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IS SYNCHRONOUS COMPUTER MEDIATED COLLABORATIVE PROBLEM-SOLVING 'JUSTIFIED' ONLY WHEN BY DISTANCE? TEACHERS' POINT OF VIEWS AND INTERVENTIONS WITH CO-LOCATED GROUPS, DURING EVERY DAY CLASS ACTIVITIES

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Abstract. Synchronous collaborative problem solving is usually examined for its learning potential, while it is often studied under experimental conditions. This paper shifts focus, and aims at exploring the gains that teachers could have from this kind of their students' activities. The presented research aims at exploring synchronous computer mediated collaborative problem solving in real school context, with collocated students, in every day practice. How valuable does this approach appear to schoolteachers? "When" and "for what reasons" do the teachers intervene, with what "mean" and to whom do they address their interventions? What kind of interventions do they apply during on-line activity and what during off-line debriefing sessions? Which are their functional roles when working on this mode compared to their roles in the usual teaching conditions? What are their points of view on the value of the implementation of this approach in class and at which moments of the teaching process, they consider that the time consumed is counterbalanced by its effectiveness? What tools do they need so as to apply on-line and/or off-line students' diagnosis in an easier way?

1. INTRODUCTION

Is synchronous computer mediated collaborative problem solving a valuable and worthwhile activity for co-present collaborators? Could teachers accept to use it? Is it possible in the class time constraints? At which moment of their teaching they estimate, that such as activity is worthwhile? Is it possible to apply it with usual problem solving activities?

Up to the present, most of the synchronous computer mediated collaborative problem-solving studies have concentrated on students' learning processes, pointing to the success with which it can be used to enhanced learning in educations settings (Baker & Lund, 1997; Soller, 1999; Constantino-Gonzalez & al. 2001, Wu, et al. 2002). The teachers' role has been much less often investigated, and when it is investigated it is mostly for experimental purposes and not for exploring usual school and class conditions. Therefore, an important aspect that needs more research is the challenges of tutoring in synchronous computer mediated collaborative problem-solving applied in real school environments.

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2. PURPOSE OF THE RESEARCH

Up to now, most of the studies on the teachers' role have been focused on networked computer supported collaborative learning scenarios: asynchronous tutoring, where the teacher studies the students' interactions and then intervenes at a distance across the network in order to help them (Lipponen, 1999), or synchronous tutoring, where the teacher observes (at a distance) the students' interaction in real-time, and intervenes during it to help them (Lakkala, et al., 2000; Baker, et al, 2000). In both cases, the teachers are not in the same room with the students. Besides, the systems that have been used in these studies, either support collaborative learning through a particular collaborative task, like CSILE (Lipponen, 1999), and FLE (Lakkala, et al. 2000), or if they are domain independent, they are conversation-based, like CONNECT (Baker, 2000).

The presented research aims at exploring synchronous computer mediated collaborative problem solving in real school context, with collocated students, in every day practice. How valuable does this approach appear to schoolteachers? "When" and "for what reasons" do teachers intervene, with what "mean" and to whom do they address their interventions? What kind of interventions do they apply during on-line activity and what during off-line debriefing sessions? Which are their functional roles when working on this mode compared to their roles in the current teaching conditions? What are their points of view on the value of the implementation of this approach in class and at which moments of the teaching process, do they consider that the time consumed is counterbalanced by its effectiveness?

This paper, independently of the effectiveness of collaborative learning, shifts focus, and aims at exploring the gains that teachers could have from this kind of activities. It presents a research that takes place in real school environment, where all participants, teacher and students, are located in one classroom, working on different computers, with typical problem solving activities. They used systems that allow synchronous collaborative learning, are easy to use, easy to get and are domain independent. Thus, it is possible for students to collaborate with almost any software they use in every day practice.

The working hypothesis underlying the present research is that teachers (supported with specific tools), could develop a few new teaching strategies, without being imposed to change dramatically their practices immediately.

3. TECHNOLOGICAL ENVIRONMENT

The approach uses Windows Netmeeting®, that allows members of one team to exchange messages, providing chat history, and use any program in common (in a shared work-space) and Netsupport School® that allows the teacher to *inspect* or *share* multiple students' screens from his computer. In this way, the most basic level of support a system might offer it is assured, making the students and the teacher aware of the participants' messages and providing a shared workspace.

