Improving the Use of Strategies in Computer-Supported Collaborative Processes

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Abstract. The members of a work group need to apply a common strategy to collaboratively solve a problem. A good strategy will mainly depend on the collaboration scenario, participants' background, and available tools. This paper presents two widgets that have been useful to help to define and use good group members' strategies in collaborative learning scenarios. The concepts behind these widgets can be reused to support strategy definition processes in order to improve the efficiency and effectiveness of computer-supported collaborative processes

1 Introduction

Computers have become very important to support group work and collaboration. People interact with other people in all aspects of life and, as computers have become prevalent, users seek computer support to extend their interactions. Besides, advances in networking technology and software systems will lead to an emphasis on inter-personal computing. Understanding group dynamics and the collaborative process of work groups are then both interesting research fields and the basis for new tools to support the findings.

In this scenario, the computer supported collaborative learning process has received much care [15]. In this process, the results of learning activities depend not only on the student's skills to execute a task, but also on the strategy of collaboration with teammates to do it. The use, understanding and adoption of a strategy are crucial for an effective and efficient collaborative learning.

In a series of preliminary experiments in Computer-Supported Collaborative Learning (CSCL) environments, it has been observed that groups with little experience in collaborative work, understand, use and adopt cooperation strategies in a bad manner [8]. In these experiments, although all groups were deficient in the strategy definition, those that tried to define and communicate a strategy got better results in CSCL activities. Based on this preliminary information, our work explores whether

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the impact of a consistent use of a strategy can produce good results during this kind of activities. Our hypothesis claims a good use, definition and adoption of strategies should imply good collaboration, which in turn it is known to lead to good learning. This hypothesis is emphasized in the case of groups just formed or with little collaborative experience.

We have designed a widget to support discussions within the learning group and another one to support monitoring the tasks done by the group. These widgets are intended to improve the strategic aspect of group work and thus, they provide a way to validate the hypothesis. Both widgets were embedded in a tool called TeamQuest, which is a labyrinth type collaborative game. Two versions of this tool were used during the experiments, one with widgets and another one without them. The performance of the learning activities was measured by using the indicators proposed by Collazos et al. [8]. The participants in the experimental activities were primary school students.

Next section presents related work about methods to promote the use of strategies in CSCL activities and the justification of our proposal. Section 3 describes the preliminary study that originates this proposal and the results obtained from such study. Section 4 presents the TeamQuest tool and the widgets developed to improve the use of strategies. Section 5 describes the experiments carried out in order to measure the impact of consistent strategy use over a CSCL activity, and the obtained results. Finally, Section 6 presents the conclusions and future work.

2 Background

Since the advent of computer supported collaborative work, CSCL research has been of major interest. It has been conclusively argued that a focus on the process of collaboration is necessary in order to understand the value of working together with peers for learning [20]. CSCL is a research area that reports a great amount of scientific work in several aspects. Unfortunately, there are no studies focused on how to improve the use of strategies in collaborative activities using computer technology. Collaborative learning technologies must go beyond generic groupware applications, and even the basic technology is not yet well developed [24]. Therefore, it is necessary to define a model describing how to design socio-technical environments that will promote collaboration within groups.

From the collaborative work viewpoint, effective groups have goals being clarified and modified as follows. There should be the best possible match between individual and group goals. They are also cooperatively structured so all members are committed to reach them. Results of experimentation have shown groups were ineffective because communication was poor. This could be explained by lack of strategy understanding shown by some members of the group. Thus, it is not only important to understand the problem, as Dillenbourg mentions [12], but to be aware that the rest of the people can understand the problem situation during a collaborative activity.

Soller et al. [23] claim the way in which a student shares new knowledge with the group and the way in which the group responds are important. They determine to a large extent how well this new knowledge is assimilated into the group, and whether or not the group members learn the new concept. Also, as Clarck & Schaefer [3] mention, for co-construction to occur, participants must not only make a contribution, but must also get their contribution to be accepted by their partners.

Team potential is maximized when all group members participate in discussions. Building involvement for group discussions increases the amount of information available to the group, enhancing group decision making and improving the participants' quality of thought during the work process [16]. Therefore, encouraging active participation could increase the likelihood that all group members understand the strategy, and decreases the chance that only a few participants understand it, leaving the others behind. Unfortunately, none of the observed groups of the reported experiment behaved in this direction [8]. Based on that finding, we have designed a software tool including widgets intended to improve the strategy performance of the groups during a collaborative activity.

