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Practical Method of Improving the Teamwork of Engineering Students Using Team Contracts to Minimize Conflict Situations

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ABSTRACT Educational models are incorporating methodologies to train students in teamwork skills in response to companies' information technology (IT) requirements. Conflict management is the key to effective teamwork. This paper proposes a method to improve students' organization, teamwork, and conflict management skills. This method consists of brief training on leadership and management styles, with minimal extra work, followed by the signing of team contracts that outline group rules, and promoting the assumption of responsibilities. The experimental results showed that this method reduced conflict rates, improved group communication and indirectly improved satisfaction, and responsibility and motivation in work groups. Consequently, students' overall academic performance improved, both as a group and as individuals.

INDEX TERMS Didactics of engineering, team work, conflict management, academic performance.

I. INTRODUCTION

Team working is one of the most common strategies used by different kinds of organisations like enterprises or public entities to organise work [1]. Team work effectiveness has been broadly studied in the literature from different points of view, such as communication, decision-making and conflict management [2]. A key topic within team effectiveness is conflict management [3]. In this paper, we propose a method to deal with conflict management in work teams at university educational level. We studied the improvement in academic results using methods to deal with conflicts in teams, thus providing students with conflict management skills.

Work teams are relatively small groups of interdependent individuals sharing responsibilities and goals [4]. Team-based structures have played an important role in organisations for many years [5]. Specifically, for enterprises and companies, work teams have been one of the most important structural elements all over the world [1]. Technological companies make use of adaptive teams to deal with changing environments, which represent a major challenge [6]. Network and technological environment evolution has led to virtual work teams emerging, which tend to experience greater and more diverse conflict [7]. In the case of distributed software development work teams, global dispersion dimensions have an important impact on coordination, team performance and project outcomes [8].

Coaching models have been extensively revised in the literature where we can find different key points related to communication, decision-making and conflict management. Studies suggest that training the team leader on team design and structure could be important for effective team coaching [2]. Team building effectiveness consists of four components: goal setting, interpersonal relationships, conflict management and role clarification [9]. Mathieu *et al.* [10] studied the importance of social skills and personality characteristics in team settings and the relationship with team performance.

This study is going to focus on conflict management, one of the main challenges that work teams face [11], [12]. Conflict can be understood as tensions produced between team members as the result of different perceptions [3], [13]. Team members interact with the group through social and task contributions and conflicts may consequently arise with relationship and task issues. Social contributions are related

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to personal preferences, values, political opinions, etc. On the other hand, task issues mainly refer to resource distribution, task procedures and policies. Some studies conclude that relationship conflicts can hinder team effectiveness, nevertheless some task conflicts, depending on the circumstances, may positively influence the team [14]. Moreover, conflict in complex teams (e.g. decision-making or project development) has a stronger negative impact on performance than in less complex teams (e.g. production) [15]. These complex teams are common in information technology (IT) companies. Alper, Tjosvold and Law [16] concluded that a cooperative approach, instead of a competitive one, improves efficacy in terms of conflict solving, resulting in effective performance. Chou and Yeh [17] studied team performance in enterprise resource planning (ERP) implementation teams and suggested that team members should learn different conflict management strategies to effectively deal with different degrees of conflict.

Teamwork is becoming an essential workplace requirement [18]. Engineering and computer science professionals are increasingly expected to have teamwork skills [19]. Including team learning in science, mathematics, engineering and technology (STEM) education can be effective in preparing students for teamwork-oriented environments [20].

Introducing active teaching models on undergraduate courses can be beneficial and learning can improve compared to traditional methods [21]. The effectiveness and learning benefits of using small groups in STEM courses is proven since its implementation is increasingly apparent. Teamwork improves students' academic achievements, attitude towards learning and reduces STEM drop-out rates [22]. It helps students build positive relationships within their cohort and develop their interpersonal and communication skills [23]. Teamwork activities promote learning, knowledge retention, thinking skills (such as analysis, synthesis, evaluation and problem solving), increase the ability to explain, improve reading, writing and student satisfaction [24]. Research on STEM courses supported this evidence [22], [25] and also proved that teamwork was related to better performance results in these disciplines [26].

Good teamwork can overcome the capabilities of individual team members [24]. For a team to function well, the team does not only need to distribute work among members, it must also share out responsibilities [23]. However, in many classes, students are placed in groups without having received adequate training and issues can arise as they are lacking in teamwork and conflict-solving skills. In such cases, students may feel unsatisfied and not part of their team [27] giving rise to a dysfunctional group.

