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Indice

Guidelines for a Computer-mediated Discussion in the Classroom

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Abstract

In this article we discuss the design of the collaborative tools that are part of CoFFEE. The discussion is centered around two issues – equal participation and coherence – that affect the performance of student groups. We relate these two issues to properties of the medium whereby the focus is on how the medium organizes the sequence of individual talk into a meaningful whole. We argue that improvements do occurs because the collaborative tools as a digital medium for communication organize the ongoing interactions differently from their verbal counterpart.

Introduction

In this article we discuss the design of the collaborative tools that are part of CoFFEE, the networked learning environment that was developed to support collaborative learning activities in the classroom. The collaborative tools mediate *part* of the communication of a group

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of students who can also talk verbally. The challenge that we faced as educational designers was to come up with the proper conditions for a computer-mediated discussion in a face-to-face setting. For that we formulated some clear expectations how the group communication will change for the better. These expectations are based on a systematic analysis of small-group discussions *and* grounded in theoretical insights about communication, collaboration and learning. They were translated into a set of empirical verifiable design guidelines that lay down the basic properties of the collaborative tools.

Our discussion is centered around two issues – equal participation and coherence – that were addressed by the tool design. We relate these two issues to properties of the medium whereby the focus is on how the medium organizes the sequence of individual talk into a meaningful whole. It is hypothesized that improvements do occurs because CoFFEE as a digital medium for communication organize the ongoing interactions differently from their verbal counterpart.

1. CoFFEE in Context Classroom Communication

Traditionally, the classroom is a place for learning where students acquire new knowledge and skills. The classroom is also a *communicative environment*; communication can be seen as the carrier through which teaching and learning takes place, and students' participation in these communicative practices affects their achievement (Green, 1983).

Classroom communication, at least the part that has to do with the acquisition of knowledge or skills, usually goes between the teacher and the students with the teacher as the pivot of the learning activities. Normally, the teacher has the initiative and directs the communication that goes on in the classroom; the teacher controls what should be learned and how. Lectures are a good example of this teacher-centered communication pattern with their strong emphasis on facts and pre-structured content. It reflects a view that knowledge is simple to 'be listened to' or 'to be looked up' (Bruner, 1996). This objectivist view towards learning has been challenged by constructivist approaches. These approaches do not see the students as a passive recipient of

knowledge; students bring in their own insights and beliefs towards the learning activities. They construct useful and viable knowledge in an attempt to make sense of the learning activities they participate in.

A number of constructivist accounts introduce a particular conception of knowledge that emphases its discursive nature. These accounts state that knowledge constructions take place within everyday discourse between people in interaction (Burr, 1995). They stress the *construing* aspect of communication. Communication, from this perspective, is a process of interpreting one's personal experiences and sharing these personal interpretations with others. Learning can then be seen as a continuing effort to improve on existing knowledge through an engagement in a discourse that advances mutual understanding (Bereiter, Scardamalia, Cassells & Hewitt, 1997).

Social-constructivist perspectives have a different view with regard to classroom communication. Meaningful interactions may look quite different, both for the teacher and the students. Sharing knowledge is not confined to the teacher; students are also considered as an important source of knowledge. Communication does not proceed in a one-way direction from an expert teacher towards novice students. Teachers should encourage students to engage in a constructive dialogue. They have to stimulate students to explain their reasoning, listen to each other, learn from, and even argue with their peers (Cazden & Beck, 2003). Students must communicate, defend, prove and justify their ideas to the classroom community (Twomey Fosnot, 1996). It makes them aware of their own thinking in relation to what other students say; from there they can progress towards a better understanding. Students may even be better able to address each other's belief systems because their concepts of things are more closely related. Together they could make sense of their mutual experiences, while differences in understanding may give rise to further explorations. This view opens up alternative learning methods such as group discussions.

1.1 Small-group Discussions

A group discussion consists of one or more meetings between a small group of people who communicate with each other, often face-to-face,

in order to achieve one or more goals such as increased understanding, the coordination of an activity, or a solution to the shared problem (Galanes & Adams, 2007). In a classroom setting these discussions are directed towards the exploration of a particular subject or the resolution of a problem. When students participate in a discussion they may develop authentic solutions for complex problems, and, while doing so, acquire useful knowledge of theories and concepts (Chernobilsky, Nagarajan and Hmelo-Silver, 2005). Through discussions, they may generate and evaluate evidence to confirm or enhance their understanding (Hogan, Nastasi & Pressley, 2000).

