# Collaborative learning and pandemic situation with online teaching. The experience in Management Skills for Engineers

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## Abstract

*In the subject of Management Skills for Engineers in the last 2020/21 academic year, it was necessary to modify radically the full teaching scheme. Given that the number of students was small and that they already knew the conceptual management basis, this subject had traditionally been developed through reverse teaching and carrying out cases and group works in a collaborative learning context. COVID and the need of structuring teaching and tutorials based on TEAMS, which the UPV has standardized, raised an important turning point and decision: moving to a traditional teaching methodology or keeping the one used until now adapting it to take advantage of the potential of TEAMS and the rest of the UPV's applications. In this communication the theoretical foundations, the planning of the subject and the most significant results are summarized.*

*Keywords: Collaborative learning, Cooperative Learning, Managerial Skills, Computer Supported Coolaborative Learning (CSCL).*

## Introduction.

An elective subject about managerial skills has the inherent challenge of being really effective in developing some skills and abilities of the participants. It is not enough to work them throughout the semestral period. It is necessary to push students to make an additional effort. Thus, when to face the COVID confinement situation was necessary, the possibility of changing towards a traditional teaching and evaluation on-line methodologies seemed to be very interesting to schedule de subject. Although maintaining as a second option the reverse teaching scheme and collaborative/cooperative methodology that had generated interesting results last years under normal teaching conditions. This second option involved starting an experience in Computer Supported Collaborative Learning (CSCL) (Barkley, Major& Cross,2014), a new field to our group, although an effort had already been made analysing with a company the possibilities, in the industrial context, of Computer Supported Collaborative Work (CSCW) in order to improve the efficiency of home work. First semester was dedicated to go deepen into concepts and tools, and subsequently to adjust the present methodology to the computer supported learning, and subject's objectives, contents and constraints.

In any case, the fact of working online is not something alien to the future of today's students when they start their work activity. Traditionally, face-to-face meetings occupied an important part of the agenda and constituted an important incentive, since in many cases involved traveling and meeting other professionals from within and outside the own organization. The development of the applications that allow these meetings on-line have led to shorter deadlines for calls meetings by due easy attendance, lower costs and cutting travel expenses; remaining meetings for cases where the cost is conveniently justified. In fact, the restrictions associated with COVID have already modified many routines and, perhaps, have advanced a process that under normal conditions would have been slower.

## Computer supported Coolaborative Learning technology foundations

Computer Supported Collaborative Learning (CSCL) emerged in 70's in practice, and in 80's as a research field (Slavin, 1983), as a means of instruction and learning, that step by step has become its maturity. CSCL was born and built under the premise that collaborative knowledge construction and problem solving could be effectively assisted by TICs. Our attempt of applying this methodology on a subject of Managerial Skills was a challenge since a big part of literature has been developed to STEM Education (Science, Technology, Engineering and Mathematics) overall in the context of middle and high school (Heinsawn, Hmelo-Silver & Jo, 2019). Conceptually, collaborative learning is a methodological option based on several heterogeneous groups of students who share common goals, and where each of them takes responsibility for their own learning and, simultaneously, helping and providing support to their peers. It differs from the cooperative in that the leadership and responsibility are distributed between the teacher/trainer and group members; while in the cooperative (Slavin&Johnson, 1999) and (Johnson&Johnson, 2015) the leadership is concentrated on the trainer while the responsibility is distributed. For this reason, the collaborative is more extended in the higher education levels where the participants have a greater degree of maturity. In the collaborative, the role of the teacher/trainer is more similar to the coach's role in a context where the process is many times more important than the results, and where co-evaluation can play a relevant role.

