c) discriminates between individuals and competencies within the same individual, and d) feasible in our educational model. We have done the statistical analysis (a) using the matrix of correlation coefficients (Pearson, 1920; Pearson, 2015) and the Cronbach's alpha (Cronbach, 1951), widely used in psychology and social sciences. The consistency (b) of the instrument was determined by comparing the results of the instrument with the qualitative appreciation of the students at the end of the process. The qualitative appreciation is based on the subjective impression that the observers obtained during the year. The observers were asked to separately evaluate only the competencies (not the elementary behaviors) on a scale from 0 to 10, considering all the period of the pilot test. Additionally, we demanded an external evaluation of the leaders from the supervisor of the internship in industry. We have used this evaluation to compare the results with those obtained in the pilot test and the qualitative appreciation. These comparisons allow us to say whether these projections of the evaluations are consistent with the results obtained from the instrument and the qualitative evaluation.

Firstly, the participants measured the time spent in completing the corresponding questionnaires (within the forms) after the weekly meeting. We found that each team member spent about 10 minutes to evaluate 2 competencies of her/his remaining 4-5 teammates together with the self-evaluation. The leader spent on the order of 20 minutes to evaluate the 5 competencies of her/his 5-6 team members and to complete the self-evaluation. In turn, the professors of PLE spent 5 minutes to evaluate one leader for the 5 competencies.

In Figures 2 a) and b) we show the competency level of two members of the fourth year team (GEQ). In blue,

we indicate the results obtained directly from the instrument. In red, we show the qualitative appreciation and, in green, the evaluation of the internship (summer 2013, ranging from 2 to 6 months). In this latter case, we established a correspondence between the items evaluated in the internship (initiative, communication, responsibility, cooperation, etc.) and our social competencies, in order to extract a projection as an estimate of the competency level with regards to the dictionary given in Table 1 (Suñé, 2015).

As we observe in both Figures 2 a) and b), the three estimations of the competency level cast a very similar profile. Considering the case of Figure 1a), the qualitative evaluation is numerically equal for the competencies B1, B2, and B5, but shows deviations in B3 and B4. However, taking into account its nature, this evaluation tends not to sharply discriminate between the competencies. Rather, it responds to an overall impression of the observers about the individual evaluated at the end of the IP. Regarding the internship, the competencies with higher scores are B3 and B4, together with B2. Instead, B1 and B5 are lower rated. Hence, we can say that the internship evaluation casts a similar profile as the other measures. In Figure 1 b), the evaluations are qualitatively coincident.
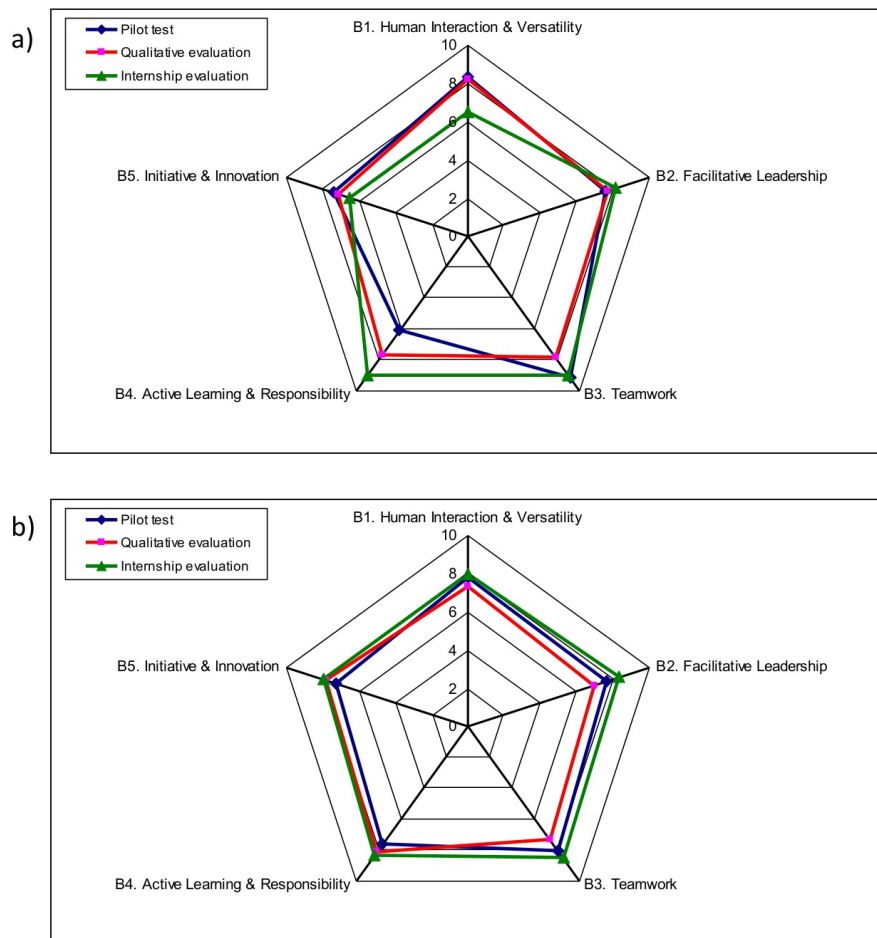

Figure 2. Competency level of two members, a) and b), of the team of fourth year (GEQ). Comparison between the results of the pilot test, the qualitative evaluation and the internship evaluation

Generally, we observe a good correspondence between the evaluations. However, in some cases, the evaluation from the supervisor of the internship overestimates the competencies (not shown), mostly because the person filling in the evaluation form is not the person that has directly worked with the student during the internship.