Different types of teamwork interventions have been used with positive effects [28]. Several authors [29]–[32] have identified and studied how to address teamwork implementation and development issues that may appear. Furthermore, various effective team building strategies and recommendations have been offered [27], [30], [33], [34].

One of the stages that work teams often experience is the storming step, characterised by hostility and conflict between team members [35]. A suitable intervention can be designed to minimise the negative effect on students, take advantage of learning and put conflict-solving tools into practice, if necessary.

The teacher's guidance on working efficiently as a team significantly affects student satisfaction [36]. Some researchers suggest an initial teamwork skills workshop [31], [33], [37], [38] while others prefer to initially give students some notes and provide a guide to dealing with problems as and when they occur, [30], [36]. Sancho-Thomas *et al.* [39] proposed using an electronic learning framework to acquire interpersonal and teamwork skills.

Using different versions of team agreements or contracts, which outline expectations, has been satisfactorily tested. Studies show that they help prevent group dynamics issues, discourage social loafing and promote student satisfaction [30], [33], [40]. Rotating roles within the team can be useful to avoid the free-rider problem and also improve cooperation levels and academic outcomes [33].

To the best of our knowledge, some proposals in the literature on teamwork skills training based on team agreements and contracts require time that is often lacking in teaching programmes. On the other hand, different versions of team agreements have been tested, but sometimes the global effect that these strategies have on academic performance has not been measured. Furthermore, few methods are proposed for training work groups that measure their impact on academic performance. In consequence, this paper proposes a method to improve students' organization, teamwork and conflict management skills. The method consists of a brief training on leadership and management styles, with minimal extra work (about one hour of in-class teaching), followed by the signing of team agreements that outline group rules, promoting the assumption of responsibilities. The method is able to reduce conflict rate, improve group communication and indirectly improve satisfaction, responsibility and motivation in teams. It consequently, improves students' overall academic performance both as a group and as individuals. The main contributions of the study in the field of engineering education respect to previous works is its capacity for improving conflict management skills with minimal extra work and the measurement of its impact over overall academic performance.

II. METHOD

A. ACADEMIC CONTEXT

1) THE SUBJECT

The Computer Engineering degree's general objective is to prepare students so they graduate with an extensive knowledge about all areas related to information and communication technology (ICT). Graduates obtain skills to lead project development, identify problems, assess risks and provide efficient solutions and are capable of learning and adapting

to possible changes, meaning that they are prepared to work in a rapidly evolving environment [41].

Computer Architecture is a compulsory fourth semester module on the Computer Engineering degree. Moreover, the module serves as a bridge to introduce advanced architectures, which are studied in more depth in the fifth semester.

The Computer Architecture module's main objective is to provide students with an understanding of the key aspects related to analysing, designing and implementing classic sequential architectures. It also includes the immediate improvements within this classic paradigm and alternative parallel architectures. As a basic working method, students are given a set of tools and models that allow them to study and analyse different architectural options in greater depth, covering abstract and generic aspects while studying specific implementations.

2) THE PROJECT

The Computer Architecture module's content was selected to achieve the aforementioned objectives. The module's procedural objectives are based on a project during which students work in teams of four to six members to analyse and evaluate different computer architectures' performance. The project's main goal is to simulate a real-life work context that students could find themselves in after graduation. Each group must write an evaluation report and comparative analysis of at least six computers with different characteristics (i.e. processor, cache and main memory). The report should provide both quantitative and qualitative evaluations, explain the group's process in detail and describe how the group reached their conclusions.

The project is made up of different phases, and in turn, each phase consists of two parts. In the first part, students work individually to acquire the basic knowledge and skills they need to approach the second part, which involves working effectively in a group. During each phase, the group explores a different computer technology and must demonstrate certain instrumental capabilities. Each group selects a group leader, a secretary and a controller. Roles are assigned and rotated between the group members for each project phase. The leader manages the phase organisation, the secretary takes notes of the conclusions for each design stage and is responsible for maintaining an organised project folder (portfolio) with all the material generated, accessed, meeting notes, etc., and the controller ensures that timelines are met.

3) ASSESSMENT

Practical assignments are assessed by considering the extent to which each project phase requirements are achieved and the abstraction and design skills demonstrated by students to do so. The lab score is based on continual assessment, i.e. students are assessed at each phase, based on their individual and group reports and a group oral presentation. The weighting index is directly proportional to each phase's estimated complexity, established at the beginning of the module, but essentially, the group part takes a higher mark percentage.

