Teamwork, Motivational Profiles and Academic Performance in Computer Science Engineering

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Abstract— **The present work is aimed at discussing several issues related to the teamwork generic competence, motivational profiles and academic performance. In particular, we study the improvement of teamwork attitude, the predominant types of motivation in different contexts and some correlations among these three components of the learning process. The above-mentioned aspects are of great importance. Currently, the professional profile of engineers has a strong teamwork component and the motivational profile of students determines both their tendencies when they come to work as part of a team, as well as their performance at work. Taking these issues into consideration, we suggest four hypotheses: (H1) students improve their teamwork capacity through specific training and carrying out of a set of activities integrated into an active learning process; (H2) students with higher mastery motivation have a better attitude towards teamwork; (H3) students with different types of motivations reach different levels of academic performance; and (H4) students show different motivation profiles in different circumstances: type of courses, teaching methodologies, different times of the learning process. This study was carried out with Computer Science Engineering students from two Spanish universities. The first results point to an improvement in teamwork competence of students if they have previously received specific training in facets of that competence. Other results indicate that there is a correlation between the motivational profiles of students and their perception of teamwork competence. Finally, results point to a clear relationship between some kind of motivation and academic performance. In particular, four kinds of motivation are analyzed and students are classified into two groups according to them. After analyzing several marks obtained in compulsory courses, we perceive that those students that show higher motivation for avoiding failure obtain, in general, worse academic performance.**

I. Introduction

In April 2009, the Ministers responsible for higher education in the 46 countries of the Bologna Process met to establish the priorities for the European Higher Education Area (EHEA) until 2020. They emphasized both the significance of student-centered learning as well as the teaching mission of higher education. 'Student-centered learning requires empowering individual learners, new approaches to teaching and learning, effective support and guidance structures, and a curriculum focused more clearly on the learner in all three cycles' [1].

One of the objectives of the EHEA is helping students to develop generic competences which they will use during their professional practice. Some of these competences are specific to one degree, but others are considered generic and can be achieved in most of the profiles: among the latter we include "planning and time management", "teamwork" or "problem solving". Whilst specific competences can be developed by carrying out different teaching/learning tasks, some of the generic competences need specific training programs to cover skill gaps during the degree. Nowadays, each university in the EHEA is defining the level of competences that their graduates must achieve. Every university needs to be able to determine at which stage the graduates have reached the required competence level. Traditional exams and written tests are focused on measuring the level acquired in specific competences, those related to subject contents. But there is less experience in measuring generic competences such as "problem solving" or "teamwork". For example, there are works that have evaluated the acquisition of generic competences using tests and questionnaires with demonstrated psychometric properties [2]-[3]. Others have assessed these competences using tasks that take into account the different facets inherent to each competence [4]-[6].

This paper is structured as follows: Section 2 presents the hypothesis of this research. Section 3 describes the experiments that have been developed. In this analysis, we will describe the participants who have taken part in the study, the teaching practice used, as well as the measuring instruments used. Section 4 shows the data analysis and the results of this study and Section 5 discusses the interpretation of these results. Finally, in Sections 6 and 7 we present the main conclusions and some limitations of the scope of this work.

II. Research Questions

In the context of higher education, a competence may be understood as the combination of skills, knowledge, attitudes, values and abilities that underpin effective and/or superior performance in a professional area [7]. The EHEA highlights the importance of generic competences in the learning process of university students. Among these competences, "teamwork" stands out in the context of engineering education. Consequently, students should acquire this competence throughout their academic period, and this should be achieved in an integrated way in the teaching-learning process by including activities that improve these skills. Besides, we should provide mechanisms to check if improvements have been reached in this competence.

As previous studies point out [8], academic motivation has a direct influence on the attitudes and habits of students. For this reason, we consider it is necessary to analyze student motivation depending on different circumstances (type of course, teaching methodology, different times of the course), as well as its influence on academic performance and on students' attitude towards teamwork.

