

STRENGTHENING AND MEASURING PROJECT MANAGEMENT COMPETENCES OF ENGINEERING STUDENTS

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Abstract

Since 2010 the Industrial Engineering School at Universidad Politécnica de Madrid (ETSII UPM) has its Plan Study accredited by ABET. Since then a big motivation has been promoted from the management team encouraging teachers to work on the measurement and strengthening of student's competences.

Generic skills or behavior acquired significant importance in the workplace, particularly in relation to project management. Because of this, and framed within the requirements of the European Higher Education Area (EHEA), the curriculum of the new degrees are being developed under the competence-based learning.

This situation leads to the need to have a clear measurement tool skills as a basis for developing them within the curriculum. A group of multidisciplinary teachers have been working together during two years to design measuring instruments valid for engineering students.

A deep analysis has been done to detect which are the trends in the extent of powers, particularly in colleges, to strengthen the teaching of competences. This analysis allowed validate measuring instruments that had already been designed on the competency framework and design those still required.

The measurements have been done in the subject Engineering Projects for the competences: an ability to communicate effectively, an ability to function on multidisciplinary teams and a recognition of the need for, and an ability to engage in life-long learning. Nearly 300 students from two different degrees (Industrial and Chemical Engineers) and three teachers have participated in the experience to obtain interesting results.

Keywords: Innovative Education; competences; communication skills; teamworking; lifelong learning.

1 TRANSVERSAL COMPETENCES

1.1 Competence

The term "competence" has numerous definitions and is used as a synonym of terms as capacity, ability and aptitude. The Royal Spanish Academy Dictionary defines competence as:

Competence (... competentia; cf. competent). f. Expertise, aptitude, suitability to do something or intervene in a particular subject.

In academia, Gonzalez and Wagenaar [1] define the competences as "the combination of attributes, in knowledge and its applications, aptitudes, skills and responsibilities that describe the level or degree of competence with which an individual is capable to carry them out, either professionally or academically".

1.2 Models of characterization of competences

In relation to the existence of multiple frames of reference for the characterization of the competences, the model proposed in the Tuning project is introduced, used in the context of the European Higher Education Area (EHEA). This model poses a set of thirty generic competences common to all degrees of study and a list of specific competences related to each discipline [2].

In the case of generic or transversal competences, these are related to personal development and do not depend on a specific discipline, but all professional fields. Specific competences are typical to each area of knowledge and develop according to the specific qualification. The thirty generic

competences were classified into three main categories: instrumental competences, interpersonal competences and systemic competences.

Other outstanding model for the purpose of this research, due to the certification given to the Escuela Técnica Superior de Ingenieros Industriales (ETSII) since 2010, is the one proposed by the international organization ABET [2]. This comprises eleven competences that the students should acquire throughout the engineering programs, including aspects like the ability to apply knowledge of mathematics, science and engineering, the ability to design and perform experiments, and interpret the results, the ability to design systems, components or processes to fulfill the posed needs, or job skills in multidisciplinary teams, effective communication and recognize the need for learning throughout life, among others, *inter alia*.

However, several studies have determined that not all the ABET competences present the same level of importance for professionals in the field. The competences related to teamwork, communication, data analysis and problem solution were valued above the rest of the criteria proposed [3]. On its part, within the competences in the field of Project Management, the competences which stand out as most valued are the ones related to scope management and communication, as well as leadership and teamwork [4].

Among the most common international standards for measuring competences in the field of Project Management, it is specially worth mentioning the ones published by the Project Management Institute (PMI) and the International Management Association (IPMA), due to its proximity with the approach of this research.

The Project Management Institute (PMI) standard define three aspects of competences for a project manager: competences of knowledge, of performance and personals. The first two are organized around ten knowledge areas of project management: integration, scope, times, costs, quality, human resources, communication, risks, acquisitions and management of groups of interest [5]. Besides, there are personal competences: orientation towards results, orientation towards the customer, impact and influence, management capacity and personal effectiveness.

The standard published by the International Project Management Association (IPMA) divides competences into three areas [6]: technical, behavioral and contextual competences.

1.3 Teamwork

Due to the relevance of this competence, the engineering programs are increasingly being designed to allow students to experience working in groups; from small exercises, to subjects of project simulation. These subjects allow students to be involved in the project from concept to completion, offering the chance to learn to work effectively in teams [7].