The group-project lab assessment was introduced to the degree during the 2011/12 academic year. Since then, we have detected some cases in which individuals did not perform their assigned tasks for the group project. To this end, the group-project lab assessment can sometimes conceal whether an individual student is not participating in the group project. These cases were mainly detected when other group members notified the lab teacher. These issues were resolved by involving the rest of the group, but this masks the real problem. The lecturers offered different alternatives, leaving the students to resolve the specific problem, and they also suggested removing the low-performing student from the group. However, this did not fully resolve the problem. We realised that we needed to establish a series of mechanisms to deal with the problem from the beginning of the project. To this end, in the 2015/16 academic year, we introduced a survey to detect group problems, which revealed that a lack of communication and coordination among certain group members caused an unequal workload. We generally discovered that the same group members who had not worked on the individual part usually did not contribute to the group work.

B. PARTICIPANTS

Students enrolled on the Computer Architecture module in the 2015/16 and 2016/17 academic years participated in this study. The total sample consisted of 225 students: 118 students of the 2015/16 academic year were selected as the control group, and 107 students of the 2016/17 academic year were chosen as experimental group.

C. INSTRUMENTS

In order to determine how the experiment impacted the students' skill acquisition, two assessment tests were carried out: one at the beginning of the experiment (pre-test) and another after the experiment (post-test). The pre-test assessed students' previous knowledge of skills required at the beginning of the module. This initial test aimed to check whether the students selected for the experimental or control group produced any bias. On the other hand, the post-test, carried out at the end of the module, aimed to find out if there were differences in the skills acquired by the control group and the experimental group.

We designed a 15-question survey (Appendix I) to determine students' opinion of how the group had worked. The survey aimed to collect information from different points of view with questions about student satisfaction in their team (items 1, 2 and 13) and detecting irregularities concerning team management. Among the factors that could lead to deficiencies, students were asked about: workload distribution (item 7), each group member's role (items 4 and 11), the team's effectiveness (item 8), members' involvement (items 6, 11 and 12), the number of members (item 3), the existence of conflicts (items 5, 10 and 11), communication within the group (items 9, 11 and 12) and team management (items 14 and 15).

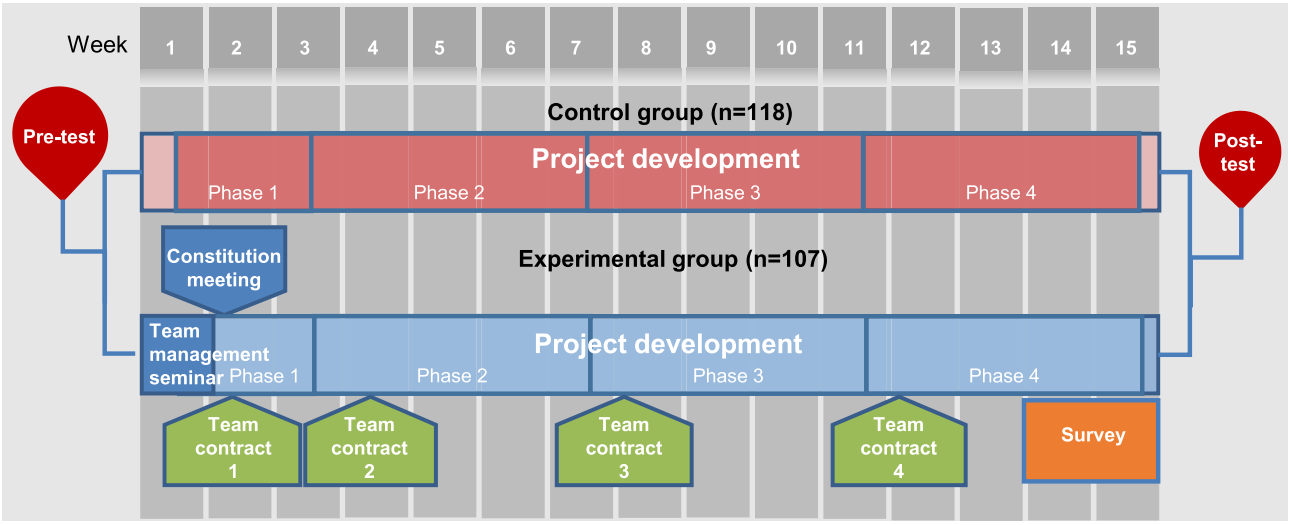

FIGURE 1. Phases of the experiment.

