

Teamwork with University Engineering Students. Group Process Assessment Tool

JUAN A. MARIN-GARCIA¹, JAIME LLORET MAURI²
¹Department of business organization. ²Department of Communications.
 Polytechnic University of Valencia.
 Camino de Vera s/n. Valencia. SPAIN

Abstract: - Various sources have shown the advantages of considering a teamwork-based methodology with university students. University teachers, however, observe certain shortcomings and disinformation, especially with regard to the assessment of group processes. For this reason we set out to answer the following research questions: Is it possible to measure the group process in classes with large numbers of students? Can shirking be prevented? What problems arise? To this end we have designed and tested a teacher observation grid and we will process a broad set of data.

Key-Words: - active methodologies, process assessment, student participation, university teaching

1 Introduction

Various sources have propounded the advantages offered by considering a teamwork-based methodology with university students. On the one hand, it enables students to experiment and acquire the skills that they will need in their future jobs. Some of these skills are: interpersonal communication, teamwork, group problem-solving, leadership, negotiation and time management [1-5]. On the other, teamwork used in a context of active methodologies provides profounder and more significant learning. In addition, positive effects have been shown on the academic performance of students, motivation and their attitudes towards learning [5-7]. Some of these advantages have also been underscored by students, who consider group activities and active methodologies to be more interesting, entertaining and learning-facilitating than traditional teaching [7; 8].

Due to its advantages teamwork has been a major aspect of university teaching [8]. Our research, therefore, is going to focus on pinpointing the snags that arise when trying to get students to work in teams. We will identify the possible opportunist behaviour of the students as one of the main drawbacks. We will draw up a proposal that sets out to tackle this problem. This proposal is based on group process assessment by the teacher. Lastly, we will verify that the proposal put forward functions satisfactorily in a subject context and we will propose the possible lines of continuation of this study.

2 University student teamwork and the role of the teacher

In our research we will use the terms group and team synonymously. They refer to a small number of interdependent persons with complementary skills, who interact in order to acquire knowledge, skills or attitudes and produce joint results [7].

In the introduction we mentioned some of the main advantages of getting our university students to work in teams. But teamworking causes problems, too. For instance, in certain contexts (faculties of engineering or other technical branches) there is reluctance on the part of the students who are not used to this way of working and who feel disoriented [6; 9; 10], or else they consider that these activities force them to devote a lot of time [6]. In other cases it is necessary to assign an individual mark to the students although they have done the work on a team basis [5]. This is especially important when opportunist or parasite behaviour patterns may appear amongst the members of the group [5; 6; 10]. Furthermore, the teacher has to become involved and devote time to motivating the students, supervising activities and supervising the group process, which is not always easy to assess [5]. Lastly, students are not usually prepared for teamworking, so they need time, training and practice in this.

Accordingly, taking into account that the advantages of teamwork (and of active

methodologies in general) are only obtained when teachers design, guide the process and assess it properly [1; 6]. We would like to point out some considerations regarding the role of the teacher when groups are introduced as part of the active methodologies in the classroom.

The teacher’s role does not end with the design of the activity and the training of the groups. It is necessary, for example, to sensitize students and prepare them so that they may work effectively in a team. This may be done through class dynamics. Normally, these sensitizing activities may take up five hours during the academic year (including a discussion session on what has been learnt in the group), although a couple of hours at the start of the year could suffice [1]. These sensitizing activities help the students to enjoy and get the most out of group activities [1]. Some teachers may be concerned about having to purloin this time from subject matter explanation. In that case, they should ask themselves whether considering teamworking for their students is in fact a genuine objective for furthering student learning or merely a way of cutting down the number of assignments to be assessed at the end of the activity.

Furthermore, it is recommendable to give the students a good description of exactly what the teacher wants to achieve with the group activity: what the product is that they have to carry out together and how they are going to be assessed for that product [1; 4; 8]. But also how they should work and how the group process will be assessed. The more detailed this information, the better. It is also best for it to be given in writing [8]. Finally, the teacher has to devote time to supervising the teamwork [1]. This supervision may be done by walking around the groups, if the group task is performed in the teacher’s presence in class time [1] or by establishing a weekly time (tutorial) to discuss with the students how they are working as a team.

