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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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

Abstract. Synchronous collaborative problem solving is usually examined for its learning potential, while it is often studied under experimental conditions. The present research aims at exploring synchronous computer mediated collaborative problem solving in real school context, with collocated students, in every day practice. This paper focus on teachers and the possibility offered to improve or empower their teaching approaches exploiting collaborative settings with minimum technological support. The analysis shows that this approach provides teachers with some new opportunities and especially concerning on-line/off-line students' diagnosis during problem-solving.

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 do they estimate, that such an 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 (Constantino-Gonzalez & al. 2001,Wu, et al. 2002). The teachers' role has been much less often studied, and when it is, is mostly for experimental purposes (Lund & Baker, 1999) and not for exploring real 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.

2. PURPOSE OF THE RESEARCH

Until 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

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intervenes to help them (Lakkala, et al., 2001; Baker, et al, 2001). 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. 2001), or they are domain independent but conversation-based, like CONNECT (Baker, 2001).

The present 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, by what "means" and to whom do they address their interventions? What kind of interventions do they make during on-line activity and what during off-line debriefing sessions? Which are their functional roles when working on this mode? Which moments of the teaching process do they consider 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? This paper, independently from the effectiveness of collaborative learning, aims at exploring how valuable this approach may be for teachers. It presents a case study, that took place in a real school environment, where all participants, teacher and students, are located in one classroom, working on different computers, with typical problem-solving activities, (usually students worked in groups of two in front of the same computer). They used systems that allow synchronous collaborative learning, are easy to use, easy to get and are domain independent. With this approach 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 to 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 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 sixteen-year old students, from two different classes (five from each class). Neither teacher had previous experience with computer supported collaborative learning, but Teacher2 is a researcher and has worked on improving teaching through computer use. The teachers were not provided any initial instruction 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). The teacher placed students into mixed ability groups. The members of each group worked on their own computers, which were not located in the immediate vicinity of 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*, during four instructive hours (4 * 45 minutes) each class. The activities were not designed for the purpose of the study. They were chosen by 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 collectively written text 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 within the shared workspaces and the teacher's screen and (c) camera recording (spoken dialogue between teacher and students) were linked and merged. Thus, a single transcription file was produced, respecting the chronological order of events, containing the teacher's interventions (verbal and/or written) as well as students' dialogues and actions. This unified file served as the base for analysis, for each team (Excerpt 1).

The analysis is separated into 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).

(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 verbal expressions, attributing 'functional roles' (Vosniadou et al. 1999) or analyzing "question types and statement types" (Hmelo-Silver, 2002) that correspond to 'how teachers intervene' 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 often take place independently.

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

In the present study, we tried to identify: A) (a) "when, and for what reason" the teachers' intervened, through previous examining and analysing students' messages and actions in the shared space. This was linked with the identification of (b) "How, with what means (verbal or written messages)" they intervened, as well as, (c) "to whom they addressed their interventions", whether to a specific group or to the whole class. Then, (B) we analysed, the way teachers intervened, by assuming the specific functional role of each intervention. Each intervention, given a specific cause, may include more than one message or verbal utterances by teachers. So, if during the conversation concerning a specific topic the teacher changes role, then we consider it as a new intervention. Referring to spoken dialogue during teachers' off-line interventions in a debriefing session, the unit of analysis was teachers' 'utterances'.

5.2. Analysis of On-Line Teachers' Interventions

5.2.1. When does a teacher intervene?

Anlysis of teacher's messages and/or verbal 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* (**teacher-requested interventions**, Table 1) 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 from their 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') while in others the chat history of the groups (e.g. revealing a misconception).

B) *Teachers intervene after students' request via messages* (**student-requested interventions,** Table 1) where, a) students ask for help (related to the content or to a merely technical problem), or b) students need to inform teachers (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 divided in three main categories. Teachers act as: A)"providers of information related to the subject matter to be taught", B)"managers of interaction" and, C)"managers of the course process".