In this context, we suggest four hypotheses: (H1) students improve their teamwork capacity through specific training and carrying out of a set of activities integrated into an active learning process; (H2) students with higher mastery motivation have better attitude towards teamwork; (H3) students with different types of motivations reach different levels of academic performance; and (H4) students have varying motivation profiles in different circumstances: types of courses, teaching methodologies, different times of the learning process.

Three experiments have been conducted in order to confirm or reject these hypotheses. The first one is focused on the first hypothesis. In previous works [3] we studied the improvement of students in "teamwork" competence measured by means of the Team Work Behaviour Questionnaire (TWBQ) [9]. The results did not show significant changes in student abilities and we found two reasons that could explain these results. First, a semester may be too short a time to accurately measure the success of the methodologies used, which are evaluated pre- and post-term. Second, it is possible that the methodologies alone do not improve the generic competences that we studied. We conclude that students need specific preparation on "teamwork" before using it for active learning methodologies. In order to carry out the first experiment we used the same test (TWBQ) to measure the improvement of a group of 20 students throughout one term. Students received specific training in team working and they had to execute some activities directly related to this competence. These activities were supervised by an instructor and were integrated into the context of two courses organized through Project Based Learning (PBL) [10]. Initial results point out significant improvement regarding the teamwork competence.

Hypotheses H2 and H3 were analyzed in the second experiment, in which we used the Achievement Goal Questionnaire (AGQ) [11], [12] in addition to the TWBQ test. The AGQ test studies the different motivational profiles of students. Firstly, we examined the correlation between the motivational profiles of students and their attitude towards the teamwork competence, observing a clear relationship. Secondly, we developed a clustering analysis to detect groups of students with different motivational profiles. Then, the correlation between these motivational profiles and academic performance was studied by analyzing marks of eight different courses. In this case we did not observe a significant influence of mastery motivation on marks. Contrarily, higher motivation to avoid failure demonstrates a strong correlation with lower academic performance.

Finally, we conducted the third experiment in order to study hypothesis H4. In this case we used the AGQ test in different courses at different universities, different years, different types of courses (compulsory and elective), different teaching methodologies and at different times during the term. Differences among academic profiles have been analyzed depending on the different contexts.

III. Method

A. Participants

To carry out this study we have taken samples of the following courses:

- Students Newly Enrolled in the degree of Software Engineering in the year 2012. Specifically, we took into account their marks previous to university incorporation (NE2012) and those obtained in four courses taught in the first year: Algebra (AL2012), Programming Principles (PP2012), Data Structure (DS2012) and Computer Structure (CS2012).
- Expansion of Software Engineering in the year 2009 (ESE2009).
- Administration of Operating Systems in the year 2009 (AOS2009)
- Operating Systems in the year 2009 (OS2009)
- Operating Systems in the year 2011 (OS2011)

Samples were taken using the two tests mentioned above: TWBQ for teamwork evaluation and AGQ for academic motivation. Data from each course are listed in Table I. Each course consists of a single group, so we will use both terms, course and group, indistinctly throughout the paper.

TABLE I
PARTICIPANTS IN THE STUDY

Course	N	University	Type	year
NE2012	90	UPM		1
AL2012	45	UPM	compulsory	1
PP2012	71	UPM	compulsory	1
DS2012	72	UPM	compulsory	1
CS2012	55	UPM	compulsory	1
ESE2009	44	URJC	elective	3
AOS2009	52	UPM	elective	3
OS2009	43 pre, 49 post	UPM	compulsory	2
OS2011	20	UPM	compulsory	2

B. Procedure

Below, we briefly describe the educational methodologies that have been used in each subject. In Group NE2012, the AGQ and TWQB tests were filled out the first day of the first semester course. AL2012, PP2012, DS2012 and CS2012 are mainly taught by using a traditional system, alternating

lectures and laboratory work, although some activities related to active learning are applied during the term. ESE2009 used a combination of master lectures along with the development of a programming project (Project Based Learning oriented). AOS2009 followed a traditional teaching method, based on lectures and closely guided practices in the laboratory. OS2009 used Project Based Learning (PBL) along with lectures to support the project development. OS2011 used Cooperative Learning (CL) [13] together with Project Based Learning. In this case, a specific training was carried out to analyze the teamwork competence. This training consisted of a short seminar, planning of the tasks that students had to perform working as part of a team and monitoring of teamwork by the instructor. Finally, in Group NE2012, tests were filled out on the first day of the first semester course.

