BREAKING PERSISTENT WORKING GROUP PARTNERSHIPS: A SOCIAL EXPERIMENT

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Abstract

Facing multidisciplinary projects is becoming quite common in companies worldwide, meaning that experts from a specific area must team up with experts from other areas in a dynamic, ad hoc manner. For a professional to meet such requirements successfully, it is important that teamwork skills are developed during college. However, such issue is usually not addressed thoroughly, and most students end up teaming with the same partners over and over again, thereby failing to achieve the critical adaptability skills expected from them. To address this drawback, in this paper we present the results of a study where students were forced to team up with other partners based on the results of a computer networking skills-ranking exam. Experimental results confirm the repeating pattern in terms of past partnerships, and student resistance to partner changes. On the positive side, results show that having new partners indeed help at achieving a more even task distribution, and that students are moderately aware of the upcoming challenges in their future professional activity, recognizing the benefits of teaming up with new people.

Keywords: Working group, classroom experiment, survey, partner assignment.

1 INTRODUCTION

In recent years, the pedagogical readjustments under which many European universities find themselves have encouraged teachers to introduce significant changes in the formative process and, consequently, in the teaching-learning methodologies employed. In most cases, the proposed changes promote a significant increase in the application of active learning methodologies, where students play an active role in their own learning process. There are many advantages attributed to active learning [1,2]. Among these, a fundamental pillar is the collaborative work, or group work, which increases the responsibility of the individuals, providing them with skills that can hardly be achieved through other means.

Recent trends in the labour market have raised new professional challenges for nowadays engineers, which typically require their integration into different working groups. Thus, collaboration on organizational and development issues has become a key component for both business and public administration working environments. Moreover, these environments have a growing need for dynamic teams with the ability to address multidisciplinary projects, which require personal and professional interaction of specialists from different areas, and having different skills.

Considering the aforementioned issues, one of the basic challenges of modern university education in general, and engineering schools in particular, is to prepare students to acquire competences in group work with the aim of being able to get fully involved in their future work environment [3]. This should combine both the psychological and the technical preparation of students.

In the literature we can find a plethora of solutions for organizing workgroups depending on the type of task to be addressed. Regarding the composition of these groups, we consider that the criteria used are also relevant since they can have an important, or even critical, impact on the quality of results.

Specifically, in our academic circle, we have observed a clear trend among students of grouping themselves by friendship affinity; moreover, this behaviour seems to become persistent throughout their studies (fact confirmed by the results presented in this paper). This shows a skewed perception of the students about the importance of teamwork and associated interpersonal skills. Also, from a formative perspective, this can be interpreted as a sign that the organization of our academic system does not guarantee that the groupwork competence is properly acquired.

In this paper we present the results of a study where the current trend in terms of group partner assignment was broken. Specifically, a group project in the scope of a Computer Engineering Degree course was proposed, and group partners were assigned by the instructor under the criterion of score similarity, according to results in prior tests. At the end of the course, a survey about the experience was filled out by the students, which allowed collecting and analysing data about their experiences.

The reported results indicate that, as expected, students have mostly been working with a same partner over and over again. Also, students themselves chose those partners, and they resist to working with different partners. Nevertheless, after the new experience, our students found that project tasks were more evenly distributed within the group members compared to previous experiences, although a significant number of students believe such improvement is unrelated to either having new partners or to a similar degree of knowledge about the course. Overall, students positively valued this group work experience for their future experiences in the labour market.

This paper is organized as follows: in Section 2, a brief review of methods and experiences related to the problem of student assignment to groups is made. In Section 3, the characteristics of the course on which the present study was carried out are described. In Section 4, key points of the social experiment, hypothesis to be validated, and questions of the survey are detailed. Then, in Section 5, results are reported and analysed. Finally, conclusions are presented in Section 6.