In any case, Dillenbourg (1999) stated that the existing definitions were partial. In this paper we follow the approach of Driscoll and Vergara (1997) that indicates that collaborative learning not only requires the existence of this collaboration in the learning process, but it is also necessary that this goal cannot be achieved individually. By other hand, interaction "builds" learning based on experience. Moreover, it is necessary to think that collaborative/cooperative learning isn't new, so it is based on Kurt Lewin's 40's works over the forces that arise in group dynamics, that are in the basis of group's behaviour. In fact, collaborative learning constitutes an academic experience characterized by (Johnson & Johnson, 1999):

- *Positive interdependence*: Group members share goals working collaboratively and cooperatively, eliminating competitiveness and individualism to their minimum level.
- *Individual responsibility*. Students know that their learning's goals have an individual component and a group component. Therefore, they must help each other and learn to request it and to give it naturally.

- *Stimulating face-to-face interaction* without isolated individuals. Students explain, discuss, learn from each other and teach what they know to their classmates in a context in which interpersonal relationships are based on mutual respect and everyone's ideas.
- *Interpersonal and team techniques*. Students should learn some interpersonal and group techniques necessary to achieve efficient collaborative learning. Among them how to exercise leadership, to make decisions, to manage conflicts and to motivate groupmates.
- *Group assessment*. Ins is tried to know their strengths and weaknesses, and constant reviews are carried out to detect how they evolve individually and as a group and, consequently, to do the necessary adjustments to achieve the objectives and to strengthen strengths and minimize weaknesses as a group and individually .

In regarding to CSCL and its assessment in the literature it is possible to find different pedagogical approaches and technological strategies (Johnson & Johnson, 2009) (Slavin, 1983) tackling how students can take more profit of their time and effort participating in this new methodology. On-line collaborative learning presents special challenges about controlling student's behaviours, since they are often outside the supervision of teachers and trainers (Kollar, Fisher & Hesse, 2006) (Barkley&Major,2016) (Dirckinck-Holmfeld, Hodgson & McCornell, 2011).

For assessing CSCL effectiveness we can observe two lines. First one, tackles learners' outcomes and processes, while the second one tackles how CSCL affects student motivations and attitudes toward subject contents (Serrano-Cámara et alt., 2014). Precisely is on this field where new TIC tools as TEAMS can help recording the meetings. By other side, the utilization of new technologies or applying known technologies in a different way in a broad context. On fact they have also demanded that teachers/trainers and learners modify their behaviours (Kafai, Fields & Burke, 2010).

## Subject's teaching plan.

Before developing the teaching plan of the subject, it is necessary to explain its atypical schedule. First two weeks have two sessions of theory and classroom practice of 3.5 hours and one of laboratory practices of 4.5 hours for one of the two practice groups each week. The rest of the weeks on Monday there are 3.5 hours of theory, and on Tuesday a laboratory practice session of 3 hours and on Thursday other of 4.5 hours, one for each practice group alternatively. So, at the end the number of hours will be the same to the two practice groups.

Given that all teaching was on-line and that the number of students did not reach 30, no distinctions were made in the laboratory practices and all sessions were open to everyone. For this reason, the students really had an extended time for working together with the help, if it was necessary of teacher/trainer, and gave great time flexibility for developing the tasks. The peculiar structure of the second semester with subsequent cuts in teaching: Fallas, Easter and partial exams' time allows groups to work with TEAMS easily. The evaluation of the subject was reduced to four cases and a work that consisted on adapting the class-notes about public presentations to online presentations. Work that is intimately linked to the rest of the cases because these must be exposed on-line. Since this is the last one delivered and exposed at the same time it serves as support and it will improve in base on the experience accumulated in the successive presentations: learning by doing.

All class sessions were recorded, but we needed to record all the meeting of each group too, in this way docents had the possibility of seeing as witnesses of all the process. Learning by

doing has been and goes on been the key of this subject. What has changed has been only the way of attempting to depict the subject and the relations among the participants.

Regarding the schedule of each case there are 15 hours of practice to do it. The objective is to have the case finished on second week Thursday. First laboratory practice day begins with the statement of the case, and a short presentation of group tools that must be applied in a mandatory way, leaving the other techniques, explained in theory class, as potentially applicable based on a justified group decision. The term to solve the case is two weeks exposing in tutorials along the next week. Deadlines must be appointed since one of the competencies to assess is "time management".

