

EFFECT OF THE TEACHING ACTIVITY EVALUATION IN THE ENGINEERING EDUCATION QUALITY

F. J. MARTÍN-CARRASCO¹, J.J. FRAILE-ARDANUY² and L. GARROTE DE MARCOS¹

¹ Department of civil engineering: hydraulics and energy

Technical University of Madrid, c/ Profesor Aranguren, s/n. 28040. Madrid, Spain

² Department of special technologies applied to telecommunications, Technical University of Madrid, Spain

e-mail: f.martin@upm.es

EXTENDED ABSTRACT

The main objective of this paper is to prove the positive effect that teaching activity evaluation of university professors has on the quality of engineering education. This conclusion can be obtained after an analysis of six years of experience in the Escuela de Ingenieros de Caminos at the Technical University of Madrid.

Professor's evaluation in Spain was introduced in 1983 with the University Reform Law (Ley de Reforma Universitaria, LRU), focusing separately on the teaching and research activities of the professor. However, while the research activity evaluation was delegated to a national commission (Comisión Nacional Evaluadora de la Actividad Investigadora, CNEAI) according to a general procedure, the teaching activity evaluation was delegated to each University by their own rules. Unfortunately, most of the Spanish universities gave no enough relevance to teaching evaluation and, of course, there was no standard procedure to perform this evaluation. In most cases, the teaching evaluation was traditionally conducted by students' unions. The usual procedure was a paper form given to students who were attending lectures on a given day near the end of the term. The results had all type of errors: arithmetic, confusion among subjects and among professors, lost data, etc. Finally, dissemination of evaluation results was forbidden and limited to the professor himself and, eventually, to the Director of his Department.

In 2005, the Escuela de Ingenieros de Caminos (School of Civil Engineers) developed a new on-line system for teaching activity evaluation. This system was immediately accepted by the students and their participation has been growing since then. Faculty were, with few exceptions, collaborative, interested and satisfied with the procedure. The evaluation results were exposed publicly (of course, within the limits of the Spanish Data Protection Law). The system has been carried out from the academic years 2005-2006 to 2009-2010.

By analysing the results of the evaluation in these years, it can be concluded that there has been a general improvement of the quality of teaching, and that one of the main reasons for that has been the public dissemination of results, since professors are more prone to make an effort to improve their own results, and consequently the quality of their teaching. This effect is most evident in younger and non-staff professors. The reasons are twofold; firstly they improve as they get the feedback of their teaching activity and can compare it with the results obtained by their colleagues and, secondly, they improve due to the necessity to get good qualifications to become permanent university employees.

KEYWORDS

Teaching activity evaluation, Professor evaluation, Teaching survey

1. INTRODUCTION: EVALUATION OF TEACHING IN SPAIN

University professor evaluation was introduced in 1983 by law. But it did not begin until 1989, when the Royal Decree 1086/1989 on professors economical retributions was enacted, proceeding to evaluate teaching and research activities of professors. A year later, the University Council delegated the evaluation of teaching to each university and the evaluation of research to a national commission (Comisión Nacional Evaluadora de la Actividad Investigadora, CNEAI).

Since then, the evaluation of teaching activity has been done in different ways by each university, through few and poorly regulated procedures, designed to give, without many qualms, the five-year terms retribution to professors, even if they had no effective teaching performance. However the evaluation of research activity centered in the CNEAI has been very selective, developing a regulated procedure with very comprehensive and specific rules, as well as clear criteria (discussed and criticized, but effective).

Therefore, after more than 20 years of professor's evaluation, the result has been what it was expected. The evaluation of teaching is not reliable or relevant for promotion of professors, but only to get additional remuneration. Meanwhile, the evaluation of research activity, as well as additional remuneration, is the only way for professors to access and to promote inside the university [3]. In a few years the damage that this procedure has caused to Spanish universities will be visible, although in some disciplines where technology-oriented vocational professors are required, the effects are already evident [9].

To correct this situation, the National Agency for the Evaluation of Quality and Accreditation (ANECA) introduced in 2007 the DOCENTIA program, to establish a consistent and verified procedure for the evaluation of teaching activity [5, 6]. The DOCENTIA program is a first step, but is far from being an effective evaluation procedure [8] and it still focuses on facilitating the provision of five-year terms, but generating more paperwork in the process. But the procedure is not useful to recognize the worth of professors who are engaged in teaching activities in a satisfactory manner, and to identify those who are not, with the consequences that can result in both situations.

To bridge this regulatory gap, the School of Ingenieros de Caminos of the Technical University of Madrid (UPM) introduced a very innovative system for teaching evaluation in 2005-06 [7]. After five years, this paper examines the results and verifies the positive impact that the procedure has had on teaching. Compared to the present Spanish university system, which greatly underestimates the teaching activity, we believe that the procedure implemented in the School has increased the interest and respect for this activity.