At Table 1, the following information is presented: who has initialised the intervention (student or teachers), what is the reason for each intervention (the 'when'), whether it results from actions' or messages' analysis, and which functional role the teacher adapted in each case. Table 1 does not compare the teachers' interventions but it is mainly an overview of the later. As far as teachers' interventions as managers of the course process are concerned, the reason of intervention had not to do with the specific solution or dialogue of groups, so they are not reported by the table, given their minor importance. Teachers intervened as

managers of the whole process by themselves or after a request 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). In these cases, there were messages addressed to the whole class, all of them oral.

S29.User3: [*typed*]: var count, i, x : integer;
begin writeln ('Give the students' marks'); readln (mark}; mark>max
S32.User5 [*sent message]*: You have to write *if* first.
S33.Teacher2 [*orally in class*]: Guys you have to put parenthesis at command readln. When we use the hooks**;** *{Provider of Information, Teacher-requested intervention, Actions' analysis, Problem solution}*.
S34.User6 [*orally in class*]: when we have comments.
S34.User3 [*sent the message*]: Sorry (and release the control of the common workspace).
S36.User5: [*(he took the control) typed*]: deleted the variables *i* and *x* from the command *var* readln (mark); If vathmos > max…..
S37.User6 [*sent the message*]: why you deleted *i* and *x*?
S38.User5 [*typed]*: if grade>max then max:=grade else if vathmos<max then max:
S39.Teacher2 [*orally in class*]:User6 asked something and you didn't answer. Why you deleted variables *i* and *x* from command *var*? You have to answer. *{Manager of Interaction, Teacher-requested interaction, messages' analysis, No help supplied y a member}*
S40.User5 [*orally in class*]: Sorry, I think we didn't need these variables.

Excerpt 1 from the transcription file (translated from original Greek).

As concluded from Table 1: A) Teachers **intervene by themselves** as providers of information concerning the subject matter to be taught 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. They act as managers of interactions when they have identified difficulties during problem solving or non-appropriate collaboration. B) Students asked 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. C) Both teachers mostly intervene in order to provide information concerning the subject matter to be taught (especially Teacher 1), while there were cases when a more suitable intervention should be needed. For instance, a student who asks for help concerning the subject matter directly to the teacher without previous discussion with its collaborator should obtain an intervention from the teacher which would incite a group discussion on the question. Teacher1 explained during the interview, that he acted like this because *"that is how I was used to working until now, since I didn't have the possibility to become familiar with the processes where the students collaborate"*. 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 get them started. 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".

Teachers' interventions were addressed to a specific group and not to the whole class. Only 6,97% (6/86) of interventions have used the written messages as support. In general, it appeared clearly that most of the teachers' messages were verbal. 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 were oral. The other reason is that "*we are used to acting this way*".

Table 1. Conditions of on-line teacher's interventions as a provider of information concerning the subject matter (Pr.info) and as a manager of interaction (M.Int).

Conditions of On-line Teacher's Interventions as a Provider of Information related to the subject matter and as a Manager of Interaction						
			Teacher 1		**Teacher 2**	
	Source	***Reason***	**Pr.Info**	**M.Int**	**Pr.Info**	**M.Int**
Teacher-requested interventions	**Actions' analysis**	**Problem solution**	26,47% (9/34)	5,88% (2/34)	25% (13/52)	7,69% (4/52)
	Messages' analysis	**Misconceptions**	11,76% (4/34)	2,94% (1/34)	7,69% (4/52)	9,61% (5/52)
		No help supplied by a member			5,76% (3/52)	9,61% (5/52)
		No participation by a member		2,94% (1/34)	1,92% (1/52)	1,92% (1/52)
		Regulation of common work-space access				1,92% (1/52)
		Monitoring group progress		5,88% (2/34)		3,84% (2/52)
		Talking instead of chatting				1,92% (1/52)
Student-solicited interventions	**Messages (asking for help)**	**Asking for help without previous discussion**	11,76% (4/34)	11,76% (4/34)	9,61% (5/52)	1,92% (1/52)
		Asking for help after impasse	11,76% (4/34)			1,92% (1/52)
		Asking for help on a "technical" problem	8,82% (3/34)		1,92% (1/52)	1,92% (1/52)
		No help supplied by a member				1,92% (1/52)
	Messages	**Informing**			1,92% (1/52)	1,92% (1/52)

In traditional classes with face-to-face collaboration, teachers' requested interventions result only from actions' analysis, either from the final common product, or from collaboration's snapshots during lessons. As far as students' requested interventions, teachers have no way of knowing under which circumstances the students requested for help (e.g. if they have not discuss the issue firstly with the rest of the group). During synchronous computer-mediated collaborative problem-solving, as we assume from Table 1, teachers can additionally

detect misconceptions, not appropriate mode of collaboration and intervene accordingly.