In some cases, samples were taken at the beginning and at the end of the semester (pre- and post-term), which has allowed us to compare the results obtained both before and after the term. In other cases, we only have an initial sample available. In these cases, we have been able to study the correlation between the TWBQ and AGQ tests within the group and the comparison with other subjects.

C. *Measuring and instruments*

Teamwork was evaluated according to the test Team Work Behaviour Questionnaire (TWBQ). Teamwork behaviour refers to the individual activities that contribute to the team process. Interpersonal behaviours (conflict and problem solving, collaboration, communication) and management behaviours (assuming leadership, establishing goals, planning tasks, coordinating the other members in the group) are assessed. TWBQ has two parts: one in which students have to assess their own ability, TWBQ (Self), and another in which they assess the ability of the group as a whole, TWBQ (Others). In each item (statement), participants have to evaluate their own behaviour or the other members' behaviour in terms of an appropriate behaviour, on a 7 points Likert-type scale (1=not at all; 7 = very much). The test gives each part a total grade. Although this test is based on self appraisal opinion, research [9] has found that a person's beliefs about teamwork behaviour predict the generic teamwork behaviour that this person displays as a team member. As far as opinion about others is concerned, Tasa [9] explains that "during a team interaction, individuals collect information not only about their own capabilities, but also about other team members´ task relevant competences".

Achievement goal was evaluated according to the AGQ test. This test supports a 2 x 2 achievement goal framework. It differentiates between Mastery (goals focused on the development of competence through task mastery) and Performance (goals focused on the demonstration of competence relative to others). Moreover, it observes Approach (goals focused on approaching success) and Avoidance (goals focused on avoiding failure). This way, the 2 x 2 framework produces four types of goal orientations: performance-approach (PeAp), performance-avoidance (PeAv), mastery-approach (MaAp), and mastery-avoidance (MaAv) goals. Three items are chosen to represent each achievement goal following a 7 points Likert scale (1= not at all for me; 7=very true for me).

The statistical techniques used for the analysis were:

- Kolmogorov-Smirnov and Shapiro-Wilk were used to determine if data can be adequately modeled by a normal distribution.
- t-Student with an m+n-2 freedom degree was used to decide whether or not the quality of the means could be considered in cases modeled by a normal distribution.
- The equality of the means between the, "before" and "after" in those cases that could not be modeled by a normal distribution, was carried out by the Wilcoxon test for dependent samples.
- The Mann-Whitney test was used to contrast independent samples of two different groups.
- Correlation between variables was studied by the Pearson correlation coefficient in those cases that follow normal distribution and Rho Spearman when the variables do not follow this distribution.
- Cluster Analysis, in particular hierarchical clustering, was used to decide the number of groups and k-means clustering to classify cases.

In particular, for H1 we ran a t-test for dependent variables to decide if the equality of the means could be considered between the "before" and the "after" of the TWBQ results. This analysis was carried out for ESE2009, OS2009 and OS2011. For the hypothesis H2 the Rho Spearman coefficient was used to study the correlation between the different facets of the AGQ and TWBQ tests. This analysis was made in all groups. The contrast of the H3 hypothesis was carried out using the Rho Spearman coefficient between the different facets of the AGQ test and individual marks obtained in groups AOS2009, OS2009 and OS2011. In the case of the NI2012 group, we took into account the average mark that the students had when they arrived at the University. In order to test hypothesis H4, several experiments were developed. Firstly, we made a contrast of means between the "before" and "after" of the AGQ test using the Wilconox test. We could develop this analysis for those groups that had these data (ESE2009, OS2009 and OS2011). Secondly, we compared academic motivation between compulsory and elective courses. In these cases we used the Mann-Whitney test, comparing the AGQ results obtained in ESE2009 (elective) and OS009 (compulsory) one the one hand, and AOS2009 (elective) and OS2009 (compulsory) on the other hand.