2. EVALUATION MODEL OF THE TEACHING ACTIVITY IMPLEMENTED IN THE CIVIL ENGINEERING SCHOOL OF UPM

Teaching evaluation in the School of Ingenieros de Caminos, as well as in most university schools, has traditionally been conducted by student unions, with their own means and at their own expense. The usual procedure was to fill out a paper questionnaire among students attending school on a given day. The processing of the results was painstaking and slow, lasting from 9 to 12 months. The results had all type or errors: arithmetical, confusion of subjects and professors, lack of evaluation of some subjects and professors, etc. Besides, it was usual that some academic years surveys were not carried out at all. The results, when available, were delivered only to the professor concerned and his Department Director.

During the academic year of 2005-06, the new School management team considered that proper evaluations could not rely on the goodwill of the students and their limited means. A new teaching evaluation system was developed by the School head-professor [1, 2]. No reference has been found that a similar procedure implemented in any other university, Spanish or foreign [4]. The system was immediately accepted by the students. Their participation has been growing since then, as shown in Table 1 (the slight decrease in 2008-09 was due to the fact that surveys had a shorter time limit, and in 2009-10 was due to the implantation of DOCENTIA in the middle of the surveying period). Professors are, with minor exceptions, interested and satisfied with the new procedure.

Table 1: Evolution of subjects and professors survey

Academic year	Number of evaluated professors							Number of evaluated subjects	Number of surveys			Dissemination
	1st year	2nd year	3rd year	4th year	5th year	6th year	Total		On professors	On subjects	Total	
New System: on line evaluation												
2009-10	31	27	39	35	68	66	266	68	2.513	1.034	3.547	Yes
2008-09	34	29	40	37	62	69	271	64	3.126	1.237	4.363	Yes
2007-08	32	32	35	36	67	71	273	68	3.449	1.352	4.801	Yes
2006-07	41	24	36	31	60	63	256	68	2.263	1.022	3.285	Yes
2005-06	28	30	28	30	51	62	235	68	908	535	1.443	Yes
Former traditional System: paper and pencil in the class room												
2004-05	7	13	36	38	29	59	182	48	No data			No
2003-04	10	26	22	26	56	58	198	59	No data			No
2002-03	No professor evaluation was conducted											
2001-02	No professor evaluation was conducted											
2000-01	9	15	0	16	28	38	106	35	No data			No

Note: The number of students ranges between 1.800 and 2.000. The number of professors ranges between 255 and 270. The curriculum in the Civil Engineering School has six years of studies with 79 different subjects, most of them compulsory for the student, plus the final Project.

The procedure had other effects not initially foreseen. On the one hand, since the results are now widely known by all professors and students, they have been used (in favor or against) in the renewal and recruitment of professors, and to assign responsibilities for coordinating subjects. On the other hand, it has made possible the delivery of teaching certificates for professors who were involved in accreditation processes, in the absence of an equivalent procedure in the UPM. Finally, the attitudes of professors and students have evolved from a situation of indifference and passivity to an awareness and appreciation for the professor's role.

In order to describe the procedure, it can be divided into two parts: (1) obtaining information through a web-oriented system for conducting surveys, and (2) the presentation of this information and its dissemination to professors and students.

Students access the system with no other requirement to be registered as users in the virtual area of the school (all students are registered from the moment they begin their studies). The student is presented with the list of subjects in which he is registered. Once selected a subject, the student can fill out the survey of the subject itself and of its professors. When conducting the survey on the subject itself, ten questions are displayed on screen which the student must rate between 0 and 10. When conducting the survey on the professors, the system displays the list of professors of that subject, among whom the student should select those who he wishes to evaluate. The evaluation of professors is also done by rating ten questions between 0 and 10. In addition, on the home page of the system students can freely express their opinions on several educational related issues.

Upon completion of the survey on a subject or a professor, the student cannot modify or re-do it (it is removed from the list of subjects that he can access). However, from that moment on or during subsequent sessions, he can fill in the surveys for the rest of his subjects and their professors. Surveys are anonymously incorporated to a data base, without any reference to the student identity.

The results obtained after processing the surveys are published in late June when the final exams have been completed (about 30 days after the deadline for carrying out the surveys). Data is presented in charts and graphs, simple enough to allow quick comparisons between results, but also with enough detail to analyze particular cases.

Dissemination of results, always within the limits permitted by Spanish data protection laws, breaks the former traditional obscurantism of survey results and is essential for the procedure to be effective. Each professor can compare his results with those of colleagues. Students, who for the first time have access to the results of professor evaluations, may use the results to choose their elective subjects.