3 Group process

The teamwork is composed of two parts that are not always easy to differentiate by students or teachers [5; 8; 11]:

- Product: what the team has to hand in or submit (e.g. reports, proposals, oral presentations)
- Process: the way in which the team carries out its tasks (activities and behaviour patterns of the members of the team).

In this communication we are going to focus on the group process only. It is important to pay

attention to the group processes as they not only affect the quality of the end product, but also the feelings and motivation of the students. It is no simple matter, however, to find specific criteria that will enable us to identify observable behaviour patterns as good group processes. In Table 1 we summarize the criteria appearing in various publications. Probably one of the aspects related to the group process that most concerns students and teachers is the opportunist or parasite behaviour of some group members [10; 11]. This problem arises most often in groups composed of four people or more [8] or when the group works outside class hours [4]. One of the ways of preventing this parasite behaviour of the students for groups to lay down working rules or that the students sign internal contracts [1; 4]. Another, and the one to which we will devote our attention in this paper, is to establish assessment mechanisms that will help to prevent such behaviour patterns [8].

Table 1. Criteria for assessing group process

Criteria	Author
Amount or frequency of participation in the group. Attendance at meetings.	[1; 4; 5; 8; 10; 12]
Quality of participations in the group or of documents presented.	[1; 5; 10]
Preparation of meetings (homework done). Gathering and processing of information prior to the meeting. Meeting deadlines.	[1; 4; 5; 8; 10]
Appropriate interpersonal communication (active listening, appreciating other points of view, showing a positive attitude, positive feedback)	[4; 10]
Delegating/Leading without dominating	[1; 8]
Accepting and assuming responsibilities	[1; 5; 8; 10]
Suitable handling of disputes	[1; 4]
Decision-making/Group problem-solving	[4]

4 Group process assessment

In traditional teaching only the product of the activities assigned to the groups is assessed. However, if active methodologies have been introduced with the idea of training the students in transverse skills as well, it is necessary to include the group process in the assessment of the subject [12]. In this way, we make it plain to the students that the way in which they have achieved the products is also important [8; 13].

All the authors agree that the process assessment may be used instructively, in other words providing the students with feedback on how they are performing and what could improve [7]. In this respect, it is preferable to carry out regular assessments instead of a single end-of-year assessment. In addition, it is recommendable to use multi-evaluators that enrich feedback. One way of

achieving this is using the students as evaluators. A further benefit of this is that they also develop their reflexive skills through being assessors of their own work or that of their fellow students.

However, there are opinions both for and against using the process assessment as a percentage of the students' mark (summative assessment). The contrary opinions are based on the fact that it is hard to establish objective criteria to assess the process. Furthermore, the teacher usually has difficulty obtaining data that may help him or her to evaluate the group process, especially if the groups do not work in class; so his or her grades may not be very accurate [10; 11; 14].

In the case of summative assessment a common doubt that teachers have is whether to award all team members the same mark or determine the mark in accordance with individual contributions to the group process [5]. The investigations published do not resolve this doubt, but they agree that proper group process assessment helps students focus on how they work as a team, and this is a learning process in itself [7].

The methods that are usually used for assessing group process are: criteria-based assessment grids and the students' written comments on how the team works [2; 4; 5]. The former methods may be used as an evaluator for the teacher or the students, who may assess themselves or their peers [7], while the latter uses students as evaluators.

At this point it would be wise to consider the students' role in group process assessment. One of the main advantages is that students have first-hand experience of how the group works and, therefore, have information to evaluate it. Some authors, however, have commented that students are not good evaluators or that it is hard for them to identify the way in which they work [5], perhaps because they focus so much on the product that they lose the notion of how they are achieving it. Another aspect to be considered is that if the students know that part of their mark comes from assessing their peers, there is less likelihood that parasite behaviour patterns will appear [8; 10]. This internal assessment, however, may produce friction, upset group cohesion [1] and, in addition, some students prefer not to give their parasite fellow students the mark they would deserve [5; 15]. Furthermore, students are more willing to accept marks that come from the teacher than those that come from peers. Peer evaluation is not, therefore, a successful option, unless it is done well and time is spent on training

the students and making a number of assessments in the course of the year [10]. In many cases, tight schedules prevent sufficient time being devoted to these activities, so to prevent parasite behaviour patterns, it would be necessary to look to other factors, such as group size and composition [8] or direct teacher observation.