2 RELATED WORKS

Workgroup-based learning is a critical topic within the scope of active learning, and it has been addressed at the academic level since the early 20th century [4]. Nevertheless, proposals for organizing workgroups transcend academic research, getting prominent attention in the field of Decision Theory. From the many applications areas defined, a special emphasis is given to business and work organization because of its impact on the productivity and reliability of organizations [3,5].

Focusing on the particular scope of engineering projects, theoretical approaches for modelling the factors influencing workgroup performance have recently arisen, including the psychological characteristics and technical skills of the individuals, as well as their specific attitude towards the group [5,6]. In practice, additional factors like the ones derived from personal friendship and acquaintance among partners should also be considered [7,8], especially in academic circles where students themselves usually define group composition.

One of the factors to be emphasized is the collective identification, also known as group identity. In fact, regarding multidisciplinary teams, some works state that, when group identity is higher, performance tends to increase [9]. Other factors rely on interpersonal relations that are necessarily established among individuals that interact in the scope of a given task. These factors should include interpersonal compatibility [10], also known as group homogeneity. Some works point out that the less compatible the group members are, the higher is the quality of results [11,12].

As pointed out, the choice of the workgroup membership can also be decisive to succeed in academic environments, and should receive proper attention. Thus, group composition criteria are tackled in many works [13,14,15]. Those criteria can be grouped in three categories:

i. Allowing students to create their own groups.

Typically, criteria followed by students include friendship (familiarity) or ability compatibility, mutual interest (e.g., work compensation deals), physical vicinity in the classroom, or just chance.

It is well known that, generally, students prefer to choose their workmates themselves (high degree of group identification). Despite of this, some of them appreciate working with new mates because they understand the opportunity to gain new prospects.

ii. Students assigned by teacher.

There is an attempt to “engineer” groups according to personal characteristics, such as personality, past achievements (e.g., previous scores), or relevant skills. The teacher may look for homogeneity or heterogeneity regarding personality or ability.

Teachers can get help from a number of applications implementing a diversity of optimal algorithms and heuristic approaches following a given programming model to assign members to groups [13,16,17,18]. Nevertheless, on the one hand, the data used are often imprecise or incomplete and sometimes fail to capture reality. On the other hand, when using a high number of constraints and criteria, the mathematical models proposed in the literature can become extremely complex.

iii. Allocating students to groups randomly.

Based on such diversity of criteria, a number of methods and procedures have been proposed, and numerous social experiments have been carried out to measure students' workgroup performances. Brickell et al. [14] discussed the effectiveness of five methods on course projects, including rank ordered assignment. Various criteria are also compared in [15].

An analysis of the acquaintance vs. friendship among group members is presented in [7], where groups formed by friends performed significantly better than acquaintance groups on different types of tasks because of a greater degree of group commitment and cooperation.

Huxham and Land [19] discussed and comparison the performances of student groups formed randomly against those formed using learning styles questionnaires. They did not find significant differences between these two sets of groups, and they discussed some possible reasons for this.

The objective of the research of Chapman et al. [20] was testing how random vs. student self-assignment affect the nature of group dynamics and outcomes, as well as students attitudes toward the group experience. The results indicated that the method of group member assignment has a clear influence on all those factors.

The work of Webb et al. [21] is closely related to our work. They gathered a wide sample to study group composition based on grouping different personal ability levels: below-average students, above-average students, and a mix of below and above-average students. As a conclusion, they state that, although heterogeneous (mixed) groups impose a small penalty to high-ability students, they provide a clear benefit for below-average students, thus being beneficial overall.

Contradictory conclusions have been presented while testing the effectiveness of the balanced-group assignment method (heterogeneity in skills and liabilities within the group) using the people-sequential heuristic [22], which consists of balancing groups according to students' competence in a given field. The findings of Muller [23] showed that balanced groups have a modest advantage over groups formed randomly: students felt slightly more satisfied and shared the workload more evenly. Also, within randomly assigned groups, student perceptions of the quality of the group-project learning experience were less homogeneous. Contrarily, the results of Donohue et al. [24] indicate that most hypothesis favouring balanced groups over randomly assigned groups were not supported.