Teamwork will include simultaneous or sequential work; i.e., team members must carry out activities in parallel or the results of some members are needed for the work of others. So there must be roles and assigned tasks, leading to the main characteristic of teamwork: coordination. The need for coordination involves that for the work to be effective is required its relation with other skills, among which the most important are: role definition, decision making and goals setting [8].

It is precisely the relation between teamwork with these skills and others as conflict resolution, communication and leadership, which significantly hinders its measuring in the classroom.

The measuring of this competence can be focused depending on the goals achieved; or it can be conducted based on the work process performed by the team throughout the project. The measuring options most commonly used are signatures based on specific criteria or feedback from students regarding the operation of the equipment [10]. In case of involving the students in the process of measuring there are two disadvantages to consider [11]: Students may decide to allocate the same score to all the members of the group; and may allocate scores based on prejudices. Therefore, to avoid such problems it is recommended that the measuring of the competence is not associated with the final grade in the subject.

For this research, the goal is to determine whether students work in teams for the development of a project and subsequent delivery of a written report and oral presentation. For this, the measuring of the competence was focused from two perspectives: the quality of the deliverables, by reviewing the final report and presentation and; the work process that the team performed throughout the project, by the evaluation during working sessions.

The final signature used can be seen in appendix 1.

1.4 Communication

Communication comprises the process of effective exchange between the parties. This competence is key to all undergraduate degrees, and particularly for engineering.

Studies point out that more than 50% of the work time of an engineer is devoted to receive and generate information [12], so most engineering schools have decided to include this competence in their study programs. However, in most cases it is done by means of a subject dedicated to communication instead of introducing the competence in the subjects of the study program.

According to López, D.; Ramírez A. (2011) [13], the competence efficient oral and written communication consists of the following dimensions: Use of graphs; Ability to synthesize; Development of arguments, reasoning and conclusions; Development of examples, metaphors and similes; Development of written memoirs and reports; Public presentations; Participation in debates and brainstorming activities; and Interpersonal communication.

All these dimensions can be reinforced and evaluated in the subjects of the university degree by using oral presentations, written works, etc. However, there is difficulty when assigning goals to each one of the dimensions and distributing these goals among the subjects of the study program.

In spite of the importance of the two dimensions of communication: oral and written, this research focuses on the oral communication, which main goal will be to assess the student's ability to convey ideas, approaches and solutions orally in the presentations of the project at the end of the subject.

The competence of oral communication has been widely evaluated and there are multiple published works about its measuring. In 1990, it was created a measuring tool called "The Competent Speaker" published by the National Communication Association (NCA) of the United States, in which oral communication is measured by means of eight criteria divided into two sections: Criteria of preparation and Criteria of presentation. [14].

Other studies of signatures application for the evaluation of communication show its ease of application and validity of the results. [15].

For measuring this competence it is used a combination of criteria of preparation: supporting material and organization of the information; and criteria of presentation: language and vocabulary, and communication techniques. The signature used is presented in Appendix 1.

1.5 Lifelong Learning

The concept "Lifelong Learning", known also by its acronym LLL, is linked to the idea that learning should be achieved in all stages of people's life, and in all contexts. [16]. This covers the learning range which includes: formal, informal and non-formal education. [17]

Besides, lifelong learning is associated with the ability of people to be self-taught. [16].

Among the diverse benefits attributed to lifelong learning by several authors we can cite [18]: improves cognitive abilities, increases job opportunities and the possibility of scaling within companies; increases self-confidence and self-esteem and improves resilience by being more in line with changes in society, particularly the technological ones.

The measuring of this competence is complex due to its wide spectrum. One of the first measuring attempts was the Self-directed Learning Readiness Scale designed by Guglielmino in 1977, which consists of a 58 items Likert type questionnaire, designed to evaluate the aptitudes, skills and characteristics of the personality which support the self-directed learning. [19].

In 2004, the Effective Lifelong Learning Inventory (ELLI) is developed, a 75 items questionnaire with seven categories: changing and learning; critical curiosity; meaning making; dependence and fragility; creativity; learning relationship and; strategic awareness [16].

In 2010, Coşkun and Demirel developed the Lifelong Learning Tendency Scale (LLTS), which presents 74 items with a Likert scale of 6 levels, from 1 –Not adequate, to 6 –Completely adequate. [20].