3 Preliminary Work

Collazos et al. have defined five indicators which evaluate several aspects of the collaborative learning process [8]. Four of the indicators of collaboration (IC) are based on these activities proposed by Johnson et al. in [1]: use of strategies (IC1), intragroup cooperation (IC2), checking the success criteria (IC3), and monitoring (IC4). The fifth indicator is based on the performance of the group (IC5).

Specifically, IC1 tries to capture the ability of the group members to generate, communicate and consistently apply a strategy to jointly solve a problem. IC2 corresponds to the use of collaborative actions in order to provide help when anyone requests it. IC3 measures the degree of involvement of the group members in reviewing boundaries, guidelines, roles and the main goal during the group activity. The objective of IC4 is to oversee if the group maintains the desired behavior to solve the problem, keeping focused on the goals and the success criteria. IC5 corresponds to the quality, time and work of the group activity.

These indicators were used to evaluate the collaboration process in a CSCL scenario at a basic school by using two similar tools, namely *Chase the Cheese* [8] and *TeamQuest* [9]. The scenario and participants used in the experimentation were comparable, and the results in both situations were similar. Table 1 presents a summary of these results.

Analysis of these results shows the shared construction of a strategy to do group work is related to a successful process, to the individual construction of cognitive context, and to the experiences shared by the group members. It could be indicating a tendency. Unfortunately, the studied groups were ineffective collaborative groups because they were weak in collaborative attitudes, and this aspect is reflected somehow in the wrong process of definition, adoption and use of strategies. In order to explore the strategy use influence on the collaborative process results, the experiment specified in [9] was repeated in a controlled scenario. The new experiment involved the same tool, but two widgets were included. These widgets were designed to promote and enhance the use of a strategy during the collaborative process. Next section describes the tool used in the experiments.

Table 1. Results of previous experiments according to the collaboration indicators[1]. IC1: Use of Strategies; IC2:Intra-goup cooperation; IC3: Checking the success criteria; IC4: Monitoring; IC5: Performance.

Group	IC1	IC2	IC3	IC4	IC5
0	0.69	0.69	0.20	0.75	0.65
1	0.31	0.71	0.20	0.80	0.57
2	0.68	0.62	0.20	0.80	0.69
3	0.48	0.61	0.50	0.74	0.63
4	0.71	0.74	0.80	0.78	0.66
5	0.75	0.84	1.0	0.86	0.61
6	0.71	0.72	1.0	0.85	0.52
7	0.47	0.80	0.20	0.80	0.53
8	0.27	0.75	0.20	0.82	0.54
9	0.28	0.75	0.20	0.81	0.54
10	0.48	0.80	0.20	0.83	0.53

4 TeamQuest

TeamQuest is a collaborative game which is played by four persons, each one with a computer. The computers are physically distant and the only communication allowed is computer-mediated. All activities by participants are recorded for analysis and players are made aware of that. The game goal is to go from an initial to a final position through a labyrinth, with the highest possible score, avoiding obstacles and picking the necessary items to carry out the mission in the way. The time spent in the trip is also considered only in case of a tie.

Each member of the work group can see only a portion of the game scenario. The members' information needs to be shared if the group wants to achieve its goal. That aspect corresponds to the positive resource interdependence, which relies on the fact that each individual owns specific resources needed for the group as a whole to succeed [17]. The difficulty level of the game - which can be adjusted - is relatively high. Therefore, the group must define and apply a good strategy in order to solve the labyrinth.

The participants are given very few details about the game before playing, and they must discover most of the rules while playing. They also have to develop joint strategies to succeed. The players of a team must reach a common goal satisfying sub-goals in each of the four game stages. Each player is identified with an avatar and name (Fig. 1).