In Table 3 we indicate the results of the evaluation of one team that presents high variations between the evaluations of its team members. The code of colors used in Table 3 corresponds to: red, for a competency level

clearly to be improved (lower than 6); yellow, that the competency level is average (between 6 and 8.25), and, green, that the competency level is excellent (higher than 8.25). These are the qualitative levels used in the assessment. As we can observe in Table 3, TM2 has the worst results of the team and TM4 has the best results, particularly in the B3 competency. The tutor of the team suggested, according to his/her experience, that TM4 was a hard worker and he/she interacted a lot with the teammates. Actually, he/she was acting as a leader among the team members in the absence of the formal leader, or during the ongoing tasks. Furthermore, the tutor also indicated that TM2 had no commitment with the team and he/she did not deliver, for example, the outcomes of the tasks on time.

	Team members					Leader
Competency	TM1	TM2	TM3	TM4	TM5	L
B1. Human Interaction & Versatility	6.65	5.95	6.89	8.63	6.11	7.92
B2. Facilitative Leadership	5.89	5.27	6.61	7.56	6.36	8.48
B3. Teamwork	5.66	5.45	5.92	8.30	6.30	7.18
B4. Active Learning & Responsibility	6.22	5.57	6.42	7.78	7.18	7.78
B5. Initiative & Innovation	6.02	3.78	6.91	6.12	5.44	7.32

Table 3. Results of the competency evaluations of a given team. Red indicates that the competency level is lower than 6; yellow indicates that the competency level is between 6 and 8.25, and green indicates that the competency level is higher than 8.25

The interview with the tutor revealed that this team had some difficulties to carry out the project. The evaluations of other teams show different results whose detailed analysis, however, go along the same lines as the case exposed here. Therefore, from this analysis we can conclude that the instrument is able to respond to the set objectives.

From a statistical point of view, the matrix of correlation coefficients (Pearson, 2015) is defined as

$$r_{x^\alpha y^\beta} \equiv \frac{\overline{\Delta x^\alpha \Delta y^\beta}}{\sqrt{\overline{(\Delta x^\alpha)^2}\,\overline{(\Delta y^\beta)^2}}} \tag{1}$$

where x^α and y^β are two observation of given pinpointed behaviors related to competency X and Y, respectively, of the same individual. The bars indicate an average over the population and Δx^α stands for the deviation with respect to the mean. In Table 4 we present the correlations between the elementary behaviors related with the B4 competency, which is part of the 37 x 37 team members' correlation matrix. The negative correlations appear in magenta. If the element is higher than 0.5, it appears in red. The negative correlations indicate *grosso modo*, that, the two correlated behaviors on average occur in opposition. If the coefficient is higher than 0.5 (and positive), it means that both correlated behaviors are simultaneously over the mean. High correlation coefficient may indicate redundancies in the questionnaire. As an example, the coefficient 0.577 that appears in Table 4, is referred to the following pair rubrics:

> i26: *Explains what new knowledge has been acquired from books, articles, web sites, conversations with professors, etc. related to the course subjects or to the development of the project.*

> i27: *The delivered reports, posters, etc. contain well quoted references that have been used to produce the outcome. She/he can qualitatively explain what the content of the cited reference is.*

Although the coefficient is high, we can see from their phrasing that these two elementary behaviors are not redundant. The correlation is hence associated to a trait of the population, namely, that a person who (i26) *Explains what new knowledge…* typically also (i27) *The delivered reports, posters…*

	i23	i24	i25	i26	i27	i28	i29	i30
i23	1.000	0.045	0.114	0.280	0.304	*-0.077*	0.417	0.249
i24	0.045	1.000	0.458	0.034	0.167	0.361	0.007	0.391
i25	0.114	0.458	1.000	*-0.023*	0.141	0.382	0.013	0.340
i26	0.280	0.034	*-0.023*	1.000	*0.577*	0.130	0.398	0.015
i27	0.304	0.167	0.141	*0.577*	1.000	0.137	0.310	0.140
i28	*-0.077*	0.361	0.382	0.130	0.137	1.000	0.144	0.412
i29	0.417	0.007	0.013	0.398	0.310	0.144	1.000	0.121
i30	0.249	0.391	0.340	0.015	0.140	0.412	0.121	1.000

Table 4. Matrix of correlation coefficients (Pearson, 2015) of the B4 competency. The coefficients are within the range [-1,1]. The rubrics related to B4 competency are from i23 to i30

Finally, Cronbach's alpha can be calculated from the variances. The maximum value of Cronbach's alpha is 1 and indicates that the internal consistency of the questionnaires is excellent. The values of Cronbach's alpha obtained for the questionnaire of the leader and team member are 0.81 and 0.87, respectively. This fact allows us to conclude that the instrument consistently measures the intended competency level.