The survey was anonymous and completed online in order to respect the students' privacy. It was available on the University of Alicante's Moodle platform during the last two weeks of the module.

D. PROCEDURE

The main goal was to evaluate students' performance and analyse different computer architectures simulating a real-life work context where teamwork is increasingly important. In order to evaluate the team's characteristics and the intervention, the students enrolled in the 2015/16 academic year were the control group and those enrolled in the 2016/17 academic year were the experimental group.

Figure 1 shows a graphical abstract of the intervention. The lecturers offered the control group different alternatives, leaving the students to solve the specific problem by themselves without providing them with specific information about team management. The experimental group was given a brief description of leadership at the beginning of the group work (around the third week of lab). They were given content about leadership types, good leader characteristics and management models. Moreover, when they performed the first practical activity, which is carried out only once during the four-month period, a set of team rules were established (extra content on leadership and contracts does not take more than one hour). The team had to hold a meeting to constitute the team, during which they had to draft and sign a team contract (Appendix II).

The rules outlined each member's responsibilities and how possible non-performance within the group should be managed. In this way, when the students are instructed to elaborate the contracts, they are given examples of strategies to follow in case one of the members of the team does not carry out the assigned task. The students can apply the given strategy as an example, customize the example, or develop their own strategy as part of the contract accepted by all. In any case, the contract should show how to decide who should assume the part of the work that has not been done and how to compensate the colleague or colleagues who assumed the part that did not correspond to them. The following are some of the examples of strategies given to students:

- In the next phase of the project the partner who made the extra work is rewarded. The reward consists in assigning part of his work to the colleague who could not fulfill his part in the previous phase.
- A percentage of the score of the colleague who was not able to do his part is distributed to the one or those who have assumed responsibility for this part.
- The "bag of points". It is one of the most chosen strategies by students in contracts. To explain it the following case is proposed: if the work of a team of 5 students has a global assessment of 8 points out of 10, then at the requirement of the team, instead of assigning 8 points to each member, the teacher grants a "bag of points" of 40 points (5×8). The students are responsible for managing the distribution and communicating their decision to the teacher.

Additionally, to ensure that the teams operated efficiently, they had to describe how the work was distributed and the mechanisms used to interact or work together at the end of each phase. At the beginning of each project phase, the team chose a team manager (director) who had to decide how to approach the project phase in collaboration with the other members. Furthermore, the manager had to set the tasks and deadlines, and distribute the tasks among members. Lastly, the team had to draft and sign a team contract, which outlined the tasks and team member responsible for carrying them out (Appendix III).

The learning goals, assessments and materials were the same for both groups. A pre-test and a post-test were introduced to evaluate the students' skills for this intervention.

All students took the pre-test to rule out possible biases in student group selection. The test evaluated entry-level skills related to the previous modules. After the experiment, the post-test evaluated the skills acquired during the module according to the related learning objectives.

E. DESIGN AND DATA ANALYSIS

Different data analysis techniques were used within an overall ex post facto comparative research design.

Academic performance was compared via statistical analysis conducted using the General Linear Model (GLM) module of the SPSS statistical software package, version 23.0. Employing a procedure widely used in profile analysis [42], a multivariate analysis of variance (MANOVA) and a univariate analysis of variance (ANOVA) of repeated measures were performed, in which measures of academic performance were treated as within-subject variables, while the groups (experimental and control) served as the between-subject variables.

An analysis of the proportions in both groups' satisfaction survey responses was conducted using the Chi-square statistic.

III. RESULTS

A. ACADEMIC PERFORMANCE

This study's results compared the control and experimental groups' academic performance (the latter had signed a team contract). To this end, the GLM Repeated Measurements statistical procedure was used, taking the methodology applied by the students as an independent variable and the grades obtained in academic performance as a dependent variable.

In this way, the assessments (pre-test and post-test) were taken as the intra-subject factor and experiment participation (experimental or control group) as the inter-subject factor. Statistical analyses were performed using SPSS (version 23.0). Table 1 shows the means and standard deviations obtained for each student group related to academic performance before and after the intervention.

TABLE 1. Descriptive statistics for each group's academic performance.