The TeamQuest main user interface has three well-defined areas: *labyrinth*, *communication* and *information*. The labyrinth area has four quadrants, each one assigned to a player who has the "doer" role (active player), while the other three players are collaborators for that quadrant. In a quadrant, the doer must move the avatar from the initial position to the "cave" that allows pass to the next quadrant. In the way, the doer

[1] Lowest score is 0.0 and highest score is 1.0

must circumvent all obstacles and traps of the map (these obstacles are not visible to all players). Moreover, the doer must pick items useful to reach the final destination. The user interface has many elements showing awareness: the doer's icon, score bars, items which were picked up in each quadrant, etc. (Fig.1).

The communication zone is located at the right hand side of the main screen and it has several windows with faces characterizing each participant avatar. Each participant has a window to write text messages, a receiver selector, and a send button. Also, there are three other windows, similar to the message writing window, which display the messages received from the other players. The information zone displays information about the game status, obstacles, traps, individual views of the game, and game final results.

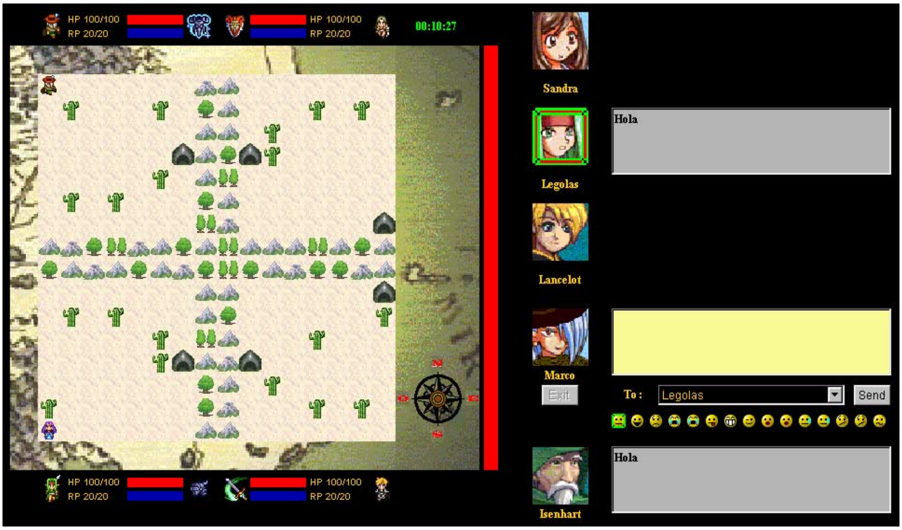

Fig. 1. TeamQuest user interface

The team game score is computed based on the individual score of each player, shown in the score bars. These individual scores start with a predefined value and they are reduced or increased whenever a player's avatar collides with a trap or gets a reward (life potion). The group final score is the addition of the individual scores.

This tool was used in the experiments mentioned in section 3, which have shown group deficiencies in the definition and use of a strategy to carry out the play. Thereafter, additional elements were designed and included in the software tool with the goal to improve the use of strategies. Next two sections present the new elements that were embedded in TeamQuest to enhance these activities. These elements were called *negotiation table* and *monitoring window*.

4.1 Negotiation Table

The negotiation table is a discussion environment. Group members can use it during a break. Breaks may be done at any time during the play. They provide opportunities for analysis of the work done, thus allowing the definition and reinforcement of the common goals. Establishing common goals is part of constructing common grounds, since actions cannot be interpreted without referring to the shared goals, and reciprocally, goal discrepancies are often revealed through disagreements on action [14]. Members of a group do not only develop shared goals by negotiating them, but they also become mutually aware of these goals.

The strategy the group must use to solve the problem is not the same if individually decided by each group member. If it is going to be shared the strategy has to be decided somehow and then communicated, understood, and - to some extent- it has to be agreed by all members of the group [5]. As Dillenbourg & Self mention, if strategic decisions are necessary, they will be object of explicit agreement like any other decision made by the members of a group [13]. Hence, the first need is for a shared environment in which communication and discussion is possible. Statement, definition and discussion of strategies may then occur. Moreover, the tool should stimulate this discussion in several occasions. Of course, the break should not be penalized: while using the negotiation table, the play chronometer remains stopped. We have included an initial Negotiation Table, where the group members must decide a group name.

The user who creates a new game session accesses directly to the negotiation table and becomes its main user. This user must also coordinate the first activity of the game, which is to give a name to the group (positive interdependence of identity). Subsequent players entering the game are directed to the negotiation table.