Based on the variety of conclusions reported in the literature, achieving an optimal group assignment strategy can still be considered an open issue. In this paper we expect to contribute with additional information from a new social experiment.

3 THE DCLAN COURSE

Design and Configuration of Local Area Networks (DCLAN) is a mandatory course for all those students enrolled at the Technical University of Valencia (UPV) in the Degree on Informatics upon selecting the Information Technology (IT) specialization. In the scope of the Degree on Informatics, the DCLAN course contributes significantly to major degree competences such as:

- Knowledge and application of the features, functionality and structure of Distributed Systems, Computer Networks and the Internet.
- Ability to design systems, applications and services based on network technologies, including the Internet, web, e-commerce, multimedia, interactive services and mobile computing.

As an IT specialization course, it aims at developing a profound comprehension about the functioning and management of commercial Local Area Network (LAN) devices, including the most widely deployed technologies (IEEE 802.3 and its variants, IEEE 802.11 and its variants) and protocols (VLAN, STP/RSTP, etc.), including security-related issues. A brief overview of access technologies and other LAN standards is also provided.

The DCLAN course takes place in the sixth semester of the degree (3rd year) for a period ranging from February to May, and it is endowed with 4.5 ECTS credits. These 4.5 credits are split into theoretical class credits (3 ECTS) and lab session credits (1.5 ECTS).

Theoretical classes take place every week as a single 2-hour session. During these sessions the instructor conveys information to students using slides, videos and the blackboard, which are interleaved with frequent quizzes and short tests for students. Lab sessions also take place once every week. During lab sessions, students have direct contact with networking hardware such as access points and high-performance switches to perform management tasks. In addition, students also carry out network simulations to gain awareness about the performance of the different network technologies under different loads, among other goals.

Concerning evaluation, a total of 7 evaluation events are defined, 4 of them related to the contents of theoretical classes, and 3 related to the contents of lab sessions. The details about these different evaluation events are presented in Table 1.

Table 1. Evaluation events

Related to:	***Number/type***	***Score weight (%)***	***Evaluation dates***
Theory sessions	2 written exams (open answer)	40%	April/June
	2 multiple choice exams	20%	March/May
Lab sessions	2 multiple choice exams	20%	April/June
	1 group project	20%	May

In this paper we focus specifically on the group project undertaken during the course. This group project, which addresses configuration of network devices using a simulation tool, requires joint work of 2 (or possibly 3) students. Group members must be working together or in a perfectly coordinated manner to complete the project successfully. Additionally, copy prevention mechanisms are deployed in order to prevent fraud. In the next section we detail the experiments using working groups, along with the main hypothesis we wanted to confirm or disprove.

4 HYPOTHESIS AND METHODOLOGY

Groupwork is a work strategy offering many benefits such as increased productivity and performance, enhanced communication skills, improved time management and planning, and gaining more self-awareness. In fact, groupwork skills are positively evaluated by most organizations during personnel recruitment [3].

To address the organization requirements in the professional sector, groupwork skills are nowadays integrated into the curricula of different university degrees, and evaluating students' skills on such area is becoming critical, receiving much emphasis from degree certification authorities. At the Technical University of Valencia, the Degree on Informatics is a clear example of this new paradigm, being groupwork one of the main competences defined.

A possible problem concerning groupwork skill acquisition in the university is that students may pick the same colleagues for groupwork over and over again, thereby failing to accomplish critical adaptability and communication skills that are typically gained when facing heterogeneous elements in the group, each having a different work style. If this occurs, we believe that the groupwork competence currently defined for the degree will not be achieved to its fullest extent, as desirable. In addition, we believe that students are not fully aware of this shortage, which will only become evident when they graduate and start working on a company requiring such skills.

In this work we try to address this problem, and so we formulate the following hypothesis:

H1. Throughout their university studies, students have worked several times in different group projects, but they were allowed to pick their own partner(s), and they chose to mostly maintain the same group partner(s).

H2. Forcing a change of partner is prone to cause resistance and problems to students, which are not adaptable as expected.