Group holds its first meeting in the first laboratory practice session. It is recommended that at the beginning group chooses a leader-coordinator for this case and establishes a initial work plan on a Gannt Chart. All them have their Belbin test, so the group has an useful information to select a coordinator and distribute tasks and roles. The work plan, role distribution, additional tools to apply, etc., are sent to the teacher/trainer by e-mail. This communication does not necessarily mean that it has to be maintained at any price, on the contrary in most cases there are changes that must be justified and subsequently assessed. It is an important part of the learning process. The last half hour of the theory on second week's Monday is dedicated to solving the problems that may have arisen in the groups, mainly in relation to the application of the tools to support group work.

Second week is dedicated to finish the case and to prepare the presentation. The two sessions of the week were open for everybody and this option was broadly utilized by nearly all the groups. Results and the direct observation of team conversations and negotiations bring to the teacher/trainer enough information in order to do group and its members assessment. But one of the subject goals is developing abilities and capacities what implies to know more about the perception that each one of the group members have about the groupmate's performance and behaviour. To attempt it alongside the week everybody, has to answer a questionnaire for completing the information in order to give better feedback. One session with each group is scheduled, while the individual one is done on demand of the students.

Table 1. Final questionnaire of case and team work

| | |
|---|---|
| 1. | Do you feel that you have taken advantage of the time you have dedicated to the case in the sense of learning new concepts and how to apply them? |
| 1.1. Rate it from 0 to 10. | 1.2. What do you feel satisfied with? Max. 5 lines. |
| 2. | Are you satisfied with your behaviour as a member of the group during these two weeks? |
| 2.1. Rate it from 0 to 10. | 2.2. What do you feel satisfied with? Max. 5 lines. |
| 3. | Are you satisfied with the solution that your group has developed for the case? |
| 3.1. Rate it from 0 to 10. | 3.2. What do you feel satisfied with? Max. 5 lines. |
| 3.3. What do you feel unsatisfied with? Maximum 5 lines. | |
| 4. | Has the relationship between the group members improved since you created it on the first day of class? |
| 4.1. Rate it from 0 to 10. | 4.2. What do you feel satisfied with? Max. 5 lines. |
| 5. | Do you think that the fact of knowing the roles of Belbin of all the members of the group has been interesting when distributing the tasks? |
| 5.1. Rate it from 0 to 10. | 5.2. What do you feel satisfied with? Max. 5 lines. |
| 6. | Are you motivated to spend time studying this subject? |
| 7. | Are you satisfied with reverse teaching even if it involves extra personal work? |

| | |
|---|---|
| 8. | Have you used any of the bibliographic references that have been suggested to deepen the matter? |
| 9. | Has any conflict arisen within the group? |
| | 9.1.  How did you solve it? |
| 10. | Have you had to hold negotiations within the group? |
| 11. | Has it been necessary to modify the schedule of activities that you reflected in the Gant Chart? |
| 12. | Have you had to modify the initial assignment of roles? |
| | 12.1.  Why did you it? Maximum five lines. |

## Students' assessment.

The evaluation has two elements: the works in Word / PDF submitted and their presentations; and each one of them two components: one directly by the teacher and another carried out by their classmates, all them based on standardized formats. In parallel, the assessment of the transversal competences that appear in the description of the subject is carried out. In principle, the final score is the average of those provided by their peers as long as it does not exceed 1.5 points of that valued by the teacher, in which case the latter is the one that prevails. Logically the natural tendency is that the qualifications provided by the companions are higher than what would reasonably correspond according to the standardized scale. However, the limitation to 1.5 points of difference leads them to be objective since otherwise they would harm their peers instead of favoring them. Obviously, the evaluations are anonymous.