4. EXPERIMENTAL CONDITIONS

The participants were two teachers (Teacher1 and Teacher2), ten children sixteen years old, from two different classes of teachers (five from each class). Both teachers had no previous experience with computer supported collaborative learning, but Teacher2 has been engaged in researches concerning the use of computers in every day school practice. The teachers were not provided any initial education on collaborative learning and best practices. After the experimental sessions an interview took place with each one separately. Each teacher had five students (one group of two and one group of three students). The class teacher placed students into mixed ability groups. The members of each group worked on their own computer, that they were not located in the immediate vicinity into the class. Before starting, the students had a short lesson (20 minutes) on how to use NetMeeting.

Students worked on two activities (simple problem solving) from the lesson *Computers' Programming*, for four instructive hours (4 * 45 minutes) each class. The activities were not designed for the purpose of the study. They were chosen from the teacher, the students would do these activities anyway. For each activity, one common program (written in Pascal) was required from each team, for example "*write a Pascal program that prints minimum, maximum and average after reading the marks of your classmates"*. So, the shared workspace was the environment of Turbo Pascal. At the first activity, it was additionally asked from students to answer the question: "*can you find how many students were above the average without using arrays*?" So, in this case, the final product was a text written in common and the shared workspace was a Word document.

5. ANALYSIS

5.1. Analysis approach and research questions

Concerning the data, transcripts from (a) chat history between students and between students and teacher, (b) data from video[*] of the actions into the shared workspaces and the screen of teacher and (c) camera recording (oral dialogue between teacher and students) were linked and merged. Thus, a single transcription file was produced, respecting the temporal order of events, containing teacher's interventions (oral and/or written) as well as students' dialogues and actions. This unified file served as the base for analysis, for each team.

The analysis is separated to the two great categories of *teachers' interventions,* according to the "moment of time" that they have taken place:

(1) *On-line interventions:* teacher's interventions during the lesson while they observe students' interactions (dialogues and actions at the common workspace).

[*] It was used CORIOscan Select®, a computer to video converter, so as to register students' actions at the shared workspace, as well as teacher's actions

(2) *Off-line interventions:* teacher's interventions, during the next course session, after studying the unified file of data provided to them by the researcher.

Usually, the teachers' interventions are studied, by assuming the intention of teachers messages or oral expressions, attributing 'functional roles' (Vosniadou et al. 1999) or analyzing "questions types and statements types" (Hmelo-Silver, 2002) that correspond to 'how teachers intervenes' and lead to the discussion on the quality of teachers interventions, their strategies, and their approach. This kind of analysis seems to distinguish teachers' interventions from students' interactions, and take place often independently from them.

In the present study, we have tried to identify: A) (a) "when, for what reason?" the teachers intervened; thus allowing us to examine and analyse the messages and students' actions in the shared space that precede the intervention of each teacher. This was linked with the identification of (b) "How, with what mean (orally or written messages)" they intervene; as well as, (c) "to whom they addressed their interventions", to a specific group or to the whole class. Then, (B) we have analysed, the way that teachers intervened, by assuming the specific functional role of each intervention. Unit of analysis was the entire single message and the action, while referring to oral dialogue during off-line interventions of teachers in a debriefing session, the unit of analysis was the teachers 'utterances'.

5.2. Analysis of On-Line Teachers' Interventions

5.2.1. When does a teacher intervene?

Analysis of teacher's messages and/or oral utterances, show that teachers intervene in the following general cases:

A) *Teachers intervene, by themselves,* after examining the short previous history of each group interaction when: a) they have identified an error or a misconception from the students' actions (e.g. a part of the program in the shared workspace) or their internal to the group messages, and b) they have identified non-appropriate collaboration modes. In some cases they seem to have studied the student's actions in the shared workspace (eg. identifying an 'error'), in others the chat history of the groups (e.g. revealing a misconception).

B) *Teachers intervene after students' solicitation via messages*: where, a) students ask for help (related to the content or to a merely technical problem), or b) students need to inform teacher (e.g. that the task is completed).

C) *Teachers intervene by themselves, without examining any previous group interaction*, for reasons of management of the whole class.