During the same year, Kirby et al. developed a questionnaire of 14 items with a Likert scale of 5 levels [21]. The questionnaire is based on the work of Knapper and Cropley who argue that it is important to teach students the ability to guide their own learning throughout their lives and in all situations that arise, and describe that those students who practice lifelong learning are able to: set goals; apply knowledge and skills; self-learning and self-directing; locate information; and adapt their learning strategies.

This questionnaire has been used effectively to measure lifelong learning from college students at universities in Malaysia [22] and the United States [23], so it is considered appropriate for this research.

2 METHODOLOGY

The research was carried out following the next steps: in the initial phase where the study of the required documentation was made, then measuring instruments to be used were chosen or designed when necessary. Subsequently, data collection and analysis was performed, using the statistical tools mentioned below.

Table 1: Research phases.

RESEARCH PHASES
1. Literature review
2. Design of measuring instruments
3. Data collection
4. Analysis of results
5. Conclusions and learned lessons

The universe of study for our research consists of all students signed up in the subject Projects of Engineering during the triannual of September-December 2013, which includes groups from the old study program (Program 2000) and the new study program (GITI).

For the Oral Communication competence, the measuring was performed during the presentations of the project posed in the subject "Projects of engineering". The final sample consisted of 178 measuring's corresponding to 24 different groups, with an average of seven students per group.

For the Teamwork competence, the measuring was performed in three different moments during the development of the subject "Projects of engineering". On one of the occasions, the measuring was carried out by two different teachers in order to validate the results.

The final sample consisted of 24 measuring's corresponding to 24 different groups, with an average of seven students per group. These groups correspond to the 24 groups referred in the results of communication.

To measure the competence of Lifelong learning, the questionnaire was delivered to all students who represented the total sample of the study. In the questionnaire was included the option of marking the student gender and the specialty to which they belong, which gave us a greater amount of variables to analyze. The sample of the completed questionnaires was of 282 questionnaires.

A summary of the characteristics of the sample for all the measured competences is shown below in Table 2:

Table 2. Characteristics of the sample for all measured competences.

Study Plan	Oral Communication		Team working		Life long learning	
	N	%	N	%	N	%
Plan 2000	90	50,6%	12	50%	173	61,3%
GITI	88	49,4%	12	50%	109	38,7%
Total	178	100%	24	100%	282	100%
Gender	N	%	N	%	N	%
Male	--	--	--	--	183	64,9%
Female	--	--	--	--	97	34,4%
Unkown	--	--	--	--	2	0,7%
Total	--	--	--	--	282	100%

Data processing was performed using the computer program STATGRAPHICS 5.1 Plus. For the analysis of the results, descriptive statistics was used. For the Lifelong learning competence a discriminatory analysis was carried out minding the gender of the students who responded to the survey. A multivariate analysis was also performed in order to see the existing canonical correlation between the competences of teamwork and communication.

3 RESULTS

3.1 Oral Communication Results

3.1.1 Descriptive analysis

The following table shows the results of descriptive statistics according to the performed measurements:

Table 3. Descriptive analysis for oral communication competence.

		Mean	Std deviation	Lower Limit	Upper limit
C1	Presentation structure	3.11	0.71	1	4
C2	Language and vocabulary	3.25	0.59	2	4
C3	Graphic resources	2.66	0.70	1	4
C4	Communication techniques	2.81	0.66	1	4

For all indicators the maximum value corresponded to the end of the scale, however for minimum values, in the case of Language and Vocabulary the minimum value observed is 2, which indicates us that there is a basic level of this indicator that has been achieved by all students in the subject.

The indicators Structure of the Presentation and Language and Vocabulary have favorable values, both with an average above three points. On the contrary, both the indicators Communication Techniques and Graphics Resources have opportunity for improvement with averages of 2.81 and 2.66 respectively.

Throughout the subject, from the measuring was clear that these indicators represented the greatest challenge for students, so it was decided to take note of all behaviors associated to these indicators in order to have more information that may be relevant for the approaching of conclusions and improvement plans. During the measurement process, the most negative behaviors observed are presented (in order of importance). The most usual behavior linked to the indicator Graphics Resources is the font size used in the presentation, particularly in the tables presented. In most cases when this resource was used, the font was too small to be clearly visible by the audience.

Linked to this behavior is the slideshow overloaded with information that would have been recommendable to separate into two, or even three different slides. In most cases the extra

information was not used, the presenter noted some relevant data on the slide before moving to the next slide, which leads to the conclusion that there is an error in the synthesis capacity.