The negotiation table has a chat tool, which allows group members to discuss in order to reach an agreement. The controls marked with (1) and (2) in Fig. 2 are parts of this tool. Typically, a player begins the group naming by making a proposal and the discussion then starts. The discussion finishes when the group members have agreed on the name. Then, the main user inserts the agreed group name in the designated area (marked with (3) in Fig. 2). The rest of the players must indicate on their windows if they accept or reject the group name. The normal users have a similar but not identical user interface than the one of the main user. The normal user window does not have the button marked with (4) in Fig. 2, but they have two other buttons to accept or reject the proposed group name in the area (3).

Once all participants have agreed the group name, the game can actually start. The main user will push the play button and automatically the user interface of the play scenario is shown to the participants (marked with (5) in Fig. 2). This is the front door of the game.

A group is never forced to have a explicit working strategy before solving the labyrinth. It is expected the own players realize this need and use the negotiation table at will. All interactions will be done through text-based dialogs. Researchers in linguistics, pedagogy and artificial intelligence have argued that dialog may be best regarded as a type of joint activity [6, 7]. Participants derive explicitly or implicitly a common set of beliefs about the activity, and they drive towards mutual understanding of their intentions and actions -a process referred to as *grounding* [4]. As Paek and Horvitz mention, in a joint activity, it is not enough to just produce utterances; speakers must check that their utterances were attended to and that listeners are still engaged in the activity at hand [21]. In that sense, the negotiation table provides an environment that supports dialogs, discussions and interchange of ideas. This tool is available at any time by just doing a "click" at the play scenario. If the group members consider the defined strategy is not working, they can revise it or redefine it using the negotiation table.

On the other hand, discussion and other interaction activities are promoted or at least not punished by stopping the chronometer while the team is at the negotiation table. Thus, TeamQuest tries to promote the existence of active players working in the definition, maintenance and review of strategies to carry out collaborative activities. Bloom & Broder say the major difference between the successful and the non-successful problem solvers in their extent of thought about a problem is in the degree to which their approach to the problem might be passive or active. A passive problem solver typically reads the problem, chooses one way to solve it and keeps trying this way even if it fails. These people are not good for collaborating. On the other hand, a more active problem solver re-analyzes frequent problems and backtracks to alternative solution paths in order to improve their strategy [19]. This strategy can only be partially set up at the outset of collaboration, it has to be negotiated and probably revised as work progresses. In this context, the negotiation table provides a mechanism to regulate the interactions.

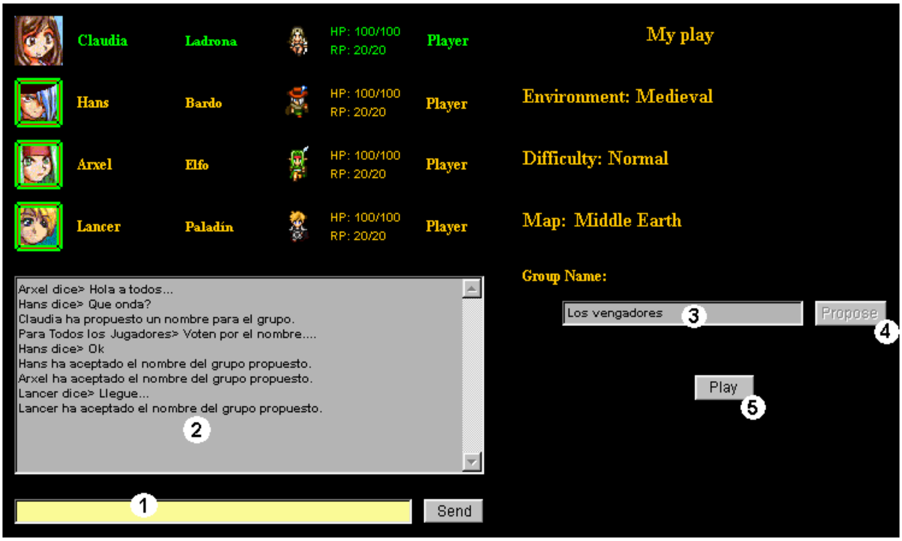

Fig. 2. User interface of TeamQuest negotiation table (in Spanish)

As we mentioned at the beginning of this section, the Negotiation Table can be used at any time during the play. This option can be selected by any member of the group or by the facilitator. Whenever this option is selected, the person who choice it will be the main user and will decide the topic of the Negotiation Table. This person or the facilitator will also define how to reach the conclusions of the negotiation.