IV. Data Analysis and Results

A. *Exploratory data analysis*

Initial exploratory data analysis was carried out in each of the groups. This analysis included the sample size, the minimum and maximum values, the mean, the variance, as well as Kolmogorov-Smirnov and Shapiro-Wilk tests to check if each of the variables followed the normal distribution.

B. Testing Hypothesis H1

Table II shows the results of the t-Student test obtained from TWBQ from the groups ESE2009, OS2009 and OS2011. Significant results were only obtained in sample OS2011, with a value t = -2.618 and a p-value of 0.017. With this result, we can reject the null hypothesis (equality of means). Due to the low number of students in this group (OS2011), we also used a non-parametric test: the Wilcoxon signed-rank test. We obtained 3 negative ranks, 16 positive and 1 draw in the TWBQ(after) – TWBQ(before) contrast. The statistic had a value Z=-2.801 with a significance level of 0.005. In the other two samples we cannot reject the null hypothesis, since the p-value exceeds 0.05.

TABLE II
TWBQ TEST

	Mean	Stand. Dev.	95% Confidence interval upper	95% Confidence interval lower	t	Sig.
ESE2009	-0.089	1.2335	-0.46402	0.28599	-0.479	0.635
OS2009	0.0053	0.8767	-0.26454	0.27511	0.040	0.969
OS2011	-0.4458	0.7615	-0.80223	-0.08944	-2.618	0.017

Then we calculated the effect size for the three courses. We used the formula for samples related with pre- and post-tests without a control group; in other words, we obtained the ratio between the mean difference (post - pre) and the standard deviation in post. For ESE2009 and OS2009, we obtained a value of d much lower than 0.2, that according to [14] is not significant. For OS2011, d has the value of 0.4049 which is a moderate value. This indicates that there has been a significant advance in the ability to work on a team by the individuals taking the course OS2011. This is undoubtedly due to the specific training that students received in this subject.

C. Testing Hypothesis H2

For this hypothesis we have taken into account only the Mastery Approach (MaAp) variable of the AGQ test. Table III shows the Spearman correlation coefficient for the ESE2009 group with a 95% confidence interval. We observed that significant results were obtained with regards to the correlation of the teamwork at the end of the semester (SET_END) and the motivation Mastery Approach, both at the beginning and at the end of the semester.

In Group AOS2009 Spearman Rho coefficient analysis has been calculated, obtaining a significant correlation between SET_INI and MaAp variables with a 1% confidence level. In Group OS2009 we observed a significant positive correlation at the 0.01 level between the TWBQ and the Mastery Approach motivation, both at the beginning and at the end of the semester. In Group OS2011 there was a positive correlation with a significance level of 0.05 between the TWBQ and the Mastery Approach motivation, both at the beginning and at the end of the semester. In Group NI2012, once again, we observed a significant correlation between the TWBQ and the Mastery Approach motivation with a 0.01 level.

TABLE III
SPEARMAN CORRELATION FOR ESE2009

		ESE2009	
		AQ_MaAp_INI	AQ_MaAp_END
SET_INI	Correlation coefficient	0.144	-0.062
	Significance (unilateral)	0.176	0.343
	N	44	44
SET_END	Correlation coefficient	0.252(*)	0.299(*)
	Significance (unilateral)	0.049	0.024
	N	44	44

* Significance level 0.05.