Analysis of the data revealed that the functional roles of teachers' interventions could be categorised in three main categories. Teachers are act as: "providers of information related to the subject matter to be taught", "manager of interaction" and "manager of the course process".

Table 1 & Table 2 were initially created according to the first two general categories of functional roles of teachers' interventions. Internal to each table, the following information are presented: who has initialised the intervention (student

solicited or teachers solicited), what is the motive-the 'cause' of each intervention (the 'when'), and if it results from actions' or messages' analysis.

It is to be noted that, each intervention given a specific cause, attributing to a specific function role may include more than one messages or oral utterances of teachers. So, if during the conversation concerning a specific topic the teacher changes role, then we consider it as a new intervention.

Table 1. Conditions of Teacher's interventions on-line as a provider of information

Conditions of On-line Teacher's Interventions as a Provider of Information related to the subject matter				
	Source	***Reason***	**Teacher 1**	**Teacher 2**
Teacher-solicited interventions	**Actions' analysis**	**Problem solution**	37,5% (9/24)	46,42% (13/28)
	Messages' analysis	**Misconceptions**	16,66% (4/24)	14,28% (4/28)
		No provision of help by a member		10,71% (3/28)
		No participation of a member		3,57% (1/28)
Student-solicited interventions	**Messages** (asking for help**)**	**Asking for help** without previous discussion	16,66% (4/24)	17,85% (5/28)
		Asking for help after impasse	16,66% (4/24)	
		Asking for help on a "technical" problem	12.5% (3/24)	3,57% (1/28)
	Messages	**Informing**		3,57% (1/28)

As presented in the Table 1, teachers intervene mostly when they identify a conceptual or procedural emerging difficulty, analysing the actions of the members of a group or identifying possible misconceptions from their dialogue or when students ask for it. They intervene in a lower degree, when they realise that collaboration between the members of a group is not appropriate (e.g. the one student does not assist or explain to the other, or someone seems to not participate).

Students ask from teachers to intervene either by asking for help or just informing (e.g. that the task is completed). Students may ask for help under different conditions: a member of the group addresses a question directly to the teacher without discussing with his/her partner, or after a common decision if they are in an impasse, etc. Teachers, in this case addressed all their messages to a specific group, and not to the whole class. Only the 11,5% (6/52) of interventions have used the written messages as support. Teachers prefer the oral intervention, approaching the specific group, instead of the written message.

Table 2, shows that teachers intervene by themselves as managers of interactions, a) when they have identified difficulties during problem solving, b) non appropriate collaboration or c) for merely procedural causes. Teacher2 intervened as manager of interaction more times than Teacher1. For instance, in a case of "non provision of help" Teacher2 intervened five times to ensure that the student will receive the help they asked from his/her collaborator. Teacher1 none, while data analysis revealed

the existence of such cases during the lesson. All the teachers' interventions were oral and addressed to a specific group.

Table 2. Conditions of teacher's interventions on-line as manager of interaction

On-line Teacher's Interventions as a Manager of Interaction				
			Teacher 1	**Teacher 2**
	Source	***Reason***		
Teacher-solicited interventions	**Actions' analysis**	**Problem solution**	20% (2/10)	16,66% (4/24)
	Messages' analysis	**Misconceptions**	10% (1/10)	20,83% (5/24)
		No provision of help by a member		20,83% (5/24)
		No participation of a member	10% (1/10)	4,16% (1/24)
		Regulation of the access at the common work-space		4,16% (1/24)
		Monitoring group progress	20% (2/10)	8,33% (2/24)
		Talking instead of chatting		4,16% (1/24)
Student-solicited interventions	**Messages** (asking for help)	**Asking for help** without previous discussion	40% (4/10)	4,16% (1/24)
		Asking for help after impasse		4,16% (1/24)
		Asking for help on a "technical" problem		4,16% (1/24)
		No provision of help by a member		4,16% (1/24)
	Messages	**Informing**		4,16% (1/24)

From Tables 1 and 2 we can observe that for the same reason the teachers acted differently: the teachers some times acted as providers of information while others as managers of interaction (e.g. when a misconception was detected). Besides, there were cases that teachers provided information, while a more suitable intervention should be needed (e.g. a student ask for help concerning the subject matter, directly to the teacher without previous discussion with its collaborator), in such a way to manage the interaction by inciting discussion on the question among them.