3. ANALYSIS OF RESULTS

In this five years there have been made and processed more than 17,000 surveys on subjects and professors (Table 1). In order to show graphically the results of the surveys in a comprehensible manner, the graph type shown in Figure 1 has been chosen. This graph compares the scores of the first year (2005-06, on the horizontal axis) and the last year (2009-10, on the vertical axis). Each point on this graph represents a subject or a professor and the grades obtained in these two years. All points (subjects or professors) that are located above the diagonal have improved their rating in that period of five years, while those falling below have worsened (the diagonal is considered a strip of width 1.5 points instead of a single line). Furthermore, for faster visual evaluation, the chart area can be divided into six zones shown in Figure 1.

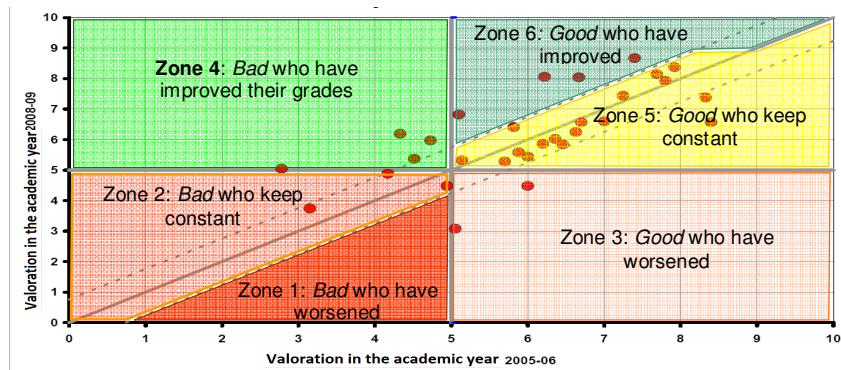


Figure 1: Graph type used to display the results of the surveys.

3.1. Evaluation of subject

The evaluation of each subject is done by the following ten questions:

- A1: You [*the student*] have enough background to follow the course.
- A2: Lectures are useful for learning the subject.
- A3: There is good coordination between the theoretical and practical aspects.
- A4: The course syllabus is appropriate in relation to the available lecture hours.
- A5: The proportion between theory and practice hours is adequate.
- A6: The selected bibliography is correct and easy to find.

- A7: The exam is appropriate to evaluate the learning objectives.
- A8: Your interest for the subject has increased after attending the course.
- A9: You would choose this course if it were optional (or would choose it again).
- A10: General evaluation of the subject.

Students may grade each question from 0 (strongly disagree) up to 10 (strongly agree). However, for questions A4 and A5, also graded from 0 to 10, their optimum value is 5.

Figure 8 (in annex) shows the ratings for each of these ten questions. To clarify the graph, there are only represented the 30 subjects which were evaluated by five or more surveys in each of the five years. When analyzing this figure, almost all questions have more subjects above the diagonal than below it.

Variation of scores from 2005-06 to 2009-10 are shown in Figure 2. Many subjects repeat their rating in all five years, but there are significantly more subjects that end up with better ratings than with worse ones (except for question A2). The evolution is also positive for the main question (A10), where eight subjects improve their score, while four make it worse, although two of these are clearly positive ratings. The remaining 18 subjects maintain their scores (remain in the diagonal band).

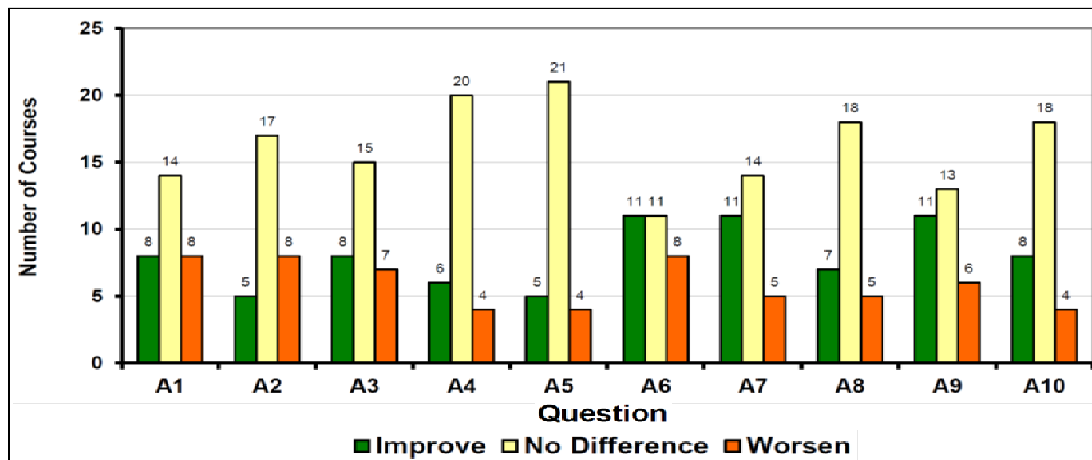


Figure 2: Variation in the rating of subjects from 2005-06 to 2009-10.