5 Questions of research and methodology

We have selected the following questions for our research: Is it possible to measure group process in large classes?; Can student opportunist behaviour be avoided?; What problems arise from teamwork carried out in the classroom in the teacher's presence?

To answer them, we have designed and tested an observation grid for the teacher to use during student teamwork in the classroom. We have also processed a broad set of data. On the one hand, we have compared the process "marks" with the product "marks" of the groups. We have also taken into account the opinions of the students on positive and negative aspects of the subject (46 subjects) and an open question: does the group activity assessment system help to prevent shirking? during a mid-term group session (115 subjects).

The subject in question (Business Strategy and Policies) is delivered in the third year of the Industrial Organization Engineering degree course. Teaching takes up 13 class weeks. It is arranged in weekly 3-hour sessions plus four additional 2-hour practicals. The number of students enrolled was 180, a hundred of whom (70 in the morning group and 30 in the afternoon) attended classes regularly.

Teaching was organized around 7 topics, four of which were addressed with an innovative methodology giving rise to this research. Each of these topics had a webquest structure [16].

The individual reports were rated as good, fair or poor, while group reports received a mark from 0 to 10. Half of this mark came from defining the concepts of the topic properly and the other half from satisfactorily reasoning the ideas and theories expounded. The individual grades were only used for setting up class groups, putting students with similar grades together. The groups consisted of 4 students and the members of the group changed for each topic.

In class, the teacher evaluated the participation of students in the group by means of an observation grid (available on request to the main author). These

grid observations were translated into points (a percentage of the total maximum points to be obtained). This percentage was multiplied by the group’s product in order to calculate the mark for the activity.

6 Results analysis and discussion

We put one process mark and two product marks in each of the four group activities performed. The two product marks are very closely correlated with each other ($\rho=0.678$; $\alpha<1\%$; $N=96$), but no significant correlation appears between either of these two marks and the process mark (ρ between 0.190 and 0.159). In other words, groups where participation is more balanced are not the ones that turn in the best reports. One reason is that to achieve a good product it is not enough merely to intervene in the group meeting. It should also be necessary to have acquired the necessary knowledge for these interventions to be gainful. To confirm this assertion, we carried out some analyses of variance (ANOVA) in order to detect the effect of students’ work during the week prior to the meeting on the product and process marks (Table 2). We were particularly interested in differentiating between groups composed of students who did not do a

preliminary piece of work and those made up of students who handed in individual reports, irrespective of the quality of those reports.

In Table 2 we can see how group product quality depends on prior preparation by the members. It is of interest to point out that group interaction enables students with only fair individual reports to be able to turn out group reports of a quality similar to those produced by groups with members who did very good individual reports. The data, however, show that it is unlikely that students who have done no work during the week would produce good group reports. Furthermore, a certain relationship is observed between the quality of individual work and participation in group activities.

In groups whose members had not done the prior activities or who had done them with poor results, it is more likely that there may be people who do not participate (an aspect that is reflected in a lower group process mark).

Table 2. Difference between groups of students

	Group member individual report	N	Mean	Std. Deviation	Minimum	Maximum
Concept Definition	Not presented	6	4.25	2.139	2	8
	Poor	6	6.92*	1.429	5	9
	Fair	26	5.71+	1.904	3	9
	Good	26	6.42*	2.120	3	10
Reasoning	Not presented	6	4.25	1.943	2	7
	Poor	6	6.25*	1.173	5	8
	Fair	26	5.79*	1.509	3	9
	Good	26	5.96*	1.881	2	10
Process	Not presented	6	6.83	2.137	4	10
	Poor	6	7.67	2.251	5	10
	Fair	26	8.92**	1.573	5	10
	Good	26	9.31**	1.123	6	10

Difference between groups made up of students who do not do the individual assignments and those that do: + significant difference $\alpha<10\%$; * significant difference $\alpha<5\%$; ** significant difference $\alpha<1\%$

We decided that student teamworking should take place in class hours only so that it could be observed by the teacher. We are interested in verifying whether this manner of assessment really fulfils its objectives, i.e. that it helps to reduce parasite behaviour patterns in students and does not generate unwanted effects. For this purpose, we are going to use student opinions collected in class weeks six and eight as a source of information.