	Control			Experimental			Total		
Moment	N	$\bar{x}$	*s*	N	$\bar{x}$	*s*	N	$\bar{x}$	*s*
PRE-TEST	107	8.20	1.27	118	8.18	1.56	225	8.19	1.43
POST-TEST	107	6.64	2.22	118	8.04	1.56	225	7.37	2.02

Box's M test shows no homogeneity of the variance-covariance matrices ($F_{(3,13901738)} = 8.716$ and $p = .000$). However, the violation of this assumption has a minimal impact since the groups are approximately the same size [43] and the higher ratio of variance between groups (1:1.51) does not exceed the 1:10 ratio considered the maximum limit in the profile analysis [42].

TABLE 2. Test for inter-subject effects.

Source	Type III error	gl	F	Sig.	η^2 partial	Obs. power [a]
Intersection	27066.474	1	7851.643	.000	.972	1.000
Group	53.554	1	15.535	.000	.065	.975
Error	768.734	223				

[a] computed using alpha = .05

TABLE 3. Test of intra-subjects effects.

Source	Type III error	gl	F	Sig.	η2 partial	Obs. power [a]
Performance	80.750	1	36.181	.000	.140	1.000
Performance * Group	56.456	1	25.296	.000	.102	.999
Error (Performance)	497.697	223				

[a] computed using alpha = .05

Table 2 shows the test for inter-subject effects. This table shows a large difference between the groups' academic performance averages ($F = 15.535$; $p = .000$; η^2 partial $= .06$).

Regarding the methodology implementation, the values resulting from the intra-entry effects test (Table 3) show that the effect of the interaction between the evaluation time (pre-test and post-test) and the intervention is significant ($p = 0.000$). The observed power is 0.999, thus rejecting the null hypothesis of the equality of means. The size of the effect resulting from the interaction between the time of the evaluation and project implementation is 0.10.

The grades obtained by each group before the experiment and after the experiment were compared by objectively examining the students' performance to assess the impact of the methodology applied on student performance. To this end, a Student's t-test was conducted on the mean difference (Table 4). This test showed that there were no significant differences at the pre-test, so it can be considered that both groups started from comparable situations. However, it shows a significant difference between the two groups at the post-test ($p = 0.000$); this difference being 1.4 points out of 10 higher for the experimental group. Therefore, we can

TABLE 4. Parameter estimation.

Moment	Parameter	Type III error	t	Sig.	Confidence interval 95%		η2 partial	Obs. power [b]
					Lower bound	Upper bound		
Pre-test	Intersection	.132	62.069	.000	7.920	8.439	.945	1.000
	Control	.191	.097	.923	-.358	.395	.000	.051
	Experimental	.	.	.	.	.	.	.
Post-test	Intersection	.175	45.845	.000	7.695	8.386	.904	1.000
	Control	.254	-5.505	.000	-1.901	-.899	.120	1.000
	Experimental	.	.	.	.	.	.	.

[a]. The parameter has been assigned the value zero because it is redundant.
[b]. computed using alpha = .05

TABLE 5. Contingency table on the response rates to the satisfaction survey.

