Improving Teamwork with University Engineering Students. The Effect of an Assessment Method to Prevent Shirking.

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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 [1-12]. 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; 8; 12-15]. 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 [14; 16; 17].

Due to its advantages teamwork has been a major aspect of university teaching [16; 18]. However, although the majority of teachers propose group activities to their students, the question still remains as to what the best way is of organizing and handling student teamwork [15; 16; 19]. These doubts are usually more common in teachers of technical subjects, who normally have less confidence in their ability to implement active methods correctly [20].

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; 9; 10; 14]. In principle, these groups may be used in any university discipline [8], either as isolated activities as a part of traditional teaching or else by integrating them into more innovative methodologies, such as work-based learning, autonomous learning, active learning or student-centred learning, or problem-based learning [8].

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 [13; 20-22], or else they

consider that these activities force them to devote a lot of time [13; 15; 23]. In other cases it is necessary to assign an individual mark to the students although they have done the work on a team basis [8]. This is especially important when opportunist or parasite behaviour patterns may appear amongst the members of the group [8; 13; 22]. 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 [8]. Lastly, students are not usually prepared for teamworking, so they need time, training and practice in this [9; 24].

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; 5; 13]. 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 [9]. 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; 6; 9; 16]. 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 [16]. Finally, the teacher has to devote time to supervising the teamwork [1; 5]. 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 [8; 9; 16; 25]:

- 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 [9], 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 [5; 22; 25]. This problem arises most often in groups composed of four people or more [16] or when the group works outside class hours [6]. 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; 6]. 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 [16].

Table 1. Criteria for assessing group process

Criteria	Author
Amount or frequency of participation in the group. Attendance at meetings.	[1; 6; 8; 9; 16; 22; 26]
Quality of participations in the group or of documents presented.	[1; 8; 9; 22; 27]
Preparation of meetings (homework done). Gathering and processing of information prior to the meeting. Meeting deadlines.	[1; 6; 8; 9; 16; 22; 27]
Appropriate interpersonal communication (active listening, appreciating other points of view, showing a positive attitude, positive feedback)	[6; 9; 22; 28]
Delegating/Leading without dominating	[1; 16; 28]
Accepting and assuming responsibilities	[1; 8; 16; 22; 28]
Suitable handling of disputes	[1; 6; 28]
Decision-making/Group problem-solving	[6; 27]
Creativity	[27]

4 Group process assessment

In traditional teaching only the product of the activities assigned to the groups is assessed [27]. 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 [26]. In this way, we make it plain to the students that the way in which they have achieved the products is also important [16; 29; 30].

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 [14]. In this respect, it is preferable to carry out regular assessments instead of a single end-of-year assessment [9]. In addition, it is recommendable to use multi-evaluators that enrich feedback [9]. 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 [27]. 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 [22; 25; 31].

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 [8; 19]. The investigations published do not resolve this doubt [32], 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 [14].

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 [3; 6; 8]. The former methods may be used as an evaluator for the teacher or the students, who may assess themselves or their peers [14; 33], 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 [8; 34], 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 [9; 16; 22]. 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 [8; 35]. Furthermore, students are more willing to accept marks that come from the teacher than those that come from peers [34]. 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 [22]. In many cases, tight schedules prevent sufficient time being devoted to these activities [9], so to prevent parasite behaviour patterns, it would be necessary to look to other factors, such as group size and composition [16] or direct teacher observation.

5 Questions of research and methodology

Recapping on the contributions of the theoretical framework that we have described in earlier sections, we may conclude that teamwork is an important facet of current university teaching and that one of the most critical aspects of the group process is how to prevent parasite behaviour patterns. At the same time we have discovered that hitherto there has been little agreement on the best way of getting round student opportunist behaviour patterns, as the alternatives available present both advantages and disadvantages. Although traditional assessment methods are assumed to be unsuitable for assessing group process [4], consensus has yet to be reached on the criteria with which to assess it properly [7].

We have, therefore, 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 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 [36], where the students worked individually during the week and handed in a written report to the teachers. Later, they took part in a group meeting in class. At the end of the group session they handed in a group report. These meetings had a duration of close on 50-60 minutes. After the groups handed in their report, the teachers gave their opinion on the topics handled and answered student queries (an example of these activities is available at reference [34]).