4.2 Monitoring Window

TeamQuest has, besides the four players, a fifth role called the wizard, e.g., Isenhart in Fig. 1. At the beginning of the game, this wizard tells the group a story before the labyrinth resolution as a motivation. An example of these stories is the kidnapping of a princess who must be liberated by the group avoiding mortal traps and by killing a dragon (fantasy positive interdependency). During the play, this wizard gives tips and suggestions to the players. They see it then as an intelligent agent on their side. What game players do not know is that another person – a cognitive facilitator – can also be connected. This fifth "player" has a user interface similar to the other ones and can monitor everything that is happening in the session. The facilitator can also send messages to the whole group or to a player in particular. Therefore, the facilitator can to help the group to define, discuss or improve the strategy used to solve the problem. The group members typically think the wizard in fact sends the facilitator's messages.

One way of assessing the effectiveness of the groups is to monitor the members' interactions as they work together. Observations allow to measure and to understand the quality of each group interaction and its progress on the assignment [10]. The facilitator not only can observe the interactions among members of the group, but also she can intervene anytime she considers it as necessary. In that way, the facilitator can become another member of the group.

According to Johnson et al., one of the most important aspects of collaborative learning is to "monitor students' learning and intervene within the groups to provide task assistance or to increase students' interpersonal and group skills" [17]. A teacher systematically observes and collects data on each group as it works. When assistance is needed, the teacher intervenes to assist students in completing the task accurately and in working together effectively. A tutor is needed to structure the process, to give advice when needed and to promote deep understanding. If students and tutors are communicating mainly through a computerized learning environment, tutors have to learn new ways to support students.

While observing students working with computer applications, teachers can see the choices students are making, ask questions regarding students' learning goals and decision making, and make suggestions for revisions when needed. With this model, applications can be designed to provide a window on the ways in which students construct meaning -their misconceptions, conjectures, and the connections they make among ideas [11]. Teachers can use this information to revise and refine instruction.

The cognitive facilitator proposed with TeamQuest can be a teacher or any person with experience in collaborative work. This facilitator has an important role as a stimulating agent in the process of group members' incorporation of general behavior patterns. Some of these patterns are: definition of an initial strategy, and the periodic review of the obtained partial results. The facilitator's influence is expected to be large on groups with little experience in collaborative work. If participants acquire these behavior patterns, the facilitator can decrease her influence. In such a case, this means the participants have learned how to collaborate. It also implies perhaps they will not need a facilitator to improve their strategies in a near future.

5 A New Experiment

A new experiment was done with the same tool (TeamQuest). It includes one of the two widgets: the negotiation table. The participants were students from four schools from Popayán – Colombia: Politécnico Empresarial Andrés Bello, Comfacauca, Champagnat, and Empresarial del Cauca. Twenty students were selected from these schools. All of them were high school seniors (4^{th} grade) and were familiarized with computer usage. The students selection took into account the previous groups and work settings in order to have comparable results. The experiment lasted three consecutive days, working three hours each day. Five 4-persons groups were assembled. One of the groups was a control group. The goal of the experiment was to check if groups using the negotiation table improved their abilities to adopt strategies to solve the labyrinth or not.

These new groups were numbered from 11 to 14, while the control group received number 15. Groups No. 11 and 12 used TeamQuest with the widget, whereas groups No. 13 and 14 used standard TeamQuest. Groups No. 1-10 were the old groups, using the standard TeamQuest (results of their work were reported in Section 3 above). The performed activities are described below.

5.1 Experimentation Process

The experimentation process involved three stages: *pre-test*, *test* and *post-test*. There was no computer support for pre- and post-test. The test involved the use of computers and TeamQuest. The control group participated in the pre- and post-test. The work was done on February 14, 15 and 16, 2003, 8:00 AM-11:00 AM. The activities carried out in each stage are briefly described below.