D. Testing Hypothesis H3

First, we ran an exploratory analysis to detect the main correlations between each motivational profile, according to the AQG test and the final marks obtained in each course. Table IV shows the Pearson coefficient for the four courses of the first year, in addition to the mark that students had before entering the University (NE2012). In this case, significant correlations were only obtained for Mastery-Avoidance (MaAv) and Performance Avoidance (PeAv). We did not find any significant value for Mastery-Approach or Performance-Approach. We highlight that all these correlations are negative, which means that students with higher Avoidance motivation obtain lower marks.

TABLE IV
PEARSON CORRELATION FOR H3

		NE2012 Mark	AL2012 Mark	PP2012 Mark	DS2012 Mark	CS2012 Mark
AQ_ MaAp	Corr. Coef.	-0.043	0.065	-0.125	-0.127	-0.201
	Sig.	0.704	0.669	0.297	0.288	0.141
	N	80	45	71	72	55
AQ_ MaAv	Corr. Coef.	-0.173	-0.303 (*)	-0.247 (*)	-0.293 (*)	-0.101
	Sig.	0.124	0.043	0.038	0.013	0.464
	N	80	45	71	72	55
AQ_ PeAp	Corr. Coef.	-0.141	-0.251	0.219	-0.030	-0.151
	Sig.	0.213	0.096	0.066	0.801	0.272
	N	80	45	71	72	55
AQ_ PeAv	Corr. Coef.	-0.307 (**)	-0.279	-0.363 (**)	-0.287 (*)	-0.165
	Sig.	0.006	0.064	0.002	0.015	0.230
	N	80	45	71	72	55

* Significance level 0.05.
** Significance level 0.01.

Table V displays the Rho Spearman coefficient for the other groups. For groups AOS2009, OS2009 and OS2011, we only took into account individual marks obtained throughout the semester, we excluded those marks obtained from group work. In this case, we only display the PeAv and MaAp variables

where we obtained the most significant results. Once again, we found significant correlations in Performance-Avoidance profile. As far as MaAp is concerned, we only detected correlation in Group OS2009. In addition, this correlation is negative, which does not make much sense, because it would mean that the greater mastery motivation the worst academic results obtained by students. In contrast, the variable PeAv offers a negative correlation in AOS2009 with significance level 0.05. This result makes more sense, since it indicates that students with greater fear of failure get worse results.

TABLE V
SPEARMAN CORRELATION FOR H3

		AOS2009 Marks	OS2009 Marks	OS2011 Marks
AQ_ PeAv_ INI	Correlation coefficient	-0.288 (*)	0.024	-0.260
	Significance (unilateral)	0.026	0.442	0.128
	N	46	40	20
AQ_ MaAp_ INI	Correlation coefficient	-0.096	-0.332 (*)	0.125
	Significance (unilateral)	0.262	0.018	0.466
	N	46	40	20

* Significance level 0.05.
** Significance level 0.01.

Once the exploratory study was finished, a cluster analysis was carried out. First, we developed a hierarchical clustering for the group of newly enrolled students (NE2012), where we estimated that the optimal number of groups was 2. Then, k-means clustering with two groups was carried out to describe the characteristics of these groups (Table VI). We can observe that both clusters have similar Mastery-Approach profiles being, in both cases, the highest value.

TABLE VI
CENTERS OF FINAL CLUSTERS

	Cluster 1	Cluster 2
AQ_PeAp	3.41	4.73
AQ_PeAv	2.49	4.77
AQ_MaAv	3.72	5.64
AQ_MaAp	6.18	6.46

The other variables explain the differences between these groups of students, where Cluster 2 has higher values. We can interpret that students in Cluster 1 are more focused on Mastery-Approach. In other words, they are more focused on achieving learning success and pay less attention to other kinds of motivations. Cluster 2 has higher values in all the profiles. The biggest difference is obtained in Performance-Avoidance. Whilst Cluster 1 does not attach particular importance to it, for students in Cluster 2 it is more notable. Therefore, this group seems to have greater fear of failure.