The CoFFEE tools that are discussed in this article aim to support group discussions in the classroom. These collaborative tools provide the students with a learning environment that enables them to carry out their learning task effectively. These tools focus on *task performance*; they provide support for specific task-related learning activities.

CoFFEE focuses on face-to-face situations which means that the students are in physical proximity and interact directly with each other. Often, several small groups populate the classroom which makes direct supervision by the teacher impracticable. Consequently, the emphasis shifts from teacher-centered communication towards the communication between students. The teacher walks around, monitors the groups, encourages the students and is available for answering questions or providing guidance. Still, group interactions, whether or not guides guided by a teacher, are considered as the primary means for learning.

2. Design Rationale: Changing Face-to-face Communication

Bringing students together in small groups does not mean that they will actually engage in a productive discussion that enables them to learn with and from each other. Particular kinds of interactions need to occur which would trigger learning mechanisms that lead to an increased understanding. It is however no guarantee that the expected interactions do actually occur (Dillenbourg, 1990). Sometimes, the commu-

nication that emerges during a discussion is counter-productive so that the group does not achieve the intended learning outcomes. Several studies into collaborative learning reported that the performance of groups may vary and that not all groups managed to engage in a productive discussion that advanced their understanding (see e.g. Barron, 2003; Kneser & Ploetzner, 2001; Sfard & Kieran, 2001: Hogan, Nastasi & Pressley, 2000; Keefer, Zeitz & Resnick, 2000).

Sfard and Kieran (2001) conclude that the merits of a group discussion cannot be taken for granted due to *ineffective communication patterns* that they observed in groups. These ineffective patterns inhibit the free expression of ideas and the further exploration of these ideas by the group. Interruptions are a good example of an ineffective communication pattern (Stein & Albro, 2001). Frequent interruptions by a dominant group member could hamper the process of collaboration and learning.

Collaborative learning puts some demands on the kind of behaviors that are beneficial for group performance. It requires *active* participation, while better understanding is acquired when students collaboratively reflect on the information they have shared. Then the students have to display communication that creates *meaning,* while *coherence* is the primary vehicle through which learning on the level of the group occurs (Allen & Plax, 2002).

Our discussion about the design of the collaborative tools centers around two issues: equal participation and coherence. The first issue of equal participation relates to verbal discussions and gave rise to the design process. One of the objectives of the tool design is to promote unhampered participation. The second issue of coherence emerged during the design process when we looked at the underlying structures that regulate individual talk into a coherent and meaningful whole.

2.2 Equal participation

An important criterion for the success of learning groups is that their members maintain acceptable levels of participation. All the group members must be able to share their knowledge with the group. Equal participation is a fundamental element of well-performing student groups (Lindblom-Ylänne, Pihlajamäki & Kotkas, 2003). Some of the

teachers that participated in our studies mentioned unequal participation as a drawback of small-group discussions. They stated that a discussion is sometimes dominated by one or two students who frequently take the floor.

Dominance and control are regularities in behavior of persons who score high on the 'dominance-submissiveness trait' (Cattell, 1965). They may guide much of the seemingly irrational behavior when people discuss their difference of opinion (Stein & Albro, 2001). A dominant group member repeatedly interferes the ongoing talk so that fellow group members are not able to finish their turn or to take the turn. Interpersonal dominance leads to an 'asymmetrical pattern of communication' (Zimmerman & West, 1975) whereby some students have fewer opportunities to share their knowledge with the group. It prevents groups from fully access the knowledge that is available so that they are not able to capitalize on the insights that fellow members have generated (Barron, 2003).

The disruptive behaviors that are associated with interpersonal dominance can be situated on the individual level as behavior regularities. However, it is hypothesized that their appearance at the level of the group depends on how the group coordinates their sequence of communicative actions. A group who communicates verbally has to organize their interactions according to the "mechanism of turn-taking" (Sacks, Schegloff & Jefferson, 1974). Turn taking rests on the principle that only one group member talks at the same time. Turn taking may hamper the sharing of ideas because rhetorically "skilled" students are able to take the turn or to overrule their fellow group members. It is expected that dominant behavior will decrease when the communicative exchanges are organized by means of parallel access. The collaborative tools offer the group such an alternative mechanism for floor control. With *parallel access*, all the group members can access a shared workspace simultaneously. They do not have to wait for their turn but immediately share their ideas with the group. Furthermore, other group members cannot interfere because a group member puts forward a contribution in a private window by typing.