The table contains the ratings of the cases and their presentations. In the case of presentations with a PowerPoint base, the co-evaluation is carried out just at the end of the presentation by all the students who have attended it using the standardized format. The deadline is 30' and the list of attendees and their presence time is provided directly by the platform. Participation in the co-evaluation is valued in the final grade within the "active participation" section.

In relation to the cases in Word / PDF, these are uploaded to a folder in TEAMS and during the two days following the opening of the folder, the completed evaluation form is sent to the TEAMS email. The fact that the deadlines are strict has a double justification. On the one hand, it is necessary to assess the transversal competence of "time management" and, on the other hand, it is important to limit the time so hinder collaboration strategies could be developed by agreeing on the assessments. The teacher's assessment is published once all the formats are received. The objective is that the evaluations are more adjusted throughout the semester. Objectively evaluating the performance of subordinates is an important skill for a manager and is a simple way to introduce this problem.

Table 2. Cases and team work score

| | | Case 1 | | | Case 2 | | | | Case 3 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Paper | Paper | Pres | Paper | Paper | Pres | Pres | Paper | Paper | Pres | Pres |
| Group 1 | Average | 8,81 | | 1,61 | 8,26 | | 1,42 | 8,42 | 8,26 | | 1,12 | 8,12 |
| | Teacher | 7 | 1,81 | | 7 | 1,26 | | 7 | 7 | 1,26 | | 7 |
| Group 2 | Average | 9,62 | | 0,62 | 8,41 | | 1,23 | 9,23 | 8,31 | | 0,71 | 8,71 |
| | Teacher | 9 | 0,62 | | 8 | 0,41 | | 8 | 7 | 1,31 | | 8 |
| Group 3 | Average | 6,1 | | 1,11 | 9,02 | | 1,57 | 8,57 | 9,12 | | 1,01 | 8,01 |
| | Teacher | 7 | -0,9 | | 8 | 1,02 | | 7 | 8 | 1,12 | | 7 |
| Group 4 | Average | 8,83 | | 1,28 | 8,98 | | 1,28 | 9,28 | 8,89 | | 0,73 | 7,73 |
| | Teacher | 8 | 0,83 | | 8 | 0,98 | | 8 | 8 | 0,89 | | 7 |
| Group 5 | Average | 9,36 | | 1,82 | 9,03 | | 1,32 | 9,32 | 8,01 | | 0,81 | 8,81 |
| | Teacher | 8 | 1,36 | | 8 | 1,03 | | 8 | 7 | 1,01 | | 8 |
| Group 6 | Average | 8,21 | | 1,36 | 9,08 | | 1,62 | 8,62 | 8,13 | | 0,62 | 7,62 |
| | Teacher | 7 | 1,21 | | 8 | 1,08 | | 7 | 7 | 1,13 | | 7 |

| | | Case 4 | | | Team Work | | | |
|---|---|---|---|---|---|---|---|---|
| | | Paper | Paper | Pres | Paper | Paper | Pres | Pres |
| Group 1 | Average | 8,64 | | 0,91 | 7,61 | | 0,82 | 8,82 |
| | Teacher | 8 | 0,64 | | 7 | 0,61 | | 8 |
| Group 2 | Average | 8,41 | | 0,62 | 7,86 | | 0,81 | 8,81 |
| | Teacher | 8 | 0,41 | | 7 | 0,86 | | 8 |
| Group 3 | Average | 8,03 | | 1,28 | 8,9 | | 0,82 | 7,82 |
| | Teacher | 7 | 1,03 | | 8 | 0,9 | | 7 |
| Group 4 | Average | 8,21 | | 1,212 | 9,01 | | -0,02 | 7,98 |
| | Teacher | 8 | 0,21 | | 8 | 1,01 | | 8 |
| Group 5 | Average | 8,26 | | 0,69 | 7,76 | | 0,64 | 8,64 |
| | Teacher | 8 | 0,26 | | 7 | 0,76 | | 8 |
| Group 6 | Average | 7,96 | | 0,33 | 8,71 | | 0,96 | 8,96 |
| | Teacher | 7 | 0,96 | | 8 | 0,71 | | 8 |