For Oral Communication Techniques two behaviors stood out: students do not look at the audience and do not know how to use their hands in order to emphasize the message that they are transmitting orally. In the first case, most of the students presented in profile to the audience, looking to the slides (reading or not the information in them), while in the second case the students kept their hands behind their back, in pockets, crossed or were carrying papers. It is of interest to emphasize that most of the students who presented with papers in hand did not read the information written in them.

3.2 Teamwork Results

3.2.1 Descriptive analysis

The following table shows the results of descriptive statistics according to the performed measurements:

Table 4: Descriptive analysis of the Teamwork competence

		Mean	Std deviation	Lower Limit	Upper limit
TW1	Meetings participation	2.88	0.74	2	4
TW2	Written work	2.58	0.58	2	4
TW3	Presentation	2.88	0.74	2	4

For all indicators the maximum value corresponded to the end of the scale, however the minimum value observed is 2, which indicates us that there is a basic level of teamwork that has been achieved by all students in the subject.

The indicators Involvement in meetings and Written Work have the same mean and deviation, which at first glance may be unlikely, but is clearly explained because as indicators of teamwork, it stands to reason that they are consistent. Those groups that better communicate and interact with each other will have greater chance of convey correctly their project to an audience. In fact, if the results are analyzed in depth is observed that 21% of the measurements present consistent evaluations for all three indicators. Only three of the measurements show a gap greater than 1 point in the evaluation range. Since measurements were taken in different situations and moments and indicators per group were not put together until the end of the project, we can conclude that the results are correct.

The indicator Teamwork shows the lesser mean obtained of 2.58, in general at first glance the works submitted despite having an adequate structure and thread, presented many inconsistencies in terms of format and did not establish logical links along the sequence of information. The information was presented in separate sections which were not indexed among themselves and in many cases they repeated information. It is foreseeable to suppose that each team member wrote his part of the report separately and then these were assembled in the final report without an editorial work of the full content.

While tasks division is a logical and desirable option when there is teamwork, it is important that the design of the school students education includes teaching of written texts reviewing and editing.

3.3 Lifelong Learning Results

3.3.1 Descriptive analysis

The descriptive statistics results for the Lifelong Learning questionnaire are shown in Table 5. Items are classified according to the following groups: Group A-Set goals; Group B-Apply appropriate knowledge and skills; Group C-Self direction and evaluation; Group D-Locate required information; Group E-Adapt learning strategies to different conditions; and Group E-Carry on the studies.

For all the questions the minimum and maximum values corresponded to the ends of the scale; 1 (totally disagree) and 5 (totally agree). In positive formulated items, mean varies from 3.38 to 4.19 which points out a clear trend towards lifelong learning.

In negative formulated or reverse codified items; where it is expected the answers to be between the values 1 and 3, mean ranges from 1.66 to 3.19. This last measure corresponds to item number 4: I feel uncomfortable in situations of uncertainty, which corresponds to Group E: Adaptability of learning strategies. Interestingly, another item in this group, number 2: I prefer problems with only one solution, also has a relatively high mean, which leads us to conclude that it is important to reinforce this aspect of learning in the study programs, by promoting the adaptability to changes and unexpected situations.

It is particularly important question 15: I think that when I finish my studies I will know everything I need for my professional performance, with an average of 1.66, which immediately tells us that the students are aware of the need to keep on training.

Table 5. Descriptive statistics of the Lifelong learning questionnaire.