The transition from turn taking to parallel access is a basic property of CoFFEE. Parallel access makes it possible to put forward a con-

tribution without any interruption or delay so that all the group members have unhindered access to the discussion. All the students can put forward their contributions at the same time without any disturbance. They use a text-based, digital medium to share their ideas with the group. Users type their ideas in a private window that is not accessible by other users. Only after they submit their text it becomes visible in the shared workspace. Findings indicate that parallel access stimulates equal participation (van Diggelen, 2011). In a study where students communicated both verbally and digitally, the degree of participation differed considerably. Group members who did not said much were as active as their talkative peers when it came to digital communication. Parallel access changed the pattern of group communication in several ways: students worked at their own pace, they focused on a topic of immediate interest, and they expressed their thoughts without being interrupted.

2.3 Coherence

Parallel access encompasses the danger of incoherence; it is just as if several people talk at the same time. Parallel, text-only communication like chat shows a high degree of disrupted adjacency, overlapping exchanges and topic decay (Herring, 1999). Online chat-rooms, for example, constitute a communication environment where these basic rules and assumptions of conversation do not hold (Greenfield & Subrahmanyam, 2003). Communication problems that are associated with parallel access are extensiveness of contributions in the shared workspace, and a lack of a common group focus with regard to the topic of discussion (van Diggelen & Overdijk, 2009; van Diggelen, 2011). The two issues are related in the sense that they strengthen each other. There is the danger that the shared workspace becomes crowded. The number of contributions increases quickly, which makes it difficult for group members to monitor what is going on. Group members are not able to keep track of the various topics that are put forward by their fellow group members. Without timely joint attention, basic processes as sharing perspectives, increased monitoring and providing explanations will be compromised (Barron, 2003).
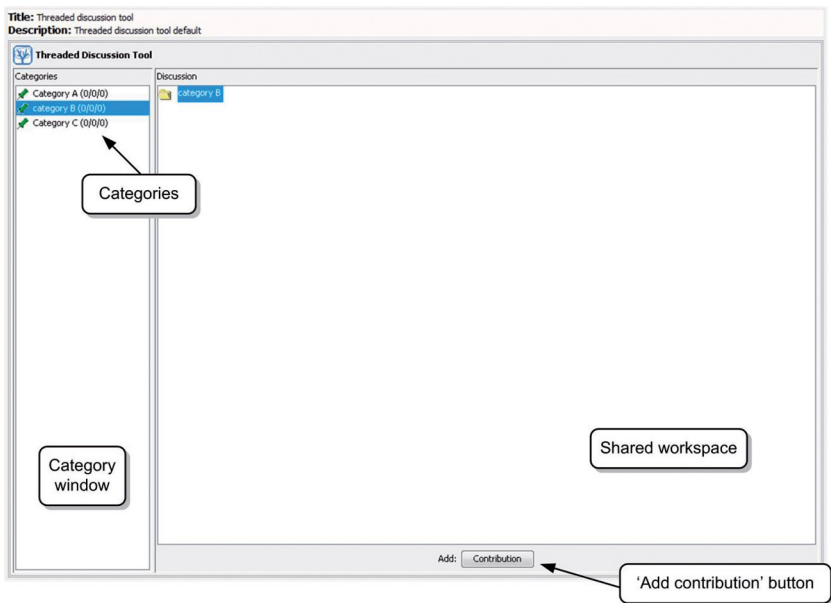
Barron (2003) studied the interaction patterns of groups who communicated orally in a face-to-face setting. The groups consisted of three students who participated in a problem-solving discussion. She found that more successful groups compared to less successful ones differed in how they respond to correct proposals. Successful groups carried out a productive discussion that is oriented at the exploration of ideas. These groups discussed or accepted correct proposals, whereas less successful groups showed a tendency to ignore or to reject them. Students from successful groups also showed a better transfer of their learning to an individual achievement task. Differences in level of knowledge of individual group members did not account for how successful the groups were. Barron found that the performance differences had to do with the interaction patterns. Successful groups carried out a *more coherent discussion* during which they directly linked proposals to the prior conversation. This observation is confirmed by a study of Kneser & Ploetzner (2001) who conclude that the successful groups produced more coherent dialogues.

To solve the issue of incoherence we developed three additional guidelines:

1. a shared digital workspace that is divided into functional spaces,
2. to associate the functional spaces with a macro structures that is associated with relevant aspects of the problem or the task, and
3. the possibility to link a new contribution to a contribution that is already present in the shared workspace.