4 CONCLUSIONS

From the analysis of the results we see that the instrument is statistically consistent and permits one to identify competency levels appearing in professional situations. At the same time, it allows one to discriminate not only between members of the same team, but also between competencies of the same individual. The predictive capability of the instrument for superior performance, in the sense of our quotation of Spencer and Spencer (Spencer & Spencer, 1993), has been checked only from the internship of the fourth year students. The consolidation of the instrument within the educational model of the ETSEQ should allow carrying out long-term studies about the professional evolution in the labor market over 5 or 10 years.

The positive results of the pilot test allowed the implementation of the methodology of evaluation of social competencies to all years in the Bachelors of Chemical Engineering and Food Engineering, during the academic year 2013-2014. This implementation demanded the participation of more than 300 students, 7 coordinators and more than 15 tutors. The treatment of the data collected, the maintenance of confidentiality, and the necessity of coordinating a large number of individuals are the main obstacles to effectively implement the instrument and, more importantly, make the methodology sustainable. These problems can be solved using specific tailor-made software to enable remote access, keep the data secure, treat the information automatically, and manage confidentiality. On the other hand, our experience suggests that a reduction of the items to be evaluated is advisable, and that the range of values per item should be increased. Both actions aim at simplifying and systemizing the procedure in order to guarantee the sustainability of the methodology.

Secondly, the implementation of this methodology of assessing social competencies reveals new information about our students. This knowledge is useful for the students since they are confronted with what the others see in them, in the context of the IP: γνωθι σεαυτόν, *know thyself*. Such knowledge should trigger by itself behavioral changes in the students. In the first place, the exposure to the rubrics, when acting as evaluators, causes behavioral changes by imitation of actions suggested by the standard, as we observed during the pilot test. In the second place, the assessment places the students face-to-face with what others see in them. If they dislike the image returned by this mirror they will have motivation to change. Furthermore, the existence of this objective knowledge about the students introduces a new educational necessity in the staff: how to help our students to improve their competency level before they are ready to enter the labor marked. Therefore, including improvement plans in our educational model will be a subject of major research in the future.

REFERENCES

Accreditation Board for Engineering and Technology (2012). *Criteria for accrediting engineering programs*. Available online in: http://www.abet.org/uploadedFiles/Accreditation/Accreditation_Process/Accreditation_Documents/Current/eac-criteria-2012-2013.pdf. (Last access date: February 22nd, 2015).

Agència per a la Qualitat del Sistema Universitari de Catalunya (2012). *Shared "Dublin" descriptors for Short Cycle, First Cycle, Second Cycle and Third Cycle Awards*. Available online in:

http://www.aqu.cat/doc/doc_24496811_1.pdf. (Last access date: February 22nd, 2015).

Belbin worldwide (2014). *Team roles*. Available online in: http://www.belbin.com. (Last access date: February 22nd, 2015).

Cronbach, L.J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika*, 16 (3), 297-334. http://dx.doi.org/10.1007/BF02310555

McClelland, D.C. (1973). Testing for competence rather than for intelligence. *American Psychologist*, 28, 1-14. http://dx.doi.org/10.1037/h0034092

McClelland, D.C. (1998). Identifying competencies with behavioral-event interviews. *Psychological Science*, 9, 331-339. http://dx.doi.org/10.1111/1467-9280.00065

Pearson, K. (1920). Notes on the History of Correlation. *Biometrika*, 13 (1), 25-45.

http://dx.doi.org/10.1093/biomet/13.1.25

Pearson product-moment correlation coefficient (2015). Available online in:

http://en.wikipedia.org/wiki/Pearson_product-moment_correlation_coefficient. (Last access date: February 22nd, 2015).

Spencer L.M., & Spencer S.M. (1993). *Competence at work: Models for superior performance*. New York: Wiley.

Suñé, F.J. (2015). *Virtual Professional Environment: a method for the education and evaluation through competencies*. Doctoral Thesis, Universitat Rovira i Virgili, Tarragona, Spain. Available online in: http://hdl.handle.net/10803/285935. (Last access date: March 24th, 2015).

Suñé, F.J., & Bonet Avalos, J. (2012). *Avaluació de competències socials a l'ensenyament d'Enginyeria Química*. Proceedings of the Congrés Internacional de Docència Universitària i Innovació (CIDUI). Paper presented at CIDUI: Barcelona, Spain. Available online in: http://www.cidui.org/revista-cidui12/index.php/cidui12/article/view/393/387. (Last access date: February 22nd, 2015).

Witt, H.J., Alabart, J.R., Giralt, F., Herrero, J., Vernís, Ll., & Medir, M. (2006). A competency-based educational model in a Chemical Engineering School. *International Journal of Engineering Education*, 22 (2), 218-235.

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