	Grupo	Media	Desviación Estándar
Q1* <i>I prefer others to plan my learning</i>	A	2.49	1.02
Q2* <i>I prefer problems with only one solution</i>	E	2.98	1.09
Q3 <i>I can handle the unexpected and solve problems as they occur</i>	E	3.79	0.72
Q4* <i>I feel uncomfortable in situations of uncertainty</i>	E	3.19	1.04
Q5 <i>I am able to find meaning when others do not find it</i>	B	3.55	0.79
Q6* <i>I rarely think about my learning and how to improve it</i>	A	2.29	1.08
Q7 <i>I feel I learn by myself</i>	A	4.10	0.80
Q8* <i>I think that others are better placed than me to evaluate my success as a student</i>	C	2.88	1.13
Q9 <i>I love learning for learning</i>	A	3.51	1.01
Q10 <i>I try to relate academic learning with practical aspects</i>	C	4.13	0.76
Q11* <i>I often find it difficult to locate information when I need it</i>	D	2.82	1.11
Q12 <i>When I learn something new I try to relate it with what I already know</i>	B	3.93	0.92
Q13 <i>It is my responsibility to give meaning to what I learn at School</i>	C	3.38	1.09
Q14* <i>When I learn something new I try to focus on details rather than get a global idea</i>	A	2.46	0.93
Q15* <i>I think that when I finish my studies I will know everything I need for my professional performance</i>	F	1.66	0.86
Q16* <i>I am looking forward to finishing my studies so I do not have to study anymore</i>	F	2.78	1.34
Q17 <i>If I had the opportunity to continue my education, I would gladly do it</i>	F	3.55	1.05
Q18* <i>I think that most of the knowledge I have acquired will be valid throughout my professional life</i>	F	2.75	1.15
Q19 <i>I value the importance of keeping current on the latest progresses</i>	F	4.19	0.87

Note: The * indicates those items with negative formulation (inverse codification)

3.3.2 Discriminant analysis by Gender of students

When performing the discriminant analysis by students' gender, we can see that the p-value obtained is less than 0.05, which indicates a significant difference depending on the gender of students.

Table 6. Discriminant analysis by gender of students from the competence Lifelong learning.

P-Value	0.0004
Plan	Centroide
Male	0.323792
Female	-0.609287

To further study the difference, the means of the items are shown in the following figure:

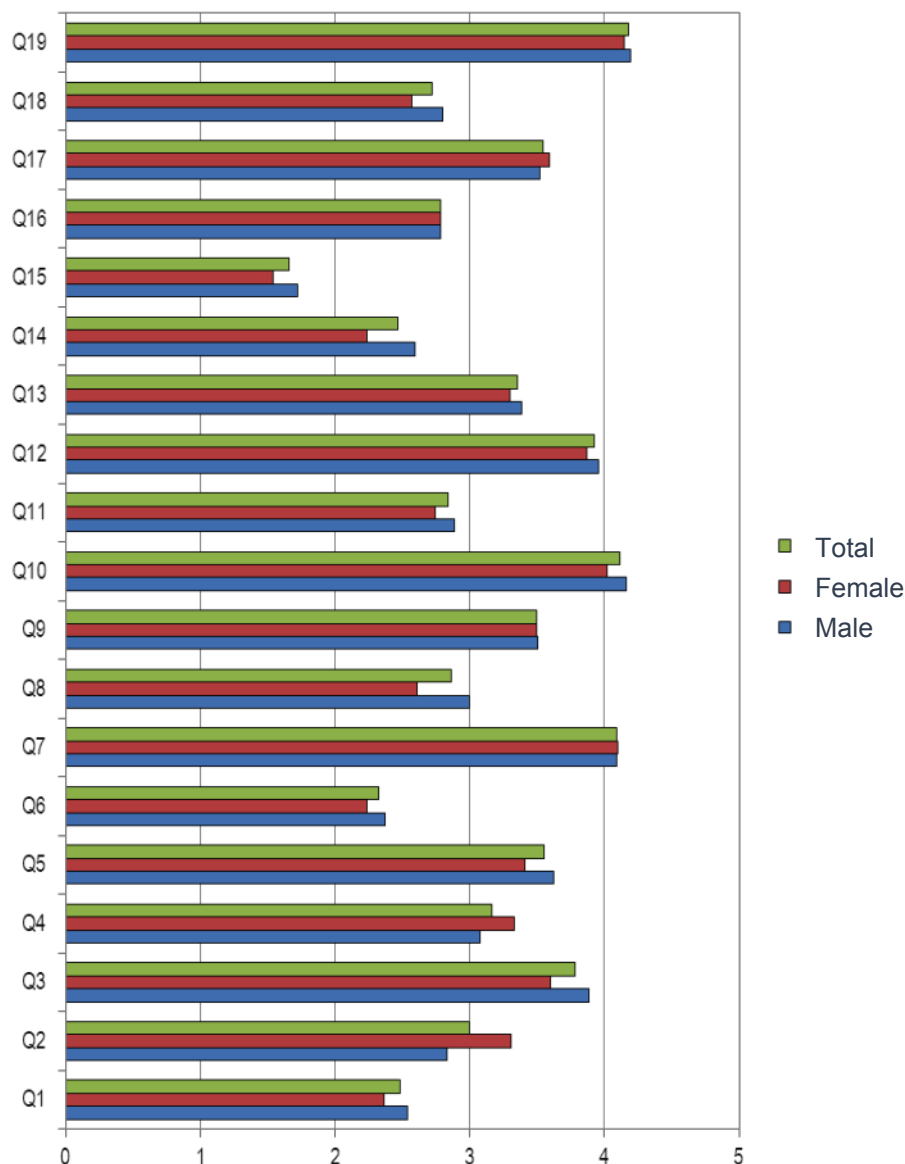


Figure 1. Results from the Lifelong learning Questionary depending on the gender of students.

Interestingly, items Q2 *I prefer problems with only one solution* and Q3 *I can handle the unexpected and solve problems as they occur* belong to Group E - Adaptability of learning strategies, which has been referred previously as one of the categories that need reinforcement. Means for both items point out that the female population shows a slight tendency to an organized planning and could present major problems in situations of change or uncertainty. We can confirm that the last item corresponding to this category, number 4: *I feel uncomfortable in situations of uncertainty* has the same trend with a mean of 3.08 for men vs a mean of 3.33 for women.

On the other hand, in item 8: *I think that others are better placed than me to evaluate my success as a student*, we observe a higher mean for male population, which points out that women are more comfortable in situations of self-assessment.

Another interesting point to highlight in Figure 1, are the similarities between the sexes, particularly in the case of item 16: *I am looking forward to finishing my studies so I do not have to study anymore*, which showed difference among study programs, however their means are exactly the same (2.78 vs 2.78) in differentiation by gender.

4 CONCLUSIONS

Students have a tendency to work together, particularly in work meetings and group presentations.

They show opportunity to improve when making written reports in group; reports show clear differences between sections from different authors. It is recommendable to encourage the teaching of written texts edition, in order to deliver a consistent and well organized final work regardless of the number of people who have worked in its production.

It is proposed to modify the signatures used in the measuring in order to get more information from students that allows us to push even more this competence.

The measuring shows a clear need to strengthen the competence of communication particularly at the level of the indicators *Communication Techniques* and *Graphic Resources*.

The study of associated behaviors shows that students do not look at the audience, do not use body language to emphasize the message and present slides that are difficult to follow due to an excess of information, or too small font to be clearly visible by the audience.

It is advisable that, at the beginning of any subject that requires oral presentations, guidelines and recommendations for the oral presentation are indicated: font sizes to use, proper use of graphs, tables and images; so their size.

Similarly, it is important that feedback from teachers at the end of each presentation is focused not only on the content, but on the structure itself. And that constructive criticism is made to each group and/or student about the format of the presentation and the communication techniques used: tone of voice, hand movement, positioning, connection with the audience, etc.

Currently, university offers the subject Communication Skills as optional for undergraduate and master students at school. It is recommendable to consider including this subject as compulsory within the study programs of the grades, due to the importance of the competence and the clear weakness that students have.

As for lifelong learning, the measuring shows a clear positive trend by students towards Lifelong learning. In particular towards the need to keep on training once formal education is completed in order to improve professional performance.

A clear need to reinforce the facet related to adapt to new learning strategies, and manage reaction to changes and unexpected situations is observed.

Regarding the study programs few differences are observed, students from GITI are more favorable to continue their studies, but is considered that this result can be associated with the plan conditions (currently, the only students from GITI who are studying the subject "Projects of Engineering" are those that are up to date with their study program and therefore less likely to be "tired" of studying).

It is recommendable to use different teaching methodologies throughout the degree, in order to give the students the possibility to cope with different situations. Subjects like Projects of Engineering that follow the methodology of Projects-based Learning are a clear example of this situation. Other options include using simulation programs, promoting international exchanges and making contests or competitions, where students are forced to deal with situations different from typical exams or written works, so that self-taught education is promoted along with other skills.