Stage 1 (Pre-test). The goal of this stage is to evaluate the participants' abilities to carry out collaborative tasks. This basic knowledge helps the experimenters to improve their understanding of the results. The activities involved in this stage are the following:

- Make an introduction (15 minutes). The experimenters introduced themselves and explained the goals of the experiment.
- Apply 16PF[2] test to determine each participant's personality characteristics (45 minutes)
- Define groups and distribute materials (10 minutes).
- Develop the collaborative activity. It was based on the "group investigation" technique [22]. This technique involves the following sub-activities:
  - Each group receives the same folder with information concerning the subject of investigation. Each group member is responsible of a part of the subject. The group must organize the available information within 20 minutes. Each group decides where to work: inside or outside a spacious room.
  - Each person must then study her assignment in 30 minutes.
  - Afterwards, the group meets again. Each member makes a presentation about her part of the subject to the rest of the members of the group (40 minutes).

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[2] The 16PF® Questionnaire is used by organizations and human resource professionals to assesses the 16 personality factors. The assessment measures levels of Warmth, Reasoning, Emotional Stability, Dominance, Liveliness, Rule-Consciousness, Social Boldness, Sensitivity, Vigilance, Abstractedness, Privacy, Apprehension, Openness to Change, Self-Reliance, Perfectionism and Tension. Five additional global factors are also measured: Extraversion, Anxiety, Tough-Mindedness, Independence, and Self-control.

- Finally, a knowledge acquisition test on the subject is applied to all groups. A randomly chosen group member represents her group. Her grade will be the group grade (20 minutes). This evaluation method was explained during the introduction.

The evaluation process was done immediately before Stage 1 was concluded. The evaluators were the same people each time. The range for the final grade was from 0.0 (lowest) to 5.0 (highest).

Stage 2. The second stage involves the test activity using TeamQuest for the groups described at the beginning of this section. A control group does not participate in this activity. The activities involved in this stage are the following tasks:

- Define groups (30 minutes).
- Do the collaborative activity TeamQuest (90 minutes).
- Make a survey and ask for final comments (30 minutes).
- Group members were distributed in two computer laboratories. Teaching assistants were available to help in case of any technical difficulty.

Stage 3. Finally, the post-test tries to assess if group members have improved their collaboration abilities through the use of TeamQuest, with and without the widget. The way in which this stage is evaluated is the same as for stage 1. The activities involved in this stage were the following ones:

- Define groups, one of which is the control group (10 minutes).
- Develop a "group "investigation" activity, following the same sequence presented while describing stage 1. The subject to be evaluated was changed in order to maintain similarities between both stages.

5.2 Results

Table 2 presents the results obtained by the groups of this experiment, during pre-test and post-test. Table 3, on the other hand, presents the results of the test; these results must be compared with the results of the previous experiment (see Section 3).

Table 2. Results of the pre- and post-test stages [3]

Group number	Pre-test score	Post-test score
11	3.0	4.2
12	3.5	3.8
13	3.6	3.5
14	2.8	2.5
15 (Control)	3.4	3.2

[3] Lowest score is 0.0, highest score is 5.0, and minimal approval score is 3.0.

Table 3. Results during the test stage[4]. IC1: Use of Strategies; IC2:Intra-goup cooperation; IC3: Checking the success criteria; IC4: Monitoring; IC5: Performance

Group	IC1	IC2	IC3	IC4	IC5
0	0.69	0.69	0.20	0.75	0.65
1	0.31	0.71	0.20	0.80	0.57
2	0.68	0.62	0.20	0.80	0.69
3	0.48	0.61	0.50	0.74	0.63
4	0.71	0.74	0.80	0.78	0.66
5	0.75	0.84	1.00	0.86	0.61
6	0.71	0.72	1.00	0.85	0.52
7	0.47	0.80	0.20	0.80	0.53
8	0.27	0.75	0.20	0.82	0.54
9	0.28	0.75	0.20	0.81	0.54
10	0.48	0.80	0.20	0.83	0.53
11	**0.70**	**0.80**	**0.80**	**0.83**	**0.60**
12	**0.68**	**0.80**	**0.80**	**0.82**	**0.59**
13	**0.48**	**0.62**	**0.20**	**0.74**	**0.64**
14	**0.48**	**0.64**	**0.20**	**0.75**	**0.65**
Average	**0.54**	**0.73**	**0.45**	**0.80**	**0.60**
St. Deviation	**0.17**	**0.08**	**0.33**	**0.04**	**0.06**

These results show Groups No. 11 and 12 obtained the best results. These groups had available the TeamQuest negotiation table feature. This would confirm our hypothesis.