Table 2 presents the average ratings for all the questions. Results are higher in 2009-10 than for 2005-06 (for A4 and A5 these differences are negative, because moves away from 5, which is their optimal value). The differences are minimal for questions A1, A2 and A3, but they are significant for A6, A7, A8, A9 and A10. This data supports the conclusion that there has been a general improvement in the subjects during this period.

Table 2: Average rating for questions about the subjects.

Term	Number of subjects evaluated with more than 5 surveys	Average rating for subjects with 5 or more surveys									
		A1	A2	A3	A4 (best if 5)	A5 (best if 5)	A6	A7	A8	A9	A10
2005-06	33	6,2	6,2	5,7	6,3	6,1	5,7	5,5	5,9	5,4	6,0
2006-07	44	6,3	6,1	5,7	6,1	5,9	5,8	5,8	6,1	5,9	6,1
2007-08	48	6,1	6,2	5,6	6,5	6,2	6,1	6,1	6,3	6,1	6,3
2008-09	53	6,5	6,3	5,8	6,4	6,2	6,3	6,3	6,5	6,2	6,4
2009-10	48	6,5	6,4	5,9	6,5	6,3	6,4	6,4	6,5	6,4	6,6

Note: Ratings from 0 (very bad) to 10 (very good), except for questions A4 and A5, where a value of 5 is their best.

3.2. Professor's evaluation

The evaluation of each professor is done by answering the following ten questions:

- P1: Attends to the scheduled lectures.
- P2: Begins and ends lectures on time.
- P3: Is clear in his explanations.
- P4: Uses properly the educational resources: voice, whiteboard, presentations, ...
- P5: Links the subject with other subjects or with the practice of engineering.
- P6: Motivates students to learn the subject.
- P7: Has, in general, a positive attitude toward the students.
- P8: Is available in his or her office hours.
- P9: You would wish that this professor would teach also other subjects.
- P10: General evaluation of the professor.

As before, students score each question from 0, when they have a very bad opinion about the professor related to that question, up to 10, when their opinion is optimal.

Figure 9 (in annex) shows the ratings for each of the ten questions. There are only represented the 89 professors who have been evaluated by five or more surveys in each of the five academic years. Professors are classified according to their professional category as full professors (Catedráticos de Universidad, CU), associate professors (Titulares de Universidad, TU) and others non-staff professors. Figure 9 shows a general improvement in the ratings since most professors are placed above the diagonal stripe.

Variation of scores from 2005-06 to 2009-10 for each of the ten questions are shown in Figure 3. For questions P4, P6, P8, P9 and P10, there are more professors who improve than those who remain equal or get worse. For questions P1, P2, P3, P5 and P7 most of the professors keep their ratings, although there are more professors who improve than those who worsen.

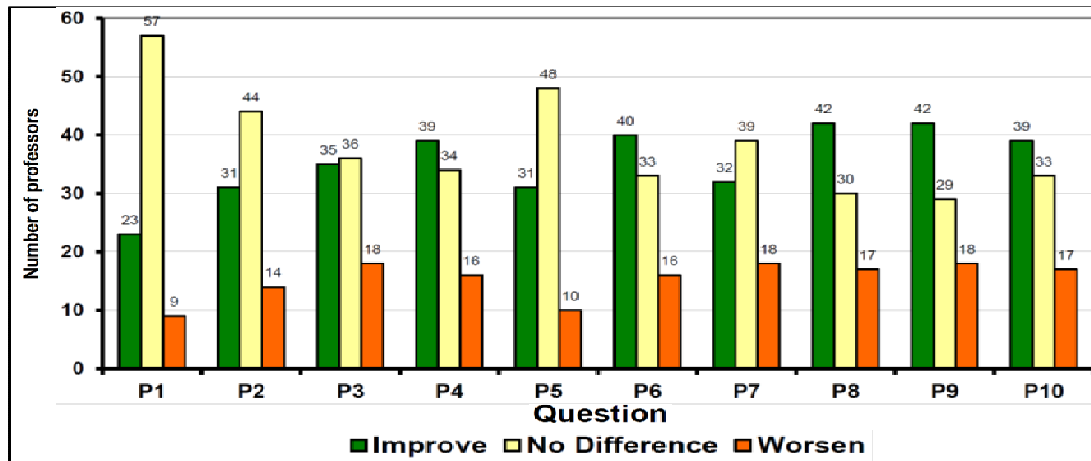


Figure 3: Variation of professor's ratings from 2005-06 to 2009-10 .