The three properties mentioned above are the *elementary sequential units* for the computer-mediated part of the communication. We *expected* that they would create coherence, order and meaning when students communicate in a shared digital workplace. The units organize a digital discussion according to a global structure of coherence. Global coherence refers to a *macro structure* that is based on topics or themes in a discourse (van Dijk, 1985). Such a macro structure was implemented in the collaborative tools whereby we took in mind the spatial properties of the shared workspace. The Threaded-discussion tool (Figure 1), one of collaborative tools of CoFFEE, makes use of categories as a representation aid that divides a discussion into a number of meaningful topics.

Figure 1. User-interface of the Threaded discussion tool

The Category window is always visible unless there is only one category. The users select a certain category in the Category window, which opens a shared workspace – associated with that category – within which the users place a contribution. Categories are defined beforehand by the teacher and they are the same for all the students that compose the group. Students connect a new contribution to any contribution that is already placed in the shared workspace. The existing contribution does not have to precede directly in time. It means that the communication does not only reflect a temporal ordering, it also displays a graphical relationship between two contributions that is based on meaning. This property sets the discussion that occurs in the Threaded-discussion tool apart from its verbal counterpart. Users organize their discussion according to a global model of coherence that enables them to carry out a discussion based on back-and-forth practical reasoning. The resulting discussion can be visualized as a

tree where each branch or thread represents a sequence of related contributions.

It is worth to notice that the *permanence* of contributions in the shared workspace is a necessary condition for global coherence. Permanence means that the contributions in the digital workspace remain visible so that users can relate their message to a relevant contribution that does not directly precedes in time.

Findings indicate that a macro structure and the use of links broaden up the discussion (van Diggelen, 2011). These two properties of the collaborative tool gave the students more freedom to follow their own lines of thinking. Several discussion lines occurred in parallel and most of them remained active during the whole discussion. These discussion lines addressed specific topics that had a direct relation with the macro structure.

3. Conclusions

The orientation taken by in this article – computer-mediated communication that *parallels* verbal communication – provides an alternative perspective to the study of networked learning. Usually, educational researchers set face-to-face discussions apart from online discussions. The two situations are incompatible with distance as an essential characteristic. A number of studies compared face-to-face with digital communication (see e.g. Meyer, 2003; Jonassen & Kwon, 2001; Marttunen & Laurinen, 2001). This is mainly done at a general level: the two situations are described in general terms with distance as the determining factor. Such a perspective was of no help in our case. The computer-mediated communication that is facilitated by CoFFEE is *also* face-to-face. So overcoming distance is not an issue for support. This drew our attention to the characteristics of verbal, face-to-face communication. Verbal discussions offer many opportunities for collaboration and learning. Still, as we argued in this article, these discussions have some drawbacks that has to do with the way humans communicate verbally. We identified interpersonal dominance as an ineffective communication pattern that hampers the sharing of knowledge. This verbal communication pattern was further described by

the rules that unify individual speech into a meaningful discourse. One of these rules for *sequential organization* is turn taking. Turn taking refers to the rule that only one person talks at a time and the frequent changes between speakers do occurs. We expected that parallel access as floor-control mechanism would counteract the negative consequences of interpersonal dominance. Parallel access became one of the basic properties of CoFFEE. Parallel access makes it possible to put forward a contribution without any interruption or delay because all the group members have unhindered access to the discussion.

The use of parallel access made us aware of coherence as a requisite for productive discussions. Group discussions can be characterized by multiparty talk that is episodic in nature (Schwartzman, 1989). The episodic character implies that the utterances of the group members are only loosely coupled. A sequence of individual talk only becomes a meaningful dialogue when the group members manage to organize their exchanges into a comprehensible whole. Coherence, order and meaning should not be taken for granted. Group members have to follow certain principles and rules for *coupling* to make their individual actions into a productive discussion. Defining the proper conditions for coherence became a central issue for the design of CoFFEE.

References

Allen, T.H., & Plax, T.G. (2002). Exploring consequences of group communication in the classroom: Unraveling relational learning. In L.R. Frey (Ed.), *New Directions in Group Communication* (pp. 219-234). Thousand Oaks, CA: Sage Publications.

Barron, B. (2003). When smart groups fail. *The Journal of the Learning Sciences*, *12* (3), 307-359.

Bereiter, C., Scardamalia, M., Cassells, C., & Hewitt, J. (1997). Postmodernism, knowledge building, and elementary science. *The Elementary School Journal*, *97* (4), 329-340.

Bruner, J.S. (1996). *The Culture of Education.* Cambridge, MA: Harvard University Press.

Burr, V. (2003). *Social Constructionism*. East Sussex, UK: Routledge.