5.3 Analysis of Results

The previous experiment did not include the monitoring option. This was because we did not want to influence the results of the collaborative process measured by the indicators (a facilitator would be involved). Nevertheless, we did some additional experimentation trying to have an idea on the usefulness of that widget.

We could check that according to what we expected, the participants were not aware of the input provided by the facilitator. They thought they received suggestions from an intelligent agent (the wizard) and accepted them most of the time. This was natural, since the wizard does provide help on game actions and their consequences. The facilitator does not have to cheat on this: simply the facilitator's role is similar to that of the wizard. Thus, their written sentences may be undistinguishable.

Of course, this ambiguity implies facilitators have to follow strict rules concerning when to monitor and what actions to suggest. The role of the wizard and facilitator is to maintain the focus of the discussion, guiding students through the knowledge constructing process. The assumption is both the contents and the pattern of the sequence

[4] Lowest score is 0.0 and highest score is 1.0.

of messages reflect the degree of collaborative learning. In this aspect, the idea is not to provide the right answer or say which person is right, but to perform a minimal pedagogical intervention (e.g., provide hints). This intervention is to redirect the group work in a productive direction or to monitor which members are left out of the interaction in order to define a strategy [14].

Participants selected for the new experiment were chosen as similar as possible to those of the previous experiment. They belong to schools with the same socio-economic profile, they have similar knowledge background and are of the same age. Group definition was made in such a way to have members from all schools, without any previous acquaintance for each group.

The group with best performance for most collaboration indicators from both experiments is Group No. 5. They are students from the same school and they work together since some time ago. It is then no surprise they have implicit strategies. The interesting conclusion is the very good results of groups using the negotiation table in the new experiment, which were composed of students who did not know each other beforehand.

Another interesting conclusion appears when taking into account results from the 16PF test. As mentioned above, this test evaluates personality features and individual ability [2]. The student with the best score belongs to group No. 13. In fact, the groups with the best collaboration results did not include the best 16PF achievers. One concludes the only free variable when considering the new experiment is the use of the negotiation table. Of course a scientifically valid final conclusion should involve a larger number of groups and a statistical test.

The way of stimulating strategy adoption presented in this paper could also be used in other collaborative environments requiring strategies for the achievement of a task or development of a product. Similar widgets could be created for this purpose.

6 Conclusions and Future Work

As reported at the beginning of this paper, one of the deficiencies found in the analysis of the interactions among group members of the previous experiment was subjects' inability to state, use and discussion of strategies. This was a key obstacle for effective and efficient collaborative work. The new similar experiment with a negotiation table and a monitoring window has presenting initial evidence that groups using these widgets have a better performance.

Using monitoring mechanisms allows the teacher to guide the students about the development of strategic abilities to get a good collaboration process. The teacher's role must be very clearly defined in these activities. A collaboration scenario must be defined; the teacher has to know when and how to intervene with the goal of improving the collaborative process. As Katz mentions, one of the main problems for a teacher in a collaborative environment is to determine when to intervene and what to say [18]. It is clear the following collaborative abilities at least should be stimulated: to give and to receive, to help, to receive feedback, to identify conflicts or disagreements.

Our hypothesis stating good use, definition and adoption of strategies should imply good collaboration has proved to be true in our experiment. Further work is needed to definitely make a general conclusion applicable to Collaborative Learning with new experiments. Meanwhile, the same type of stimulus and widgets could be developed for other collaborative scenarios. We defined our Negotiation Table as a mechanism intended for discussion. Any member of the group can select it during a break; the clock is the stopped so that the use of the Negotiation Table is not penalized in time.

Additional experiments could be made to observe and measure the effect of time pressure on the negotiation process for strategy definition, since in our reported experiments the clock was stopped during the negotiation. Another feature of the Negotiation Table could be a mechanism for reviewing the plays performed during some previous period. The mechanism would display an animation of the game moves and the interchanged messages. This feature would also allow group members to learn from the good and bad news they made.

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