Finally, we ran a t-student test to study if there were significant differences in the marks obtained by students of these groups (clusters). In this analysis, we included the four courses of first-year students above-mentioned. Table VII shows the statistics of both clusters and Table VIII shows the results of the t-student test.

TABLE VII
STATISTICS OF MARKS (CLUSTER 1 AND CLUSTER 2)

	Cluster	N	Mean	Standard deviation
AL2012	1	22	4.9000	2.87866
	2	23	2.6826	2.27589
PP2012	1	27	7.1852	1.88837
	2	44	4.4386	3.15559
DS2012	1	30	6.523	2.0175
	2	42	4.388	2.8771
CS2012	1	25	3.332	2.6389
	2	30	2.357	2.2933

TABLE VIII
DIFFERENCE OF MARKS (CLUSTER 1 – CLUSTER 2)

	Mean Diff.	95% Confidence interval upper	95% Confidence interval lower	t	Sig.
AL2012	2.2174	0.6610	3.7737	2.873	0.006
PP2012	2.7466	1.4066	4.0866	4.089	0.000
DS2012	2.1352	0.9165	3.3540	3.494	0.001
CS2012	0.9753	-0.3586	2.3092	1.467	0.148

The null hypothesis establishes the equality of means between the marks obtained by students of Cluster1 and Cluster 2. According to the significance level obtained from the t-students test, we reject this null hypothesis in three cases out of four (AL2012, PP2012 and DS2012). Therefore, we can conclude that students who belong to Cluster 1 obtain better marks in these three subjects.

In order to find an explanation for these results, we ran a Pearson correlation analysis between the Trapnell´s Smart scale [15] and motivational profiles (Table IX). Trapnell´s Smart scale consists of four items on a 9 points Likert scale and it is focused on measuring the self-perception of students with regards to their own academic capacity. This test is identified in this work as CPT (Continuous Performance Test).

TABLE IX
PEARSON CORRELATION FOR CPT AND MOTIVATIONAL PROFILES

		AQ_ MaAp	AQ_ MaAv	AQ_ PeAp	AQ_ PeAv
CPT	Corr. Coef.	0.166	-0.267 (*)	0.037	-0.236 (*)
	Sig.	0.120	0.011	0.727	0.026
	N	89	89	89	89

* Significance level 0.05.

We obtained a significant negative correlation between the CPT and the two kinds of motivations: Performance-Avoidance and Mastery-Avoidance. These results clearly indicate that students with a lower academic self-perception have higher motivation for avoiding failure. Moreover, according to previous results, these students obtain lower

marks.

E. Testing Hypothesis H4

First of all, we studied the difference in motivation between the beginning and the end of the semester in groups IS2009, SO2009 and SO2011. In all three cases, we have used the Wilcoxon signed-rank test, since the MaAp variable does not follow the normal distribution. Table X shows the rank test for the ESE2009 group, in which we obtained 23 negative ranks, 14 positive and 7 draws in the MaAp_END - MaAp_INI contrast.

TABLE X
WILCOXON SIGNED-RANK TEST

	ESE2009	N	Average rank	Rank sum
AQ_MaAp_END - AQ_MaAp_INI	Negative ranks	23(a)	22.89	526.50
	Positive ranks	14(b)	12.61	176.50
	Draws	7(c)		
	Total	44		
AQ_PeAv_ END - AQ_PeAv_INI	Negative ranks	17(d)	15.44	262.50
	Positive ranks	22(e)	23.52	517.50
	Draws	5(f)		
	Total	44		

a AQ_MaAp_END < AQ_MaAp_INI
b AQ_MaAp_ END > AQ_MaAp_INI
c AQ_MaAp_ END = AQ_MaAp_INI
d AQ_PeAv_ END < AQ_PeAv_INI
e AQ_PeAv_ END > AQ_PeAv_INI
f AQ_PeAv_ END = AQ_PeAv_INI

The statistic Z (Table XI) has a value of -2.646 with a significance level of 0.008. These results indicate that the MaAp motivation at the end of the semester is significantly lower than at the beginning in the ESE2009 group. We calculated the effect size for this case obtaining a value of d equal to 0.439, which according to [14] is a moderate value. In the case of groups OS2009 and OS2011 no significant differences were obtained.