5.2. 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 later. 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 Table2 and Table 3. Analyses of the data revealed that the teachers adopt three different roles: A)"providers of information related to the subject matter to be taught", B)"commentator of collaboration that took place" and C)"commentator of students' knowledge concerning the subject matter to be taught. According to the role that the teacher adopted each time, he/she intervened in some of the following cases.

Table 2. 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 in the final product, not discussed on-line**	11,76% (2/17)	0% (0/7)
	Verifying 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)
	Verifying that students had understood a subject discussed on-line	23,52% (4/17)	42,85% (3/7)

Table 3. Teacher's interventions off-line as commentator

Teacher's interventions off-line as commentator 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 with face-to-face collaboration, 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 above cases, they intervene to: verify that the portion of the final product that had been written by one participant, without discussion, has been understood by the rest of the team; when he/she wants to verify that the students had understood a subject that had been discussed on-line; when there are misconceptions (after studying history of dialogues between students of each team) that were not discussed on-line. The last case is very significant because misconceptions (in

programming at least) are more likely to be "resolved" if the teacher 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). So teachers after studying the transcription file didn't solely focus on students' errors or on their final product (program) as they were used to, something that is consistent with the findings reported at (Lund & Baker, 1999). During this phase, in contrast with on-line, teachers 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.

5.3. Teachers' Points of View

During the interviews at the end of all sessions, teachers expressed their points of view on: A) **How valuable does this approach appear to them?** Teacher 1: "*these opportunities are valuable to us. It was interesting to see how a specific team works, or what was the contribution of some students in a team".* Teacher 2: *"This approach gives you the possibility to inspect a specific team, while they work and collaborate, to detect misconceptions, in order to intervene*. *I like to reproduce in the classroom snapshots from the problem solving process, and discuss 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*)*". B) **When during the teaching process do they consider it appropriate to apply?** Teacher 1: *"…Of course, I cannot apply it, all the time. This approach is valuable 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".* Teacher 2: " *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*". C) **What tools do they need so as to apply on-line and/or off-line students' diagnosis in an easier way?** Both teachers noticed: "*A log file with the dialogues and the actions that took place at the shared workspace in parallel for each team is needed",* that is a possible linked presentation of dialogues and actions in the shared space. *"The contribution of each student in the final product must be obvious*, and *anything that has been deleted in the common product must be cancelled",* that is the history of students actions in the final product, in order to see more easily who has contributed. "V*isualize the dialogue in a way, that the teacher is helped while he/she is watching the dialogues on-line but also afterwards during the analysis of the dialogues"* that is a kind of threatened discussions.

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. The analysis showed that computer supported collaborative learning provides the teacher with some new opportunities, in spite of certain difficulties (such as 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 assess the learning that has taken place. Additionally, a teacher can monitor the actions at the shared workspace during problem-solving. Viewing the details of a problem-solving interaction between students could elucidate students' puzzling behavior (Lund & Baker, 1999). Besides, 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, 2000). 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 instruction, neither on collaboration value, nor on teachers' effective roles under these conditions. The conclusion that we derived is that application was possible and that it had positive effects on teachers' strategies, even when it was applied under minimal conditions: typical school problems, minimum technological support, teachers without any instruction, in the frame of limited school type. Maybe teachers face the whole approach positively, in contrast with findings of other researches (Lipponen, 1999), because they are familiar with the usage of computers and because synchronous computer supported collaborative learning was an integrated part of the learning environment. With this new approach, students solved the problems that were going to solve, they "carried out the assigned tasks". The need for providing teachers with tools that analyse students' activity (both on content and collaboration) and presenting their actions and dialogues in a form that facilitate teachers' understanding, is apparent from our research.

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 for teachers to explore more powerful approaches that the 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).

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