As far as teachers' interventions as managers of the course process is concerned, the reason of intervention had not to do with the specific solution or dialogue of groups. Teachers intervened by themselves or after a demand by the students when (a) there were technical problems due to the new approach, b) it was needed to do procedural comments, or c) off-task comments (it is not reported by the table, given its minor importance). In these cases, there were messages addressed to the whole class, all of them oral. But, in general, it appeared clearly that most of the teachers' messages were oral. During interviews, teachers have commented on this point, "*typing messages is time consuming, almost double the time is needed*". According

to them that's the reason most of theirs messages was oral. The other reason is that "*we are used to act like this*".

Both Teachers mostly intervene in order to provide information concerning the subject matter to be taught. This is especially the case for Teacher1, who explained during the interview, that he acted like this because *"that is how I am used to work until now, since I didn't have the possibility to be familiar with the processes that the students are using when solving a programming problem. Even, when they are collaborating they are sitting in front of the same computer"*. Teacher2, who acted more as a manager of interaction than Teacher 1, had a totally different opinion: "*…these are activities that must be completed. You must activate them, to learn by doing. So you leave them a period of time and then you intervene. Also, we must have in mind that the students must learn certain things during the day or even the school year and we don't have unlimited time*".

5.2.2. Tutor's Guidance Activity

Tutor's messages were re-analyzed in order to assess their guidance activity. We analyze the functional roles of the utterances of the teachers. Each teacher' s utterance has been assigned to a functional role and they have divided to the three main categories that we have already mentioned (Sabah et all 2000).

Teacher's utterances belonging to the category of provider of information are subdivided in two main categories: statements thereby which the teacher provided information to the students; questions-seeking explanation asked by the tutor to the students related to the subject matter. Analysis was based on taxonomy of functional roles produced after analysis of teachers-students discourse in a traditional class setting, without technological support (Sabah et all 2000). It was necessary to add some functional roles, related mostly to the collaboration and group monitoring such as: Reformulates students' comments, Verifies understanding, Ask student if they want help, Encourages collaboration, Conducting assessment on members' contribution, Monitoring group dynamics, Group formation (defining group synthesis), Assigns a role.

Our analysis reveals that the guidance activity of two teachers was different, as expected. Teacher2 not only asks more times the students to explain instead of providing the information himself, but he also elaborates on these explanation questions, by asking students to validate and clarify their explanations more than Teacher1. Teacher1 mostly asked students to Approve/Disapprove. When a team reached at an impasse both teachers provided directly the information themselves, except of just one case: while Group1 had finished the activity while Group 2 had reached at an impasse. The Teacher1, instead of providing the information, he exchanged members between the two groups (*Group Formation*).

5.3. Analysis of Off-line Teachers' interventions

After studying the transcription file with teacher's on-line interventions and students' dialogues and actions, the teacher intervened one or more days afterwards.

In order to analyse the teachers off-line interventions, we focus again on the motive of each teacher's intervention, analysing this time the data from camera recording. The conditions, under which the teacher made interventions off-line are presented in the Table3. Analyses of the data revealed that the teachers takes three different roles: "providers of information related to the subject matter to be taught", "commentator of collaboration that took place" and "commentator of students' knowledge concerning the subject matter to be taught. According to the role that the teacher adopted each time, he intervened in some of the following cases.

Table 3. Conditions of Teacher's interventions off-line as a provider of information

Teacher's off-line interventions as a provider of information related to the subject matter			
Source	*Reason*	**Teacher 1**	**Teacher 2**
Actions' analysis	**Activities that were not solved**	5,88% (1/17)	0% (0/7)
	Different Solutions from the two teams	5,88% (1/17)	0% (0/7)
Actions' and messages' analysis	**Mistakes at the final product, not discussed on-line**	11,76% (2/17)	0% (0/7)
	Verify that a portion of final product was shared by group members	23,52% (4/17)	28,57% (2/7)
Messages' analysis	**Misconceptions**	29,41% (5/17)	28,57% (2/7)
	Verify that students had understood a subject discussed on-line	23,52% (4/17)	42,85% (3/7)

Observing Table 3, one can derive, that there were dome "errors" at the final product, that teachers didn't comment on-line. During this phase, in contrast with on-line, they intervened more on cases that maybe they were not used to. Probably, because they had the time to study the transcription file, unlike on-line.