In class week six we carried out a focus group activity forming part of one of the practicals. In this

we asked them to individually and anonymously answer an open question in preparation for a meeting with fellow students. The 115 students attending the practical answered the question: does the group activity evaluation system help to prevent shirking? We analysed the content of their answers with the help of the Atlas-Ti program. 87% of students consider that the system used does help to prevent opportunist behaviour patterns of students. Many of them consider that it encourages participation by everybody in the team and some

point out that it encourages people to do the prior individual assignments. One of the aspects most mentioned is that it successfully prevents shirking, as the performance of students has an impact on the mark. We have included some of their opinions here to illustrate these ideas:

- “Depending on how you have done the individual assignment, when it comes to the teamwork you will be put into one group or another, which supposedly will affect your final mark” (s.38)
- “Shirking is prevented as the teacher observes our contribution to the group all the time” (s.46)
- “It is one of the subjects where, as far as I know, there is least shirking” (s.60)
- “It makes all team members participate” (s.82)

14% answer that how the system works depends on the students’ priorities. If the idea is only to get a pass, the system does not work as students can always pass by just by sitting the final examination, which is compulsory for everyone. But if they want to get a good grade, the system encourages them to work all the time and not just take advantage of the work of other team members without making their own contribution. 10% of students consider that shirking will always exist and so the system will never work. Below we set out some opinions representative of this group of students:

- “In group activities there are people that do not participate, partly because they have not done the necessary preparation individually” (s.21)
- “I think that shirking will always exist whatever you do. Although it is true to say that people generally participate.” (s.79)

Other details of interest are that some students consider it necessary to differentiate between shirking and not being able to do the tasks because they conflict with other obligations, such as for instance their occupation. In this respect, they point out that in teamwork they try and contribute as far as they can, even though they have not done the prior individual activities. Some people are also of the opinion that shirking is not only prevented by the way that teamwork is assessed but also by the motivation of the students who would not be wasting their time in class if they had not come to learn and get the most out of the activities.

Finally, in order to see whether the system is generating unwanted effects, we will use the data collected upon terminating the week eight class. We collected these data as part of an activity aimed at showing the usefulness of bottom-up communication in organizations. We asked students to record on two blank sheets all the positive and

negative things that they encountered in respect of the teaching of the subject. 46 students gave their impressions. In Table 3 we summarize the opinions relating to the assessment system. These opinions confirm that the system is working: student involvement is achieved and the teamwork performed is rated as positive, as social skills are learnt and the classes are lively and enjoyable. At the same time the negative effects are few, although 10% of students consider that the marks awarded for their teamwork are not in line with their effort or expectations. The predominant complaint is the excessive amount of work to be done at home. We hope to address this matter in a subsequent paper, although for the time being we can disclose that the average time devoted by students to this 5-credit subject was less than 90 hours (75% of the ECTS recommendation).

7 Conclusion

Recapping on the contributions of the theoretical framework described in the previous sections, we may conclude that teamwork is an important aspect in current university teaching; teamwork is made up of product and process; both components may and should be assessed; process assessment is not easy and, although it has been studied, further research on the matter is required; one of the most critical aspects of the group process is how to prevent parasite behaviour patterns.

The first of our questions was whether it is possible to assess group process in large classes using the only teacher as the evaluator. The results of our research enable us to answer affirmatively, albeit with certain limitations. First of all, we have limited the behaviour patterns to be observed for the summative assessment of the group process, including the degree of participation of group members only. Our view is that this is the conduct most closely related to the possibility of preventing parasite behaviour patterns in students. Since students work in teams during class hours, there will be teachers concerned about what happens to subject matter when teaching hours are used for student teamwork instead of explaining subject matter. For questions of space in this paper we are unable to address this matter. It will be examined in a later study. The other questions were whether shirking was prevented and whether unwanted effects took place with the system proposed. It seems evident that the proposed system successfully curbs opportunist behaviour patterns of students and that the main drawback, from the students' point of

view, is that they are obliged to put more effort into the subject. Probably, from the teacher's point of view, this is precisely what we are seeking in our teaching, namely that the students should end up devoting the necessary personal effort for significant learning to take place. Lastly, despite the possible advantages of incorporating students into the assessment of the group process, in our research we

have opted for examining the possibilities of using the teacher as the sole data source. This does not mean that we waive the positive aspects of self-assessment or peer assessment, but that we are conducting ongoing experiments and will include further assessment methods in future researches.