H3. Putting students together with new partners having a similar knowledge about the course will help to achieve a more even task distribution.

H4. Although students are aware of the relevance of groupwork skills when joining the labour market in a near future, they fail to understand how important it is to work with different project partners in order to properly acquire these skills.

In the scope of the DCLAN course, groupwork is promoted through a group project that is performed outside class periods, and that requires perfect student coordination, as referred above. In this work, and using the group project as our target population, we perform a social experiment to confirm or disprove the different hypothesis presented above, to check whether project tasks are evenly distributed among group members, and to obtain feedback about students' perception concerning the experiment. To achieve this, in our experiment students are assigned to instructor-defined groups. Since one of our goals was to team up students with similar knowledge about the course, such assignment was not random; instead, the results obtained by students on multiple choice tests are used as reference to rank students, and then group them in pairs by following the ranking order.

On the last lab session of the course the different workgroups presented their work, and all the participants answered to an online survey addressing the concerns presented above. In particular, the most relevant questions to our purposes were the following:

Q1. How many group projects have you made to date?

Q2. How was your group partner(s) selected in previous projects?

Q3. Concerning the group partner(s) for the current project, did you work together in previous projects?

Q4. Rate the degree of coordination with your group partner(s) in the current project.

Q5. How would you describe your experience of working with your partner in this project?

Q6. How evenly were tasks distributed among participants in previous projects?

Q7. How evenly were tasks distributed among participants in this project?

Q8. Do you agree with the statement: "Having a project partner with similar knowledge helps at achieving a more even task distribution."?

Q9. Do you think that working with a project partner for the first time helps at achieving an even task distribution?

Q10. Concerning your future work within an organization, how useful do you think this groupwork experience will be?

Once completed, we processed the answers' database obtained using the R tool. The output of such statistical analysis is presented in the next section.

5 RESULTS AND DISCUSSION

In this section we presents the results of our survey, discussing the validity of the different hypothesis.

To check the first hypothesis, that is, "students have worked several times in different group projects, but they were allowed to pick their own partners", we asked questions 1 and 2.

Figure 1 shows the results for Question 1. It can bee seen that nearly 50% of the students have participated in more than 20 groupworks during their university studies, while only less than 13% of the students claim to have participated in less than 5 groupworks. Such results evidence that, throughout their degree, students usually participate, on average, in 4 groupworks per year.

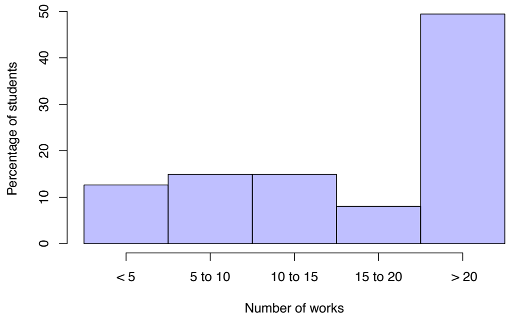

Figure 1: Number of groupworks during college.

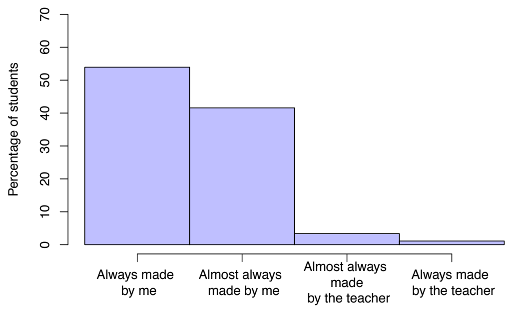

Figure 2: Who defined the working groups?

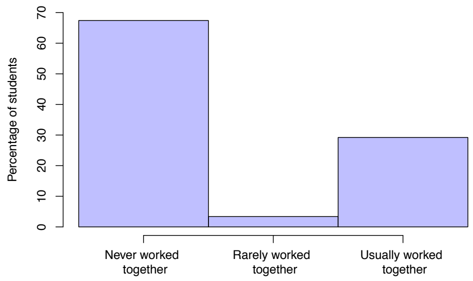

Figure 3: About the partner in the DCLAN course.