Table 4. Teacher's interventions off-line as commentator

Teacher's interventions off-line as assessor of students' collaboration and knowledge		
	Teacher 1	**Teacher 2**
Comments on the collaboration of each team	50% (4/8)	37,5% (3/8)
Comments on students' knowledge	50% (4/8)	62,5% (5/8)

In traditional classes, teachers usually intervene when they want to correct mistakes at the final product, to solve problems that were not solved due to lack of time and to ask students questions in order to test their knowledge. Apart from these cases now they intervene to: verify that the portion of the final product that had been written from one participant, without discussion, had been understood by the rest of the team; when there are misconceptions (after studying history of dialogues between students of each team) that were not discussed on-line, when he/she wants to verify that the students had understood a subject that had been discussed on-line.The last case is very significant because misconceptions (in programming at least) are more likely to be "resolved" if the tutor not only discusses the misconception during problem-solving but also using probing feedback and post-summarisation strategies to address them after the problem-solving phase has ended (Pilkington, 2001).

5.4. Teachers' Points of View

During the interviews at the end of the whole sessions, teachers have expressed their points of view on the benefits and the difficulties of such an approach in class. According to Teacher 2, this approach gives the possibility to a teacher: "*to inspect a specific team, while they work and collaborate, to locate misconceptions, in order to intervene*. *I like to reproduce in the classroom snapshots from the problem solving process, and discuss on it, …either with the specific group of students or even with the whole class." "Usually, when I work with my students in the lab, I can't follow what they do, and so I have only the final program (*product*)*". " *I can use it from time to time, when we work on basic concepts and procedures, that are central for the rest of the course during the year*". According to Teacher 1: "*these opportunities are valuable to us, especially in cases where we have already taught a unit, and we need to see what our students haven't understood, what they have misunderstood". "But, it was also interesting to see, how a specific team works, or what was the contribution of some students in team". "…Of course, I cannot apply it, all the time".* Both teachers have noticed that "*take some time to read the logfiles*". During the interview, they have provided significant requirements on tools that could assist them, related to (a) a possible linked presentation of dialogues and actions in the shared space, b) a kind of threatened discussions, *(c*) the history of students actions in the final product, so as to see easier who has contributed.

6.DISCUSSION

The main purpose of the present study was to examine if synchronous computer mediated collaborative problem solving is valuable in every day practice with collocated students and teachers. Teachers' interventions were analyzed in two axes. The analysis showed that computer supported collaborative learning provides the teacher with some new opportunities, in spite of certain difficulties (like time consumption). This is so, because learners interact through messages, and this information is available to the teacher as a resource that can be used to understand the learning that has taken place. Additionally, a teacher can attend the actions at the shared workspace during problem-solving. Making the learning process of a group explicit, the teacher can be aware of the students weak and strong points and thus be able to intervene and monitor the group more effectively using different strategies according to the situation (Daradoumis, Marques, 1999). Diagnosis is a really hard activity for teachers, and if they have the opportunity to apply it, at least to a certain degree, we consider that it is significant both for teaching and learning.

Before this research implementation, our assumption was that eventually, this approach could be interesting for teachers, (especially after some practice), even though they hadn't any special education, neither on collaboration value, nor on teachers' effective roles under these conditions. The conclusion that we derived, is that application was possible and it had positive effects to teachers' strategies, even it was applied to minimal conditions: typical school problems, minimum technological support, teachers without any education, in the frame of limited school type. It also seemed to inspire teachers to work more on the direction of

collaborative settings. We consider that the use of a networked environment for collaborative problem solving with co-present students, was legitimated. Eventually, such a minimal approach could be considered as a first step to explore more powerful approaches that computer supported collaborative learning inspire. Moreover, such approaches applied to minimal conditions, which are not far away from current teachers practices, neither are they linked to ambitious objectives, are often considered as a first step for teachers' involvement to new educational practices with technologies (Casey, 1996*;* Sandholtz, et al. 1997; Baki, 2000), as well as for teachers' education.

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