Results of the question P10 can also be analyzed depending on the professional category of professors (CU, TU and others non-staff) and their age (with 58 years or more, between 57 and 47 years, and younger than 46 years). The results are shown in Figures 4 and 5, and in all cases there are more professors who have improved their assessment than professors who have worsened, regardless of professional status and age. However, the proportion of professors who improved is significantly higher for the "others non-staff" category and the younger ones. Equal conclusions can be obtained

from Figures 6 and 7, where it seems that the improvement is more related to the age factor than to the professional status.

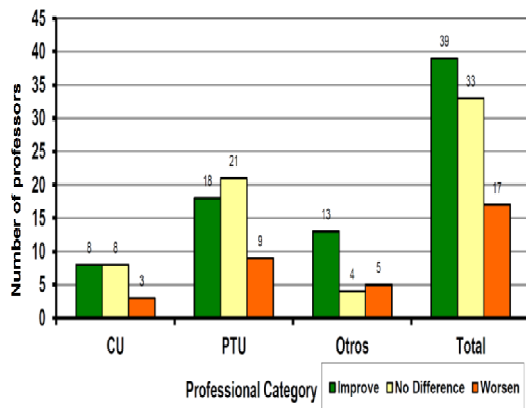


Figure 4: Variation in the assessment of professors depending on their professional category.

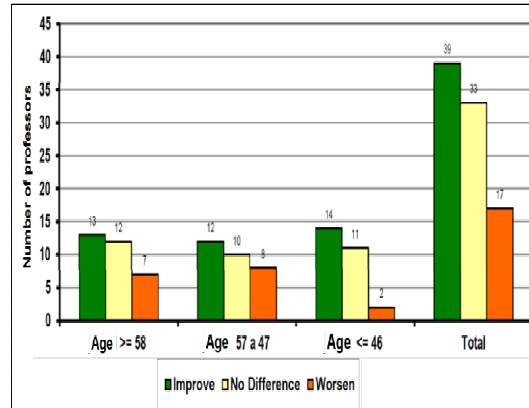


Figure 5: Variation in the assessment of professors depending on their age.

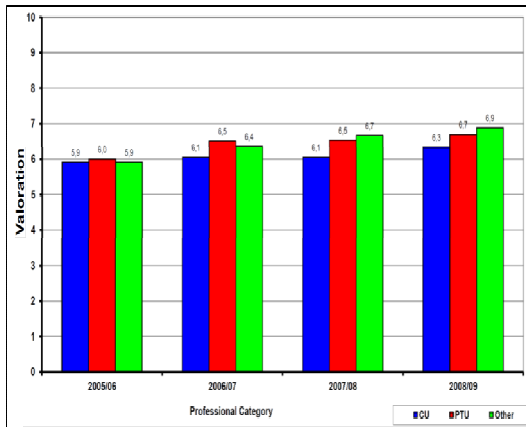


Figure 6: Question P10: General evaluation of professors by his or her professional status.

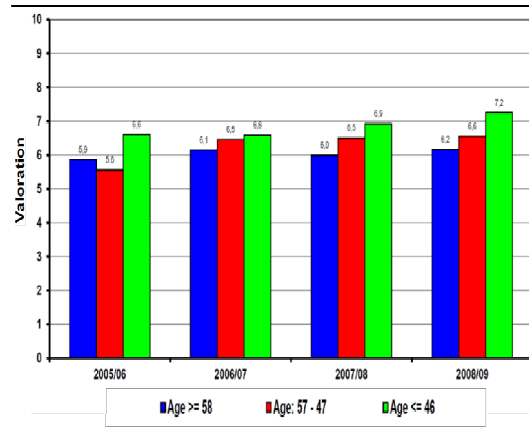


Figure 7: Question P10: General evaluation of professors by his or her age.

Table 3 shows that the average ratings in 2009-10 are significantly higher than in 2005-06. This numerical data supports the conclusion that there has been an improvement in the teaching activity during this period.

Table 3: Average scores for questions on professors.

Year	Number of professors evaluated with more than 5 surveys	Average score for professors evaluated with more than 5 surveys									
		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10
2005-06	103	8,8	7,3	6,0	6,1	6,2	5,7	6,6	6,1	4,6	5,9
2006-07	160	8,9	7,7	6,5	6,5	6,5	6,2	7,1	6,9	5,4	6,4
2007-08	185	8,9	7,6	6,6	6,6	6,6	6,2	7,2	6,9	5,6	6,5
2008-09	200	9,1	8,0	6,8	6,9	6,8	6,5	7,4	7,3	5,9	6,7
2009-10	173	9,2	8,2	6,9	6,9	6,9	6,6	7,6	7,3	5,9	6,8

Note: Rating from 0 (worst) to 10 (best).