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. Those who had good reports were put together with other students with good individual assignments; the ones who had done nothing were put with other students who had not done prior individual work, and so on, while the group scores were used for the students' final mark (15% of the mark). All the members of the group received the same mark. 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 (see appendix A). The observation process was similar to that followed for detecting activities with no value-added in the improvement of business processes. A sample of random observations was obtained according to this process: the class groups were numbered sequentially (17-20 groups in the morning sessions and 7-8 groups in the afternoon ones); before recording observations there was a pause of 5 minutes to give the group time to get organized for the activity; from then on each of the groups was observed in accordance with its numbering; what was seen at the time of observation was entered in the grid before moving on to the next group; on completing the round of all the groups, there was a pause of a couple of minutes and the process was repeated. In all some 10-15 observations of each group were obtained at each session. 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

In our research we have set out to monitor the opportunist/parasite behaviour patterns of students. On the one hand, students who attend group meetings with no knowledge or preparation through not having done their individual assignments and, on the other, students who do not add to the group product with their individual contributions.

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.

Table 2.Difference between groups of students

	Group member individual report	N	Mean	Std. Deviation	Minimum	Maximum
Concept Definition	Not presented	11	4.36	1.95	2	8
	Poor	6	6.92*	1.42	5	9
	Fair	35	5.64*	1.67	3	9
	Good	40	6.55*	1.81	3	10
Reasoning	Not presented	11	4.52	1.76	2	7
	Poor	6	6.25*	1.17	5	8
	Fair	35	5.70*	1.43	3	9
	Good	40	5.93*	1.60	2	10
Process	Not presented	11	73.6%	19.11	4	10
	Poor	6	76.7%	22.50	5	10
	Fair	35	92.0%**	14.30	5	10
	Good	40	95.5%**	9.59	6	10
Group scoores= 0.5x(concept+reasoning)x process	Not presented	11	3.3	1.70	0.80	7.50
	Poor	6	5.0*	1.74	2.75	7.25
	Fair	35	5.2*	1.51	1.50	8.00
	Good	40	5.9*	1.57	2.10	9.00

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 $\alpha<1\%$

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).

For summative assessment of the group process we have only included the degree of intervention by group members as a behaviour pattern to be observed. In pilot versions of the observation grid we introduced other behaviour patterns. The observation process became complicated, however, and did not appear to discriminate reliably between the groups that worked well and those that worked badly. Yet for the students' formative evaluation we did observe an extensive set of behaviour patterns (Table 1) and, after completing the activity, we gave the class general feedback on what we had observed on our walk round the classroom. In addition, we decided that student teamworking should take place in class hours only so that it could be observed by the teacher. Assuming the two restrictions aforementioned, 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 following the recommendations of the grounded theory [37-43] and 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:

- "Students can select the system, participate in group activities or simply take the exam" (s.4).
- "If the mark for group activities is high in the final grade, then opportunist behavior will be avoided" (s.6).
- "Students are free to choose not to participate in these activities, but for those who want to learn, the system gives better motivation to learn techniques and concepts rather than learning by heart things that will quickly be forgotten" (s.28).

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:

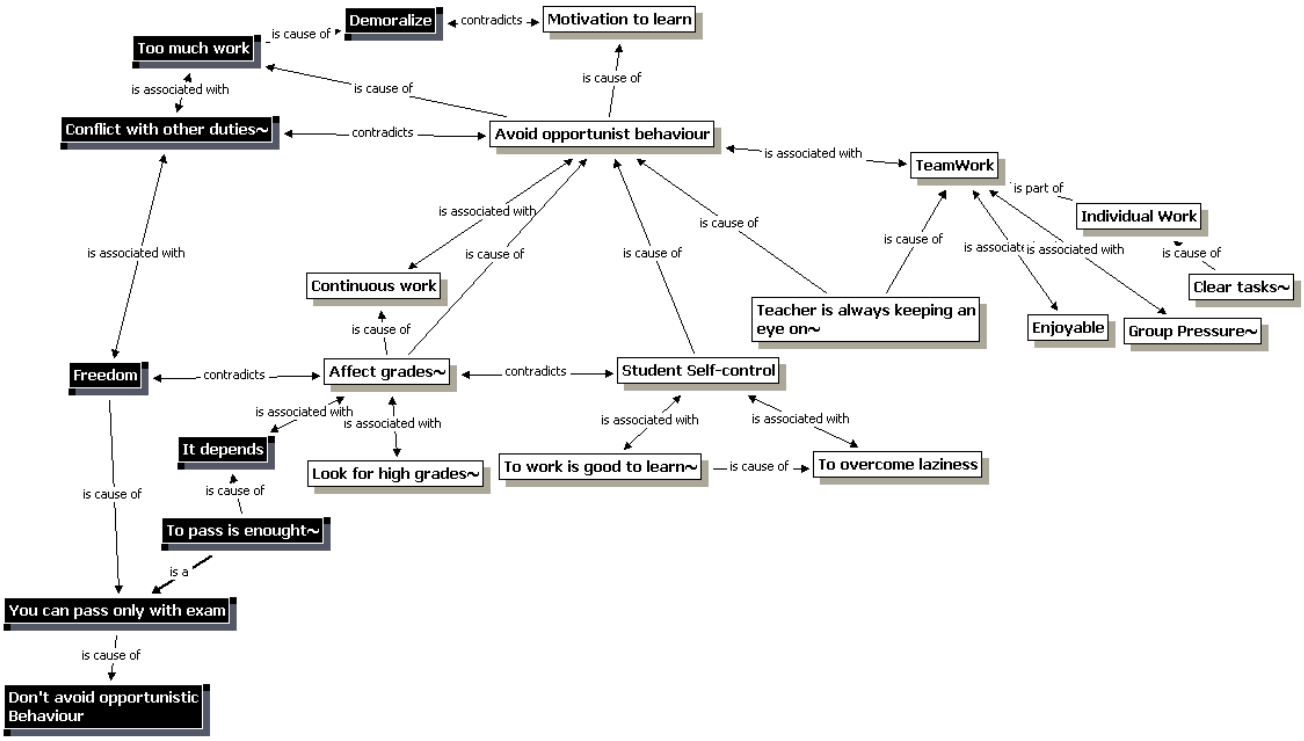
- "In group activities there are people that do not participate, partly because they have not done the necessary preparation individually" (s.21)
- "I think that shirking will always exist whatever you do. Although it is true to say that people generally participate." (s.79)

Figure 1 summarizes the suggested relationships after analysing student responses. The causes for avoiding opportunist behavior are identified with white labels; black labels denote possible reasons for justifying certain opportunist behavior by students, i.e. not finishing individual assignments before group activities (attending meetings without contributing anything to the group and thus taking advantage of the work of other team members without offering anything in exchange).

Opportunist behavior is avoided when the students' work is continuous. This continuous work is preferred for various reasons.

One of the principal reasons is that continuous work and active participation in group activities are necessary to obtain a good final grade.

Figure 1.- Factors related to the possibility of avoiding opportunist behavior



Also, teachers are continually supervising activities, so students know that teachers can detect cases of inadequate previous individual preparation and non-participation in the group. Students also make a greater effort to work together as a group, since these activities are seen as interesting and enjoyable and there is a motive for not letting other team members down. Group work is also preferred because individual assignments previous to group meetings are clearly defined by the teacher and this helps students to carry them out satisfactorily. Finally, we must not forget that one of the important factors in avoiding opportunist behavior is the student's own self-control. Students are aware that they are the ones who benefit most from their own efforts, since the work carried out both individually and in the group is a valuable source of learning.

The combination of all these factors encourages students to make an effort. However, we must remember that continuous work is regarded as a heavy burden. It can also occasionally come into conflict with work on other subjects or be difficult to carry out for those who have a job. This factor is especially important for working students. When students see that they cannot keep up with class activities they become demoralized and may give up participation in group activities and thus miss out on the learning opportunities they provide. This is possible because they can still pass the subject without taking part in group activities. However, they will not achieve high marks since they will not obtain the percentage assigned to the continuous evaluation of activities. It has to be recognized that not all students are sufficiently motivated to obtain high marks and some are quite happy with a pass.

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 behavior 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.

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

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.

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Appendix A: Observation Grids

Group process observation grid. Initial version

		G1	G2	G3	G4	…
	Nº components					
Participation	One does not participate (0)					
	Distracted and does not listen to the opinions of the others (1)					
	(2)					
	They all participate (3)					
Moderator	The decision of one prevails. (0)					
	The decision of a couple prevails. (1)					
	(2)					
	Discussion is conducted in an orderly fashion allowing everyone to take part (3)					
Reporter	Takes no notes during the discussion (0)					
	Textual notes with no information to the group (1)					
	(2)					
	Recasts and notes down ideas when they arise. Keeps the group informed (3)					
	Total group process					

Group process observation grid. Final version

		G1	G2	G3	G4	…
	Nº components					
Participation	Only one or two people take an active part (0)					
	--- (1)					
	There is one person left out (2)					
	Balanced participation of all the components until handing in the report (3)					
Total group process						