Table 3. Positive and negative aspects of the subject (number of students who select each option). Cases= 46.

Positive		Negative	
Student involvement	21	Too much work to be done at home	21
Teamwork	12	Assessment unfair	4
Classes lively	12	Assessment system complicated or they are not used to this type of assessment	3
Social teamwork skills practised	11	Too many teamwork activities	1
Classes enjoyable	9	Too much control by the teacher	1

Acknowledgements:

We would like to thank the R&D+i Linguistic Assistance Office at the Universidad Politécnic de Valencia for their help in translating this paper.

References:

[1] Bolton, M.K., The Role of Coaching in Student Teams: A "Just-in-Time" Approach to Learning, *Journal of Management Education*, Vol.23, No.3, 1999, pp. 233-250.

[2] Christoforou, A.P., Yigit, A.S., Al-Ansary, M.D., Ali, F., Aly, A.A., Lababidi, H., Nashawi, I.S., Tayfun, A., Zribi, M., Improving engineering education at Kuwait University through continuous assessment, *International Journal of Engineering Education*, Vol.19, No.6, 2003, pp. 818-827.

[3] Fruchter, R., Dimensions of teamwork education, *International Journal of Engineering Education*, Vol.17, No.4-5, 2001, pp. 426-430.

[4] Sheppard, K., Dominick, P., Aronson, Z., Preparing engineering students for the new business paradigm of international teamwork and global orientation, *International Journal of Engineering Education*, Vol.20, No.3, 2004, pp. 475-483.

[5] Michaelson, R. Assessing group Work. 2003. Briefing paper for LTSN-BEST. <http://www.business.heacademy.ac.uk/publications/misc/briefing/groupwork/assessing%20group%20work%20-%20michaelson.pdf>. Last accessed april 2007.

[6] Holtham, C.W., Melville, R.R., Sodhi, M.S., Designing Student Groupwork in Management Education: Widening the Palette of Options, *Journal of Management Education*, Vol.30, No.6, 2006, pp. 809-817.

[7] Watts, F, García-Carbonell, A, Llorens, J,. 2006. Introducción a la evaluación compartida: investigación multidisciplinar. In *La evaluación compartida: investigación multidisciplinar*. 1 ed. Edited by Frances Watts and Amparo García-Carbonell. Valencia: Editorial de la UPV.

[8] Bacon, D.R., Stewart, K.A., Silver, W.S., Lessons From the Best and Worst Student Team Experiences: How a Teacher Can Make the Difference, *Journal of Management Education*, Vol.23, No.5, 1999, pp. 467-488.

[9] Wenger, M.S., Hornyak, M.J., Team Teaching for Higher Level Learning: A Framework of Professional Collaboration, *Journal of Management Education*, Vol.23, No.3, 1999, pp. 311-327.

[10] Brooks, C.M., Ammons, J.L., Free riding in group projects and the effects of timing, frequency, and specificity of criteria in peer assessments, *Journal of Education for Business*, Vol.78, No.5, 2003, pp. 268-272.

[11] Willcoxson, L.E., "It's not Fair!": Assessing the Dynamics and Resourcing of Teamwork, *Journal of Management Education*, Vol.30, No.6, 2006, pp. 798-808.

[12] Dancer, D., Kamvounias, P., Student involvement in assessment: a project designed to assess class participation fairly and reliably, *Assessment and Evaluation in Higher Education: An International Journal*, Vol.30, No.4, 2005, pp. 445-454.

[13] Humphreys, P., Lo, V., Chan, F., Duggan, G., Developing transferable groupwork skills for engineering students, *International Journal of Engineering Education*, Vol.17, No.1, 2001, pp. 59-66.

[14] Van Duzer, E., McMartin, F., Methods to Improve the Validity and Sensitivity of a Self/Peer Assessment Instrument, *IEEE Transactions on Education*, Vol.43, No.2, 2000, pp. 153-157.

[15] Brown, G, Pendlebury, M, *Effective learning and teaching in higher education. Vol. 11 Assessing active learning*, CVCP Universities' Staff Development and Training Unit, . 1992.

[16] Dodge, B. Five Rules for Writing a Great WebQuest. 2001. International Society for Technology in Education.