4. CONCLUSIONS

Four years ago the School of Civil Engineering of the Technical University of Madrid introduced a new procedure for the evaluation of the teaching among its staff of

professors. Among its most remarkable elements, student surveys via Internet and the general dissemination of results, stand out particularly. This paper examines the effect that this procedure has had on the quality of teaching.

After analyzing the evolution of scores, there has definitively been an improvement in the quality of teaching, both in mean and individual values. One of the reasons for that improvement has been the public dissemination of results. Now professors know the feedback of their work and can compare with colleagues, or simply are more prone to make an effort when they know that their results will be exposed. This effect is most evident in younger and non-staff professors. This conclusion is obtained from the analysis of more than 17,000 surveys of 68 subjects (out of 79 of the degree) and of 273 professors-subject (out of about 260 professors, some of which teach more than one subject). These numbers are representative enough to validate the conclusions.

Subject quality is evaluated by 10 questions. The results show that the average rating of each of these ten questions has increased in these four years, which allows us to say that there has been an improvement in all aspects of subjects. Teaching activity is also evaluated by other ten questions. The results also show that the average rating of each question has increased, even more than the rating of the subject quality, and that most professors have improved.

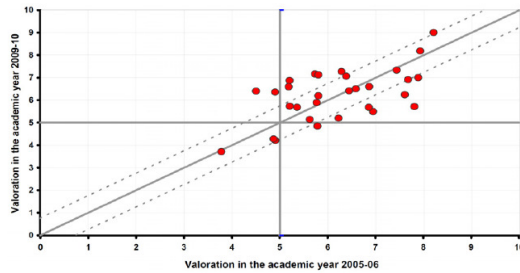
Professors have been separated according to their professional status and by age. Results show that professors improve their ratings in all categories and ages, although improvement is more pronounced for non-staff and younger professors. The improvement has more incidences in this group of younger professors, who are probably more motivated to get good qualifications in order to become permanent university employees.

REFERENCES

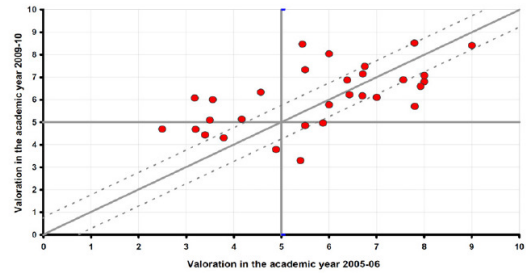
1. R. Sproule, "Student evaluation of teaching: A methodological critique of evaluation practices", *Education Policy Analysis*, Vol. 8, Nº 50 (2000).
2. D. Kember, D.Y.P. Lueng and K.P. Kwan, "Does the use of student feedback questionnaires improve the overall quality of teaching?", *Assessment and Evaluation in Higher Education*, Vol. 27 Nº 5, 411-425 (2002).
3. F.J. Martín Carrasco and L. Garrote, "The effect of the new law of universities on the technology subjects", *International Meeting on Civil Engineering Education*, Universidad de Castilla la Mancha (in Spanish), (2003).
4. B. Algozzine, J. Beatti, M. Bray et al., "Student evaluation of college teaching: A practice in search of principles", *College Teaching*, Vol. 52, Nº 4, 134-141 (2004).
5. ANECA, Docentia. "Evaluation form" (in Spanish), v.1.0,14/11/2006, (2006).
6. ANECA, Docentia. "Guidelines for the preparation of the assessment procedure" (in Spanish), v.1.0,10/01/2007, (2007).
7. F.J. Martín Carrasco, J.H. García Palacios and J.A. Sánchez Fernández, "Evaluation of teaching activity in the University using the Web", *I International Conference of UPM on Educational Innovation and European Convergence* (in Spanish) (2007).
8. F.J. Martín Carrasco and J. Fraile Ardanuy, "The evaluation of teaching: advantages and disadvantages of the DOCENTIA procedure proposed by ANECA", *II International Conference of UPM on Educational Innovation and European Convergence* (in Spanish), (2008).
9. F.J. Martín Carrasco and L. Garrote, "The current model of faculty", *Engineering and Territory* (in Spanish), Vol. 87,66-73 (2009).

ANNEX

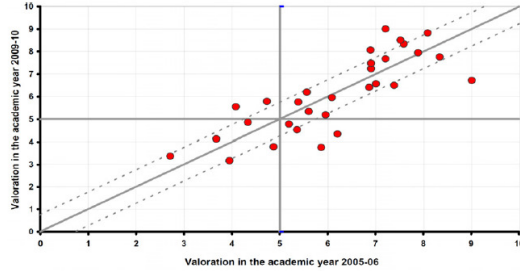
This annex contains Figures 8 and 9 with the detailed results of questionnaires on subjects and professors.