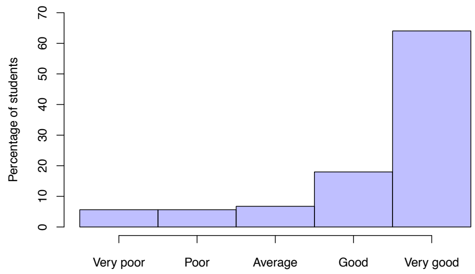

Figure 4: Coordination with the project partner.

Concerning Question 2, figure 2 shows that students were allowed to choose their partners about 90% of the times. Only a 6% of the students claim that the teacher wass the one defining the groups. Based on the results of both figures, we confirm the first hypothesis.

Since for the DCLAN course project partners where defined by the instructor, more than 65% of the students answering to Question 3 claim that project partners were new to each other, while only less than 30% of the students were coupled with a previous partner (see figure 3).

This change of partner caused several students to orally transmit to instructors their discomfort about working with new partners, validating the second hypothesis. Despite their lack of comfort, students state that the coordination between partners was "Good" or "Very good" for the majority, while cases of "Poor"/"Very poor" coordination are scarce (see figure 4).

The same trend is noticeable in answers to Question 5 (see figure 5), evidencing that the work experience with a new partner was "Good" or "Very good" in most cases, although some students had a very bad experience with the new partner.

If we focus on task distribution fairness, student answers to questions 6 and 7 show that the new partner assignment method allows distributing tasks more evenly compared to previous projects. Specifically, answers to Question 6 (see Figure 6) evidence that, although about 45% of students consider that the task distribution was "Very good", still a significant number the students think that the distribution was "Average" (~20%) or even worse (~10%). On the contrary, answers to Question 7 (see figure 7) show that, for the current project, more than 55% of the students think that the task distribution was "Very good". That is a 10% increase compared to previous works, thereby validating our third hypothesis.

Concerning Question 8, we find that, despite students have achieved a better workload distribution in this project, they have different opinions about whether having a partner with the same knowledge and skills helps to evenly distribute the workload (see figure 8). In general, students believe that fairness was not strictly related to this factor. Similar results are obtained for Question 9 (see figure 9). In general, students do not believe that having new partners helped to achieve a better workload distribution, believing it was pure chance.

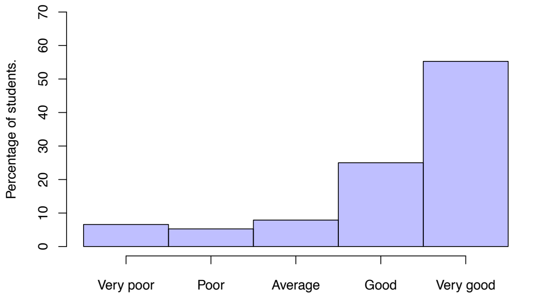

Figure 5: Workgroup experience in the project.

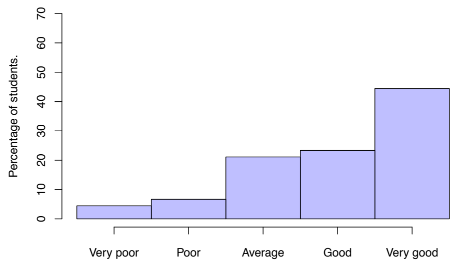

Figure 6: Task distribution fairness among students (previous projects).

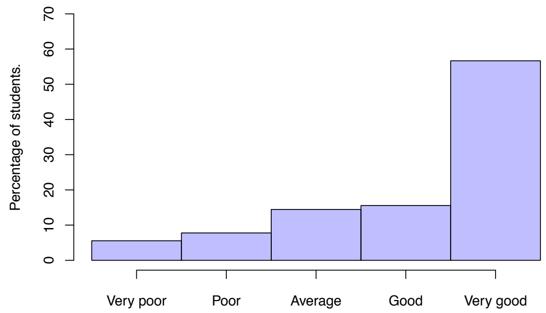

Figure 7: Task distribution fairness among students (current project).