Item		*Control*	*Exp.*	*Total*	χ^2	*Sig.*
1- Are you satisfied with the work done by the group?	No	22.5%	12.9%	18.1%		
	Yes	77.5%	87.1%	81.9%	3.154	.076
2- Have you been motivated working within the group?	No	34.2%*	21.5%*	28.4%		
	Yes	65.8%*	78.5%*	71.6%	4.029	**.045***
3- What do you think of the number of people in the group? 1- adequate. 2- too large. 3- too small	1	83.8%	83.9%	83.8%		
	2	13.5%	15.1%	14.2%	.768	.681
	3	2.7%	1.1%	2.0%		
4- Do you think the role you have been assigned within the group is appropriate?	Don't know	18.9%	10.8%	15.2%		
	No	11.7%*	3.2%*	7.8%	8.690	**.013***
	Yes	69.4%*	86.0%*	77.0%		
5- Has there been any conflict in the group?	No	70.3%*	82.8%*	76.0%		
	Yes	29.7%*	17.2%*	24.0%	4.350	**.037***
6- Of all the members of the group. How many have been actively involved most of the time? 1- almost all. 2- very few. 3 few. 4-all.	1	44.1%	44.1%	44.1%		
	2	7.2%	2.2%	4.9%		
	3	16.2%	12.9%	14.7%	4.008	.261
	4	32.4%	40.9%	36.3%		
7- Do you consider that the workload of the group members has been uneven?	No	40.5%*	54.8%*	47.1%		
	Yes	59.5%*	45.2%*	52.9%	4.152	**.042***
8- How do you judge the effectiveness of your group? 1-high. 2-low. 3-medium	1	41.4%	51.6%	46.1%	4.601	.100
	2	13.5%	5.4%	9.8%		
	3	45.0%	43.0%	44.1%		
9- Have you had difficulty talking/negotiating with your group members?	No	78.4%*	90.3%*	83.8%		
	Yes	21.6%*	9.7%*	16.2%	5.324	**.021***
10- Have you had difficulty working with certain people in your group?	No	75.7%	84.9%	79.9%		
	Yes	24.3%	15.1%	24.3%	2.708	.100
11- Do you think that one or a few have taken up too much of the work and have barely allowed others to intervene?	No	82.9%	87.1%	84.8%		
	Yes	17.1%	12.9%	15.2%	.697	.404
12- Do you consider that one or more have been very quiet. with little intervention?	No	54.1%	54.8%	54.4%		
	Yes	45.9%	45.2%	45.6%	.013	.911
13- Do you consider that you have worked with unmotivated people?	No	61.3%*	74.2%*	67.2%		
	Yes	38.7%*	25.8%*	32.8%	3.880	**.049***
14- Do you think you lacked order. to find a working method that would help you make the most of your time?	No	34.2%*	48.4%*	40.7%		
	Yes	65.8%*	51.6%*	59.3%	4.200	**.040***
15- Do you think there is a lack of someone to really lead. coordinate or manage the group?	No	58.6%	66.7%	62.3%		
	Yes	41.4%	33.3%	41.4%	1.416	.234

*significant at .05 level

conclude that there were initially no significant differences between the two student groups before the intervention, but there were for group performance after the intervention.

Figure 2 shows a graph of the scores obtained by both groups before and after the intervention. The post-test assessment shows that control group students who did not sign the team contract had worse results at the end of the module, while the experimental group had higher scores and maintained their academic performance throughout the module.

B. SATISFACTION SURVEYS

The satisfaction survey analysis shows that the experimental group performed better in all dimensions studied. However, applying the Chi-square statistic to the proportions of both groups' responses, this improvement is significant for seven of the 15 questions asked. For the remaining questions, although the proportion is favourable for the experimental group, the differences may be due to chance. Table 5 shows the differences between each groups' response rates.

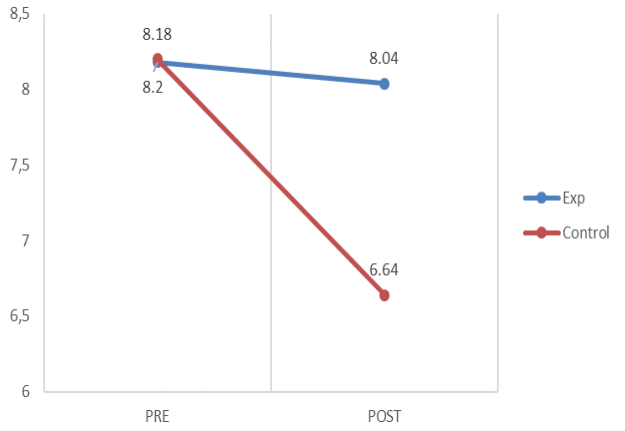

FIGURE 2. Average scores obtained by the control and experimental groups, before and after the intervention.

The experimental group was clearly more motivated than the control group, as the differences in two of the three related items were significant. On the one hand, personal motivation (item 2) was 13 percentage points higher in the experimental group (78.5% vs. 65.8% with $\chi^2 = 4.029$ and p =.045). The motivation perceived for the rest of the members (item 13) was also 13 percentage points higher in the experimental group (74.2% vs. 61.3% with $\chi^2 = 3.880$ and p =.049).

With regard to the student's perception of how work was distributed in the group (item 7), the experimental group mainly felt that the workload was distributed equally (54.8%) while this was perceived by a smaller percentage in the control group (40.5%). The experimental group had more than 14 percentage points, representing a significant difference ($\chi^2 = 4.152$ and p =.042).

Regarding team roles (item 4), the survey showed that more students in the experimental group accepted their assigned roles (86.0%) than in the control group (69.4%). The difference of more than 16 percentage points was statistically significant ($\chi^2 = 8.690$ and p =.013).