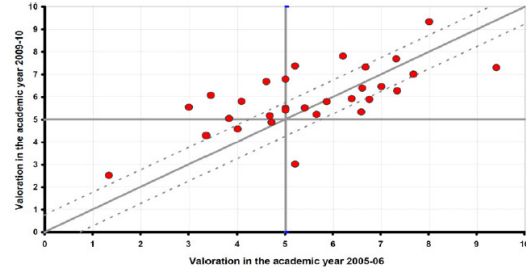
Question A1: You [the student] have enough background to follow the course.



Question A6: The selected bibliography is correct and easy to find.



Question A2: Lectures are useful for learning the subject.



Question A7: The exam is appropriate to evaluate the learning objectives.

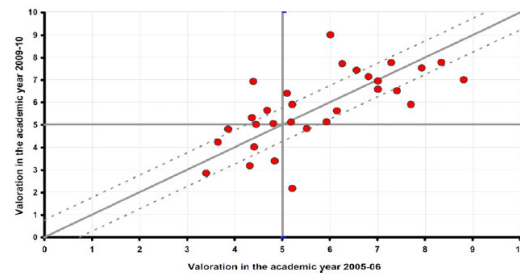
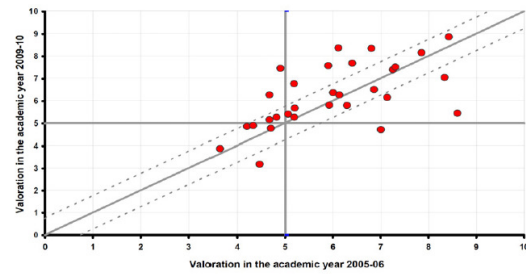
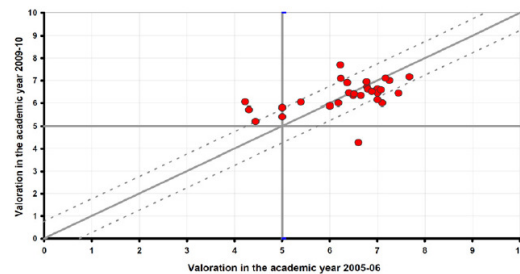


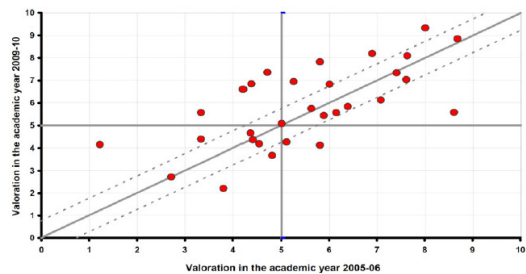
Figure 4: Question A3: There is good coordination between the theoretical and practical aspects.



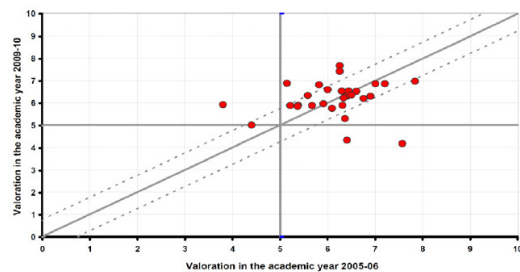
Question A8: Your degree of interest in the subject has increased after attending the course.



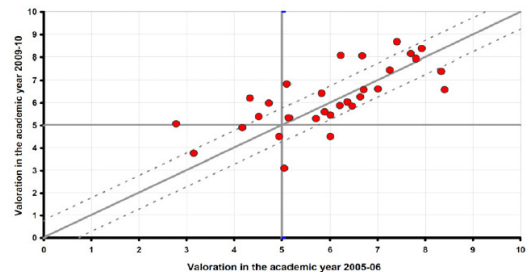
Question A4: The course syllabus is appropriate in relation to the available lecture hours.



Question A9: You would choose this course if it were optional.

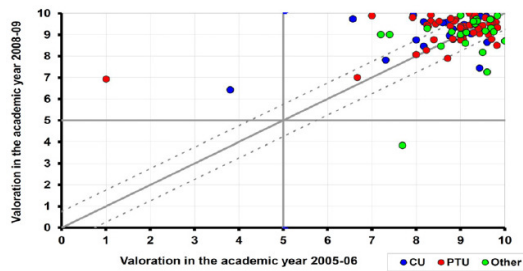


Question A5: The proportion between theory and practice hours is adequate.

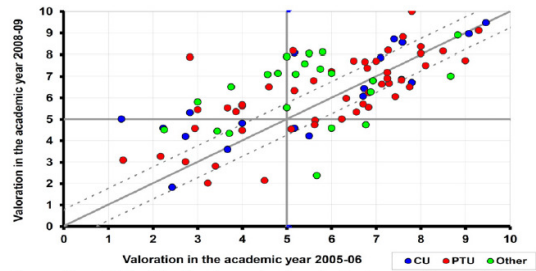


Question A10: General evaluation of the subject.