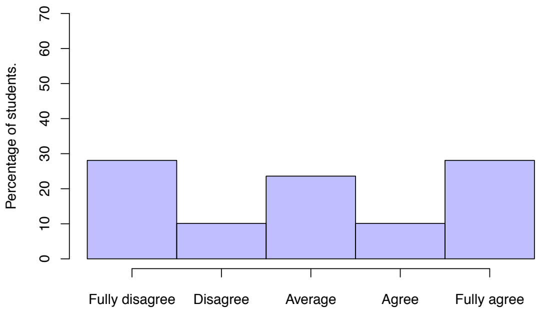

Figure 8: Partnership with students having similar skills promotes a fair task distribution.

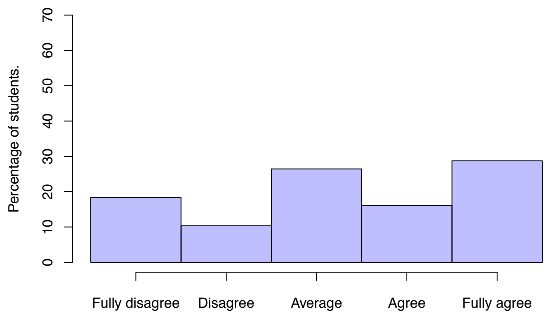

Figure 9: Having new partners promotes a fair task distribution.

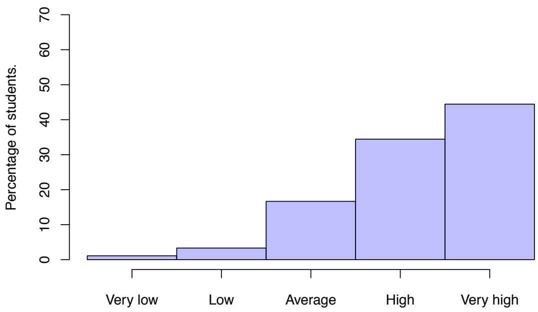

Figure 10: Usefulness of the groupwork experience in future jobs.

Finally, concerning Question 10, figure 10 shows that about 80% of the students consider that this groupwork experience will be of a “High” or “Very high” usefulness for their future, as it implies working with people that may not be a friend or usual companion. Such results partially disprove hypothesis 4, meaning that students do find the experience of working with partners as being helpful when facing future jobs. We believe this finding is quite positive since it means that, although students prefer to undertake minimum effort strategy (same partners during the entire degree), they remain aware about the need and convenience, as future professionals, of working with a heterogeneous group of people, despite task fairness distribution is not guaranteed, as it will be the situation they will often face in the labour market.

6 CONCLUSIONS

Groupwork is one of the most sought-after skills for recruiters as it involves interpersonal skills as well as organizational skills. Therefore, it is important for engineering students to acquire habits and experience in this skill.

Nowadays, although engineering students are involved in lots of different group projects, we find that the groupwork skill is not being properly developed as students are allowed to select their partners. As a result, groups remain mostly the same year after year.

In this work, we present the results of a study where students were forced to team up with other partners based on the results of a networking-skills ranking exam. This pairing method also permits to break previous persistent partnerships, creating an environment more similar to one they could encounter in a future job, where a boss may define the different working groups.

Experimental results confirm that, in our academic circle, groups are usually conformed by the same students, and that students tend to resist to partner changes. By enforcing new group partners, we find that workload distribution was improved. Also, despite facing initial complaints about having new partners, results also show that, in general, the experience and coordination with the new partner was very positive.

Overall, most students considered that having new group partners was a useful experience, allowing them to better prepare for future job conditions.

As a future work, we plan to repeat our experiment using a different group selection method to better assess the influence of this factor on the workload distribution fairness.

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