Conflict management was one of the factors that led to this study. Items 5, 10 and 11 aimed to find out if there were such conflicts or if there were situations that could potentially cause conflict. Students were asked if any conflict had arose in the group (item 5), and the survey showed a more favourable result (fewer conflicts) in the experimental group (82.8% thought that there had been no conflicts compared to 70.3% in the control group). More than 12 percentage points difference was significant ($\chi^2 = 4.350$ and p =.037). With respect to potential conflict situations (items 10 and 11), the survey showed fewer risk situations for the experimental group than the control group. However, these differences were not statistically significant. Although there are significantly fewer conflicts, conflicts still exist in the experimental group. For this reason, a series of qualitative questions were included in the survey, aimed at finding out the nature of the conflict. These questions (items 5.1, 5.1.1 and 5.1.1.1 respectively in the Appendix I) because of their qualitative nature were not included in the quantitative study. The questions ask about the type of conflict that has taken place and how it has been resolved. From the analysis of the answers given in case of conflict, it can be stated that the most common cause of conflict (more than 90%) was attributed to the lack of motivation of a team member. Other causes (<5%) include lack of organization or communication in the team.

Precisely, communication within the group is a key factor for avoiding and managing potential conflicts (item 9). The analysis indicates that the experimental group had less difficulty in expressing itself and negotiating when a conflict arose. More specifically, 90.3% of experimental group students stated that they had no difficulties in expressing themselves or negotiating within the group, compared to 78.4% of the control group. Almost 12 percentage points difference was statistically significant ($\chi^2 = 5.324$ and p =.021).

The survey revealed organisational weaknesses (item 14) in both groups, although they are less noticeable within the experimental group. In this group, 51.6% admitted that there were organisational problems compared to 65.8% in the control group. More than 14 percentage points difference was significant ($\chi^2 = 4.200$ and p =.040).

Other factors such as team members' involvement (items 6, 11 and 12), effectiveness (item 8), team size (item 6) or leadership (item 15) were evaluated and the results showed that, although the experimental group was quantitatively favourable, this difference could be due to chance.

IV. DISCUSSION AND CONCLUSIONS

Companies require IT professionals with teamwork skills [19] and educational models are incorporating methodologies to prepare students with such skills. Some researchers propose an initial workshop on teamwork skills [37], which require time that is often lacking. Different versions of team agreements have been tested promoting student satisfaction [33], [40], but sometimes the global effect that these strategies have on academic performance has not been measured. Furthermore, few methods are proposed for training work groups that measure their impact on academic performance. This paper proposed a method to improve students' organisation, teamwork and conflict management skills. As the experimental results show, this method reduced the conflict rate, improved group communication and indirectly improved satisfaction, responsibility and motivation in teams, consequently improving the students' overall academic performance, both as a group and individually.

The experiment results show different trends for the experimental group and the control group: the control group's performance clearly deteriorated. This decrease is significant in comparison to the experimental group, as shown in Table 4. The explanation for this worsening may be attributed to the post-test being more difficult than the pre-test, since the pre-test is carried out at a time when students' knowledge is

still limited. This behaviour was already observed in previous years and is considered ''usual'' by teaching staff.

However, the experimental group trend is different to the control group. The usual tendency to obtain significantly lower scores in the post-test is not observed. Despite the post-test's difficulty, there was only a slight decrease in test scores, which was not significant according to the statistical tests and could therefore even be attributed to chance. When we compare both groups' post-test performance with that of the t-test, the experimental group's average improvement (+1.4 points out of 10) is significant and therefore cannot be attributed to chance.

The teaching staff involved in the experiment believe that this improvement may be due to two factors: increased responsibility within the group and motivation. On the one hand, the increased responsibility in the group, due to the team contract, serves as an incentive for the student who, by becoming more involved in the teamwork, makes better progress on an individual level. On the other hand, a better work environment may also have affected the mood with which students face individual tests.

In general, a greater degree of involvement was observed in the experimental groups, showing that students made more effort when carrying out their teamwork. This study aimed to reduce the conflict rate, improve group communication and indirectly improve satisfaction and motivation in this type of assignment. The survey results revealed that all of these aspects improved significantly. Other indirect aspects also improved, such as workload and role distribution within the team. On the other hand, member involvement, work organisation and management did not improve significantly, which is logical as no tools or strategies were implemented to correct or improve these aspects. The positive evolution observed could be due to the general atmosphere within the team improving, although these strategies must be included in the future for the improvement to be significant.