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APPENDIX 1: RUBRICS USED

Table 1: Oral Communication Rubric

		Unsatisfactory - 1	Needs to be improved - 2	Satisfactory - 3	Excellent – 4
A	Organizes clearly the content and information of the presentation	<p>The presentation is messy and does not have a logical structure. It is not organized using sections, parts, numbering, headings, etc.</p> <p>The listener can only follow it with great effort and is hard to identify the core message.</p>	<p>The presentation is organized confusingly. The organization into sections, parts, titles, etc. is unclear.</p> <p>The listener can not properly understand the communication and must strive to follow it.</p>	<p>The structure is clear with some minor points which are messy or confusing.</p> <p>The organization into sections, parts, titles, etc. is clear though with some improvable small aspect.</p>	<p>The structure of the presentation is clear, logical and well cohesive.</p> <p>The listener can easily understand it and follow it.</p>
B	Uses the right style to facilitate the understanding by the recipients considering their expectations and prior knowledge	<p>The communication level and vocabulary are not suited at all to the situation and the audience.</p> <p>It is too simple or too specialized and technical according to the audience background and to the nature of the communication</p>	<p>Often, the style in which the communication is done does not take into account the audience. Often, ideas and vocabulary not suitable to prior knowledge of the audience and the nature of the communication are introduced.</p>	<p>In general, the style is suitable for the audience although, sometimes, introduce some ideas and vocabulary or too simple or, conversely, too complicated for the audience.</p>	<p>The style used is suitable for the nature of the communication. The way to explain the content and the vocabulary used are perfectly adapted to the type of audience (expert or not).</p>
C	Uses the graphic resources and the necessary means to communicate effectively the information.	<p>Does not use graphic resources or additional communication support means.</p>	<p>The graphic resources or other means are poorly prepared or are used inappropriately (figures have poor quality, graphics presentation does not help for the analysis and interpretation of the information, etc.)</p>	<p>Uses different resources but, at some time, are not the most adequate or do not help to the analysis and interpretation of information.</p>	<p>Uses graphic resources or other means which ease communication, interpretation and analysis of the information. They are prepared professionally and constitute a good support for the communication..</p>
D	Uses correctly oral communication techniques	<p>The way of communicating does not help to keep the attention of the audience.</p> <p>Presents very nervous, read directly from the notes and does not use oral communication techniques.</p>	<p>The speech is not well supported by oral communication techniques.</p> <p>Does not look at the audience, does not modulate the tone or, sometimes, does not use the proper volume, does not reinforce the oral message through gestures or includes tags in the speech.</p>	<p>In general, uses well oral communication techniques but, sometimes, does not look at the audience, includes tags or does not use the appropriate volume.</p>	<p>Reinforces the message and gets to kept the attention of the audience using effectively oral communication techniques: looks at the audience, uses the appropriate volume, modulates the tone, reinforces the oral message through gestures, does not include tags in the speech, etc.</p>

Table 2. Teamwork Signature

		Unsatisfactory - 1	Needs to be improved - 2	Satisfactory - 3	Excellent - 4
A	The student takes part/participates in work meetings contributing with his/her knowledge and skills to achieve the common goal.	Group members have a passive attitude, do not take part nor collaborate to achieve the result. The group does not work, they require constant support of the teacher and fail to achieve their goals.	One or more members of the group have a passive attitude and do not participate, nor collaborate to achieve the result though, through the effort of the remaining members, the group gets to achieve the objectives.	All students take part in the tasks assigned to the group but some of them have less involvement or reduces its participation to simple tasks (write down data, setting equipment closer, etc.).	All students participate and contribute to the group, ordering and reconciling their contributions in order to achieve the result.
B	The work done by students has a thread, logical structure and style homogeneity.	The work has heterogeneity of styles and formats and/or large inconsistencies between different parts of the document.	Sometimes, the different parts of the work are not fully connected and there are inconsistencies in style, content and sequencing.	The work has a thread and in general logical connections between parts are set. In any section, minor inconsistencies in style, format or content may appear.	The work has a thread, is well organized and logical connections between all parts are set. The style and formats of the entire document are homogeneous.
C	Any student of the group is able to present, explain and defend any part of the work.	Generally, in the presentation becomes evident that one or more students do not know some parts of the work or that they are unable to relate the constituent parts. In general, most of the group members do not have an overview of the work.	At any time, any of the team members has had difficulties justifying arguments or providing answers referred to any part of the work. Only some students seem to have participated in all the work and have an overview of it.	The students in the group are able to expound, explain and defend with ease and fluency any part of the work but certain inequality between them can be seen Some student in the group shows a degree of participation in the work and overall control of it that is somewhat smaller than their team mates.	Throughout the presentation any student in the group is able to expound, explain and defend with ease and fluency any part of the work. All students in the group prove to be copartners of the work as a whole