The teacher assessment is made to the group. If it has n members, the maximum grade would be 10n. The distribution of the points corresponds to the group and the teacher only participates, as a mediator in the event that the group cannot resolve the conflict. Logically, it will never be a divisible value by the number of members, since the objective is to influence the decision-making process. The assignment must be done without decimals, only whole numbers. If the works are carried out and exhibited in English, 0.5 to 1.0 points are added, except for Erasmus students,. In the table the data of the teacher's qualification are collected divided by ten and truncated at the unit level.

This small change introduces two important elements from a decision-making point of view. On the one hand, the factor of responsibility as an individual and as a member of the group. With regard to decision-making up to this point, problems have always been treated aseptically without considering influences or repercussions in the personal sphere. The second is the fact of introducing conflict, which forces the group to negotiate and resolve conflicts, two important skills for managers. It must be remembered that the group is stable throughout the entire semester so that everyone depends on their colleagues and they have to face conflicts and negotiation processes where the actions will have repercussions in the future. The distribution of the points is made only with whole numbers, without decimals, which necessarily involves a negotiation process.

Figure 1. Difference average values.
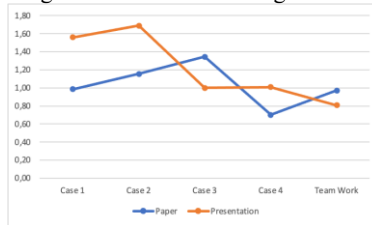


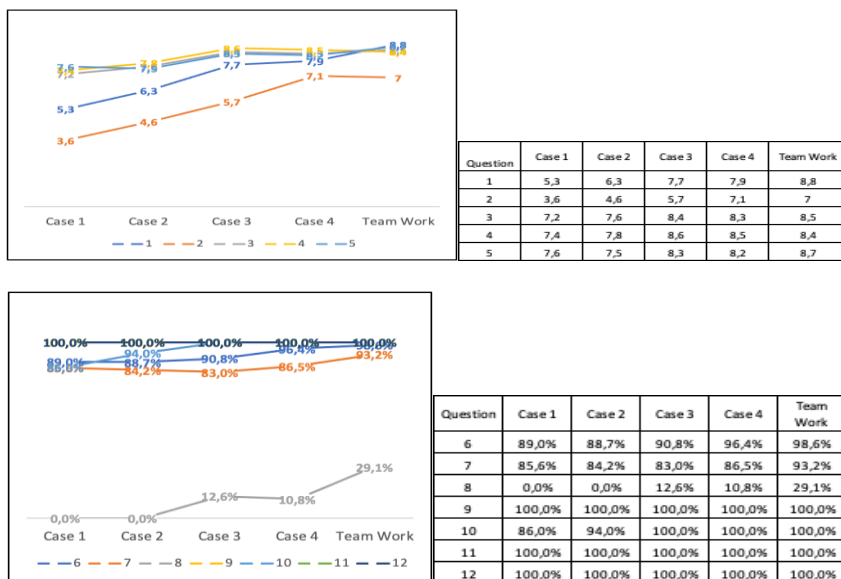| | Case 1 | Case 2 | Case 3 | Case 4 | Team Work |
|---|---|---|---|---|---|
| Paper | 0,99 | 1,16 | 1,34 | 0,70 | 0,97 |
| Presentation | 1,56 | 1,69 | 1,00 | 1,01 | 0,81 |

Second part of the evaluation aims to have objective information to provide the student with effective feedback on their evolution in the development of their skills and competencies and, secondly, to have information to improve the teaching methodology each year. The attached table shows the mean values of the responses, although the most important component is logically reflected in the open-ended questions.