In summary, this paper has shown computer-engineering students' academic performance can be improved through an experiment that aimed to improve the students' degree of responsibility when working in teams.

The authors consider that this advantage could be extrapolated to other studies where teamwork is also used. Educators of similar programmes could find a way to improve the teamwork environment while improving the students' individual performance. It will be easier for educators to integrate this methodology into their programmes since the workload for both teachers and students is less than that required for a specific teamwork skills training programme.

A future study could be to extend this practice to other modules on the degree that also include teamwork assignments. As the study states, conflicts remain in the experimental group. It reveals that most of them are related to the lack of motivation of a team member. Therefore, the authors consider in future to implement a specific program that allows the student to recognize in themselves and in their peers this lack of motivation and to prevent conflict through techniques of role reassignment or similar. We would also like to improve other teamwork aspects, such as assertiveness, leadership, etc., in order to improve students' social skills. Nevertheless, the authors recognize that the use of these programs could lead to a reduction in the time students have to study the subject.

APPENDIX I
STUDENT SATISFACTION SURVEY

See Tablae 6.

APPENDIX II
MEETING MINUTES MODEL

MINUTES FROM THE EXTRAORDINARY MEETING TO FORMALLY CONSTITUTE (team name)

In [place], at [time] on _[day]_____[month]_____ 2017, Team __[team name]_____ hereby meets in ordinary session in the Classroom ___ [classroom name]_____ at the University of Alicante's Polytechnic School.

Meeting Agenda:

1) Constitution of the Team __[team name]_____
2) Approval of the rules of team responsibilities
3) Approval of the rules of action in case of non-compliance
4) Other matters
5) Questions and requests

Agreements reached

Point 1:
Point 2:
Point 3:
Point 4:
Point 5:

With nothing more to add, Team ___[team name]_____'s meeting is adjourned at __[time]____.

THE FOLLOWING TEAM MEMBERS WERE PRESENT AT THE MEETING (All members' names and signatures)

Signed _____ Signed _____
Signed _____ Signed _____
Signed _____ Signed _____

APPENDIX III
CONTRACT MODEL FOR EACH PROJECT STAGE

TEAM CONTRACT FOR TEAM _____ PHASE _____

In Alicante, at _[time]_____ on _[day]_____[month]___ 2017, Team __[team name]_____ hereby meets in ordinary session in the Classroom ___[classroom name]_____ at the University of Alicante's Polytechnic School.

Meeting Agenda:

1) (Approval, if appropriate, of the previous meeting's minutes)
2) Decision of the place chosen to develop the project phase

TABLE 6. Survey.

Item	Question
1	Are you satisfied with the work carried out by the group?
2	Did you feel motivated working within the group?
3	What do you think about the group size? 1- Adequate, 2- Too large, 3- Too small
4	Do you think you were assigned an appropriate role within the group?
5	Were there any conflicts in the group?
5.1	If so, to which reason do you think this may be due?
5.1.1	If so, do you think it has been successfully resolved?
5.1.1.1	If the conflict has been successfully resolved, what has been the mechanism for dealing with it?
6	Of all the members of the group, how many were actively involved most of the time? 1- Almost everyone, 2- Very few, 3- Few, 4- Everyone
7	Do you consider that the group members' workload was uneven?
8	How effective was your group? 1- High, 2- Low, 3- Medium
9	Was it difficult talking/negotiating with your group members?
10	Was it difficult working with certain people in your group?
11	Do you think that one person or several people took on too much of the work and barely allowed others to intervene?
12	Do you consider that one person or several people were very quiet, with little intervention?
13	Do you consider that you worked with unmotivated people?
14	Do you think your group lacked order to find a working method that would help you make the most of your time?
15	Do you think your group was lacking someone to really lead, coordinate or manage the group?

3) Tasks to be carried out and member responsible for each of them (present appendiz)
4) Communication/collaboration mechanisms
5) Other matters
6) Questions and requests

Agreements reached

Point 1:
Point 2:
Point 3:
Point 4:
Point 5:
Point 6:

With nothing more to add, the team manager hereby declares that Team ____[team name]_____'s meeting is adjourned at ____[time]_____.

Signed _____

THE FOLLOWING TEAM MEMBERS WERE PRESENT AT THE MEETING (All members' names and signatures)

Signed _____ Signed _____
Signed _____ Signed _____
Signed _____ Signed _____

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