TABLE XI
STATISTICAL CONTRAST

	ESE2009 AQ_MaAp_END - AQ_MaAp_INI	OS2009 AQ_MaAp_END - AQ_MaAp_INI	OS2011 AQ_MaAp_END - AQ_MaAp_INI
Z	-2.646(a)	-.621(a)	-.469(a)
Signif.	.008	.534	.639

Secondly, we compared the academic motivation between elective and compulsory courses. For this purpose we used the Mann-Whitney test for ESE2009 against OS2009 groups and AOS2009 against OS2009. We found significant differences in the MaAp variable. However, a significant difference in PaAp was observed in both comparisons and, when comparing ASO2019 against SO2009, there was also a significant difference in PeAv. Specifically, in the case of AOS2009 against OS2009, PeAv and PeAp have higher values in the compulsory subject than in the elective one. PeAv is also higher in the compulsory course OS2009 than in the elective course ESE2009. Table XII shows this statistical contrast.

TABLE XII
STATISTICAL CONTRAST

		AQ_ PeAp _END	AQ_ PeAv _END	AQ_ MaAv _END	AQ_ MaAp _END
ESE2009 Vs. OS2009	U of Mann-Whitney	814	832	844	905
	W de Wilcoxon	1804	1822	1834	1895
	Z	-2.03	-1.897	-1.805	-1.339
	Significance (bilateral)	0.042	0.058	0.071	0.181
AOS2009 Vs. OS2009	U of Mann-Whitney	737.5	689	1239.5	1112
	W de Wilcoxon	2115	2067	2617.5	2337
	Z	-3.65	-3.984	-0.235	-1.111
	Significance (bilateral)	0	0	0.814	0.267

We then calculated the effect size in those cases in which there was a significant difference between the arithmetic means. We used a standard deviation combined, since the samples were independent (different subjects in each sample) and we did not have a control group. To do this, we used the formula of Cohen [14] which takes into account the variances, as described in (1).

$$d = \frac{\overline{X}_1 - \overline{X}_2}{\sigma} \quad ; \quad \sigma = \sqrt{\frac{(N_1)\sigma^2_{n(1)} + (N_2)\sigma^2_{n(2)}}{N_1 + N_2}} \qquad (1)$$

For the variable AQ_PeAp we compared ESE2009 against OS2009 and AOS2009 against OS2009 courses. Table XIII shows the most interesting data for the calculation of the effect size of the three courses.

TABLE XIII
DATA TO CALCULATE THE EFFECT SIZE ABOUT AQ_PEAP_END VARIABLE

AQ_PeAp_END	Mean	Variance	N
OS2009	4.2882	2.2468	43
ESE2009	3.5076	3.2273	44
AOS2009	3.0545	2.3786	52

The value of effect size is indicated in Table XIV. As we can see, the difference is greater in the case of AOS2009-OS2009. In this case, an average individual of OS2009 is more motivated to obtain a good result than 84% of the individuals in the AOS2009 course.

TABLE XIV
EFFECT SIZE ABOUT AQ_PEAP_END VARIABLE

Courses /effect size	d
ESE2009 vs. OS2009	0.443
AOS2009 vs. OS2009	1.015

For the variable AQ_PeAv we compared the course AOS2009 against OS2009. Table XV shows the most interesting data for the calculation of the size effect.

TABLE XV
DATA TO CALCULATE THE EFFECT SIZE ABOUT AQ_PEAV_END VARIABLE

AQ_PeAv_END	Mean	variance	N
OS2009	4.7287	2.9114	43
AOS2009	3.1026	2.1069	52

The value of d is 1.034, which is very significant. As in the case of the AQ_PeAp variable, this result indicates that an average individual of OS2009 is more motivated by the fear of failure than 84% of the students of the course AOS2009.