Table 2. Results of final questionnaire of cases and team work

| | | | |
|---|---|---|---|
| 1. Do you feel that you have taken advantage of the time you have dedicated to the case in the sense of learning new concepts and how to apply them? | 7,2 | | |
| 2. Are you satisfied with your behavior as a member of the group during these two weeks? | 5,6 | | |
| 3. Are you satisfied with the solution that your group has developed for the case? | 8,2 | | |
| 4. Has the relationships among group members improved since you created it on the first day of class? | 9,4 | | |
| 5. Do you think that the fact of knowing the roles of Belbin of all the members of the group has been interesting when distributing the tasks. | 8,6 | | |
| 6. Are you motivated to spend time studying this subject? | | 92,7 | 7,3 |
| 7. Are you satisfied with reverse teaching even if it involves extra personal work? | | 86,5 | 13,5 |
| 8. Have you used any of the bibliographic references that have been suggested to deepen the matter? | | 10,5 | 89,5 |
| 9. Has any conflict arisen within the group? | | 100 | 0 |
| 10. Have you had to hold negotiations within the group? | | 96 | 4 |
| 11. Has it been necessary to modify the schedule of group activities that reflected in the Gant Chart? | | 100 | 0 |
| 12. Have you had to modify the initial assignment of roles? | | 100 | 0 |

The first five are valued from 0 to 10 and the next seven Yes / No. Consequently, for the former, the table shows the average value, while for the latter, the percentage is collected.

Figure 2. Results final questionnaire of cases and team work.



| Question | Case 1 | Case 2 | Case 3 | Case 4 | Team Work |
|---|---|---|---|---|---|
| 1 | 5,3 | 6,3 | 7,7 | 7,9 | 8,8 |
| 2 | 3,6 | 4,6 | 5,7 | 7,1 | 7 |
| 3 | 7,2 | 7,6 | 8,4 | 8,3 | 8,5 |
| 4 | 7,4 | 7,8 | 8,6 | 8,5 | 8,4 |
| 5 | 7,6 | 7,5 | 8,3 | 8,2 | 8,7 |



| Question | Case 1 | Case 2 | Case 3 | Case 4 | Team Work |
|---|---|---|---|---|---|
| 6 | 89,0% | 88,7% | 90,8% | 96,4% | 98,6% |
| 7 | 85,6% | 84,2% | 83,0% | 86,5% | 93,2% |
| 8 | 0,0% | 0,0% | 12,6% | 10,8% | 29,1% |
| 9 | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% |
| 10 | 86,0% | 94,0% | 100,0% | 100,0% | 100,0% |
| 11 | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% |
| 12 | 100,0% | 100,0% | 100,0% | 100,0% | 100,0% |

## Conclusions.

In relation to decision-making in the co-evaluation, it can be observed how with five iterations it has been possible to significantly reduce the differences. In addition, from the beginning the valuations were quite tight and that from the third case the deviations have no longer exceeded the established limit. On the other hand, there have been no conflicts where the participation of the teacher as a mediator has been necessary.

The evaluation of the students in relation to the time dedicated to the subject has been positive (5.3 / 8.8), as well as the progressive improvement between the relationships between the members of the group (7.6 / 8.7). which must be related to the generalized existence of conflicts (100%) and the corresponding internal negotiations in relation to the scheduling of activities, assignment of roles, preparation of the presentation and writing of the work. It is important to highlight the level of satisfaction with reverse teaching even though it entails an additional workload. A differentiated section corresponds to the satisfaction of the participants with their behavior within the group. It has improved throughout the semester (3.6 / 7.0) although it is important to clarify that this improvement is doubly positive since the comments especially highlight the idea that they could have contributed more and that these demands at work in group was new to them. Finally, comment that there has been no conflict in the distribution of the points that required the participation of the teacher as a mediator.

As a negative aspect to highlight the fact that only a small part of the students have consulted the complementary bibliography, which raises interesting questions to which they will try to answer in future courses.

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