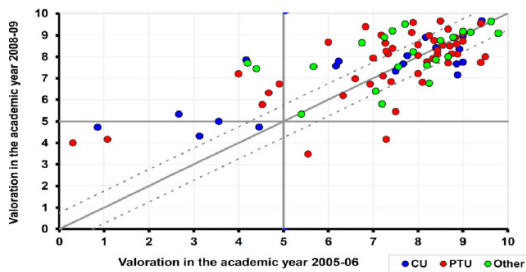
Figure 8: Results of surveys on subjects for every question.



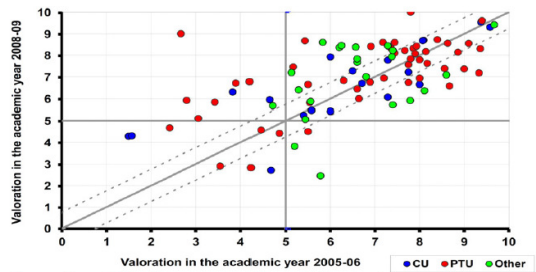
Question P1: Attends to the scheduled lectures



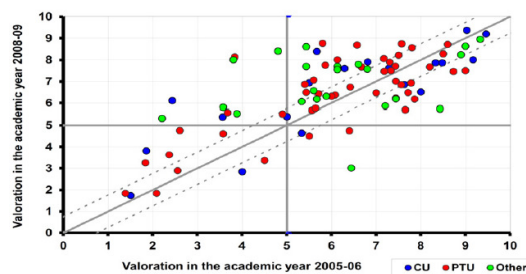
Question P6: Motivates students to learn the subject.



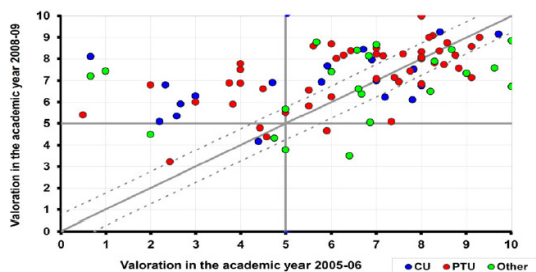
Question P2: Begins and ends lectures on time



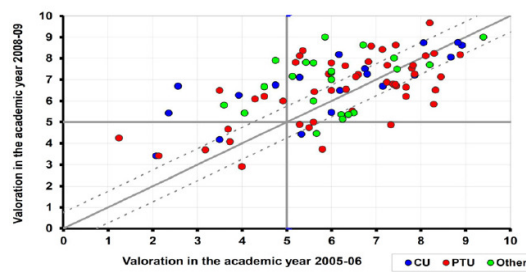
Question P7: Has a positive attitude toward the students.



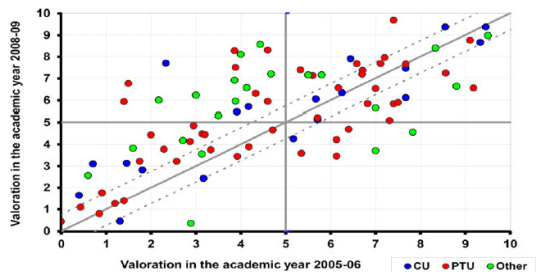
Question P3: Is clear in his explanations.



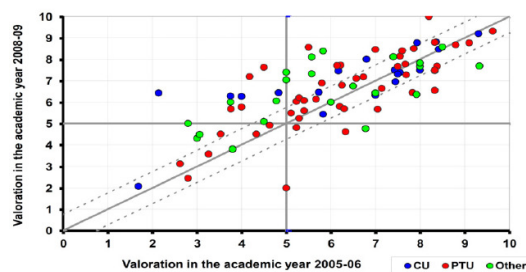
Question P8: Is available in his or her office hours.



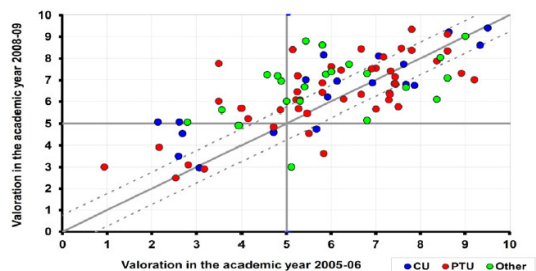
Question P4: Uses properly the educational resources.



Question P9: You would wish that this teacher would teach also in other subjects.



Question P5: Links the subject with other subjects or with the practice of engineering.



Question P10: General evaluation of the teacher.

Figure 9: Results of surveys on professors for every question.