V. DISCUSSION

Hypothesis H1 is confirmed: "students improve their teamwork capacity through specific training and carrying out of a set activities integrated into an active learning process". Among the three subjects analyzed, improvement in the teamwork competence was only present in the OS2011 sample. This is precisely the course where students were trained in this competence. We should also highlight that, despite having a small sample (20 students), we detected a difference between the pre and post measurements. This difference is confirmed by the calculation of the effect size that has a value of 0.4049. In the case of academic performance or educational research, we usually consider significant values equal to 0.5, even lower values (of around 0.3) are taken into account.

Hypothesis H2 is also confirmed: “students with higher mastery motivation have better attitude towards team working”. As we have shown in the analysis, there is a positive correlation between the motivation for learning and the teamwork competence in all of the courses analyzed: ESE2009, AOS2009, OS2009, OS011 and NE2012.

Hypothesis H3, “Students with different kinds of motivation reach different levels of academic performance”, is partially confirmed. In particular, we analyzed four motivational profiles: Mastery-Approach, Mastery-Avoidance, Performance-Approach and Performance-Avoidance. Initially, we expected that students with the highest Mastery-Approach would obtain better academic results. However, we did not obtain these results. By using clustering analysis we classified students into two groups. The first one clearly had a Mastery-Approach profile. The second group, although Mastery-Approach was the highest motivation, also regarded other kinds of motivations as significantly important. The difference is especially noticeable in the Performance-Avoidance profile. This study demonstrated that this second group of students obtains lower marks in compulsory courses taught in first year. Besides, this group showed a lower academic self-perception according to the CPT test. Thus, we can confirm that students with lower self-perception have a greater fear of failure and achieve a lower level of academic performance.

However, we have found a counter hypothesis in the course OS2009. In this case, the correlation is reverse: greater interest in learning is correlated to worse academic results. We have not found data that may explain this case. The course took place normally in a PBL environment. The only possible explanation is based on which marks were considered to measure academic achievement: only individual marks and not those of the group should be considered. It may be that the marks of the group hid the individual marks of some members of that group.

As far as hypothesis H4 is concerned: "students show different motivation profiles in different circumstances: type of courses, teaching methodologies, different times of the learning process" we have analyzed the motivation according to the type of subject (compulsory vs. elective). We also have analyzed the difference in motivation between the beginning and the end of the semester. Although the results do not confirm the hypothesis, there are indications that in the compulsory courses students have: (a) greater fear of failure; (b) greater motivation for academic success.

VI. CONCLUSIONS

In this work, several aspects of student’s academic motivation have been studied according to the facets listed in the AGQ test. We have also studied the perception that students have about their teamwork competence, using the TWBQ test for this study.

One of the first conclusions of this study suggests that students improve their teamwork competence if they receive specific training in areas related to this competence. It is not enough for students to work in a group to acquire this competence on their own. It is necessary to schedule training on leadership, conflict management, planning, etc. In addition, it is necessary to program activities within the course that help develop this competence. These activities should target not only specific course content, but also encompass learning some of the facets that will enable them to achieve teamwork competence. In addition, as it has been shown, the teamwork competence is enhanced if the student has a motivation for learning.

We can also conclude that motivation for results is higher in compulsory courses than in elective courses. This motivation has a double perspective: to improve academic performance and to avoid failure. However, we have not detected higher motivation for learning (mastery).

Regarding the relationship between motivational profiles and academic performance, Mastery motivation does not seem to be determinant to discriminate between students who obtain better or worse academic performance. On the contrary, Avoidance failure is the main feature to predict this difference.

Finally, this study suggests a counter hypothesis. It seems illogical that the greater the interest in learning, the worse the academic results. Surely, some variables that we have not taken into account in this study must influence the results. As these results were obtained through the data analysis of a single group, a further in-depth study will be necessary to test this issue.

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