Cattell, R.B. (1965). *The Scientific Analysis of Personality.* Baltimore, MD: Penguin Books.

Cazden, C.B., & Beck, S.W. (2003). Classroom discourse. In A.C. Graesser, M.A. Gernsbacher & S.R. Goldman (Eds.), *Handbook of Discourse Processes* (pp. 165-198). Mahwah, NJ: Lawrence Erlbaum.

Chernobilsky, E., Nagarajan, A., & Hmelo-Silver, C.E. (2005). Problem-based learning online: Multiple perspectives on collaborative knowledge construction. In D. Suthers, T. Koschmann & T.W. Chan (Eds.), *Proceedings of the International Conference on Computer Supported Collaborative Learning* (pp. 53-62). Mahwah, NJ: Lawrence Erlbaum Associates.

Dillenbourg, P. (1990). Introduction: What Do You Mean by "Collaborative Learning"? In P. Dillenbourg (Ed.), *Collaborative Learning: Cognitive and Computational Approaches* (pp. 1-29). Oxford, UK: Pergamon.

Galanes, G.J., & Adams, K. (2007). *Effective Group Discussions: Theory and Practice.* New York, NY: McGraw Hill.

Green, J.L. (1983). Research on teaching as a linguistic process: A state of the art. In E. Gordon (Ed.), *Review of Research in Education* (Vol. 10, pp. 151-252). Washington DC: American Educational Research Association.

Greenfield, P.M., & Subrahmanyam, K. (2003). Online discourse in a teen chatroom: New codes and new modes of coherence in a visual medium. *Applied Developmental Psychology*, *24*, 713-738.

Herring, S.C. (1999). Interactional Coherence in CMC. *Proceedings of the 32nd Hawaii International Conference on System Science.* Los Alamitos: IEEE Computer Society Press.

Hogan, K., Nastasi, B.K., & Pressley, M. (2000). Discourse patterns and collaborative scientific reasoning in peer and teacher-guided discussions. *Cognition and Instruction*, *17* (4), 379-432.

Keefer, M.W., Zeitz, C.M., & Resnick, L.B. (2000). Judging the quality of peer-led student dialogues. *Cognition and Instruction*, *18* (1), 53-81.

Kneser, C., & Ploetzner, R. (2001). Collaboration on the basis of complementary domain knowledge: Observed dialogue structures and their relation to learning success. *Learning and Instruction*, *11*, 53-83.

Lindblom-Ylänne, S., Pihlajamäki, H., & Kotkas, T. (2003). What makes student group successful? Student-student and student-teacher interaction in a problem-based learning environment. *Learning Environments Research*, *6*, 59-76.

Sacks, H., Schegloff, E.A., & Jefferson, G. (1974). A simplest systematics for the organization of turn-taking for conversation. *Language*, *50* (4), 696-735.

Schegloff, E.A. (2000). Overlapping talk and the organization of turn-taking for conversation. *Language and Society*, *29*, 1-63.

Schwartzman, H.B. (1989). *The Meeting: Gatherings in Organizations and Communities.* New York, NY: Plenum Press.

Sfard, A., & Kieran, C. (2001). Cognition as communication: Rethinking learning-by-talking through multi-faceted analysis of students' mathematical interactions. *Mind, Culture, and Activity*, *8* (1), 42-76.

Stein, N.L., & Albro, E.R. (2001). The origins and nature of arguments: Studies in conflict understanding, emotion, and negotiation. *Discourse Processes*, *32* (2&3), 113-133.

Twomey Fosnot, C. (1996). Constructivism: A psychological theory of learning. In C. Twomey Fosnot (Ed.), *Constructivism: Theory, Perspectives and Practice.* New York, NY: Teachers College Press.

van Diggelen, W. (2011). *Changing face-to-face communication: Collaborative tools to support small-group discussions in the classroom*. Groningen, The Netherlands: University of Groningen.

van Diggelen, W., & Overdijk, M. (2009). Grounded design: Design patterns as the link between theory and practice. *Computers in Human Behavior*, *25*, 1056-1066.

van Dijk, T.A. (1985). Semantic discourse analysis. In T.A. van Dijk (Ed.), *Handbook of Dscourse Analysis* (pp. 103-136). London: Academic Press.

Zimmerman, D.H., & West, C. (1975). Sex roles, interruptions and silences in conversation. In B. Thorne & N. Henley (Eds.), *Language and Sex: Differences and Dominance* (pp. 105-129). Rowley, MA: Newbury House.