

# Polyphonic Inter-Animation of Voices in Chats

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## ABSTRACT

This paper presents and discusses the idea that one reason for the success of collaborative problem solving is the polyphonic character of work in small groups. Polyphony, a concept taken from music, may occur in chats for problem solving, transforming dialog into a “thinking device”: Different voices jointly construct a melody (story, or solution) and other voices adopt differential positions, identifying dissonances (unsound, rickety stories or solutions). This polyphonic interplay may eventually make clear the correct (“sound”) construction. The paper also proposes software tools for identification and visualization of voices in chats.

**Keywords:** Computer Supported Collaborative Learning, polyphony, chat summarization, inter-animation, discourse analysis

## INTRODUCTION

This paper is considering the role of polyphonic inter-animation of multiple voices in collaborative learning. Inspired by the work of Mikhail Bakhtin (1981, 1984), this perspective shed new light on the dialogic nature of discourse in human language. It would also have consequences for the design of collaborative learning environments.

In polyphony, a number of voices jointly construct a harmonious musical piece, generating variations on one or several themes. They have to avoid dissonances even if they are playing several themes or themes variations, and even if sometimes they situate themselves on differential positions.

Bakhtin considers that multiple voices are present also in texts and, sometimes (e.g. in Dostoevsky’s novels) they constitute a polyphonic framework (Bakhtin, 1984). Extrapolating this idea, we observed that voices following polyphonic patterns occur also in dialogs, in general, and in Internet instant messenger’s chats, in particular. A polyphonic collaboration involves several voices that play several themes and their variations in a game of sequential succession and differential positions. The existence of different voices emphasizes “dissonances,” unsound, rickety stories or solutions. This polyphonic game may eventually make clear the correct, sound solution.

1 The above ideas are exemplified in the paper with chat excerpts for collaborative learning  
2 in two domains, mathematics problem solving, investigated in VMT (Stahl, 2006), and  
3 human-computer interaction at Computer Science department at Bucharest “Politehnica”  
4 University. Inter-animation patterns were discovered in two dimensions: longitudinal  
5 (chronologically sequential) and vertical, towards two opposite trends: unity vs. difference.  
6 We consider that even individual thinking is also an implicit collaborative (dialogic) process  
7 that involves multiple voices. However, actual collaborations, in small groups of different  
8 personalities empower the dialogic process.

9 An environment for collaborative learning based on the polyphonic inter-animation  
10 principles is introduced. A major facility of it is the visualization of voices inter-influences,  
11 that are a starting point for a polyphonic analysis.

12 The paper continues by introducing discourse, the dialogic theory of Mikhail Bakhtin and  
13 polyphony. The next section of the paper introduces Computer-Supported Collaborative  
14 Learning (CSCL) and analyses the polyphonic welding of longitudinal-vertical unity-  
15 difference dimensions. Software tools that support the visualization of voices, allowing the  
16 analysis of polyphonic inter-animation are presented in the fourth section. The paper ends  
17 with conclusions and references.

## 18 DISCOURSE, DIALOGISTICS AND POLYPHONY

19 Learning may be seen as directly related to discourse building, as Sfard (2000) remarked:  
20 “rather than speaking about ‘acquisition of knowledge,’ many people prefer to view learning  
21 as *becoming a participant in a certain discourse*”. Koschmann (1999) emphasized the social  
22 dimension of learning and discourse, quoting Deborah Hicks: "Learning occurs as the co-  
23 construction (or reconstruction) of social meanings from within the parameters of emergent,  
24 socially negotiated, and discursive activity" (Hicks, 1996, p. 136).

25 The above ideas follow the socio-cultural learning paradigm initiated by Vygotsky. He has  
26 a permanently increasing influence on learning theories, stating that learning is a social  
27 process, mediated by specific tools, in which symbols and especially human language plays a  
28 central role (Vygotsky, 1978). However, he did not investigate in more detail how the  
29 language and discourse are actually used in collaborative activities. It is the merit of Mikhail  
30 Bakhtin to propose a sound theory of how meaning is socially constructed.

31 Mikhail Mikhailovici Bakhtin extended Vygotsky’s ideas in the direction of considering the  
32 role of language and discourse, with emphasis on speech and dialog. Bakhtin raises the idea of  
33 dialogism to a fundamental philosophical category, *dialogistics*. For example, Voloshinov (a  
34 member of Bakhtin’s circle who, according to many opinions, signed a book written by his  
35 more famous friend because the former has an interdiction to publish during Stalin regime)  
36 said: “... *Any true understanding is dialogic in nature*. Understanding is to utterance as one  
37 line of dialogue is to the next” (Voloshinov, 1973). This is in consonance with Lotman’s  
38 conception of text as a „thinking device” (Wertsch, 1991), determining that: “The semantic  
39 structure of an internally persuasive discourse is not *finite*, it is *open*; in each of the new  
40 contexts that dialogize it, this discourse is able to reveal ever new *ways to mean*” (Bakhtin,  
41 1981).

42 Any discourse may be seen as an intertwining of at least two threads belonging to  
43 dialoguing voices. Even if we consider an essay, a novel or even a scientific paper, discourse  
44 should be considered implying not only the voice of the author. The potential listener has an,  
45 at least, as important role. The author makes a thread of ideas, a narrative. Meanwhile, in  
46 parallel to it, he must take into account the potential flaws of his discourse; he must see it as

1 an utterance that can be argued by the listener. In this idea, discourse is similar to dialog and  
2 to music polyphony (in fact, it should not be a surprise that different art genres like music,  
3 literature and conversation have similar features), where different voices inter-animate.

4 Discursive voices weave sometimes in a polyphonic texture, feature which Mikhail Bakhtin  
5 admired so much in Dostoevsky's novels. They are characterized by Bakhtin as "a plurality of  
6 independent and unmerged voices and consciousnesses" (Bakhtin, 1984).

7 However, polyphony is not only a randomly overlay of voices. It has also musicality; it is  
8 in fact one of the most complex types of musical compositions, exemplified by the complex  
9 contrapuntal fugues of Johann Sebastian Bach. "When there is *more than one independent*  
10 *melodic line happening at the same time* in a piece of music, we say that the music is  
11 contrapuntal. The independent melodic lines are called counterpoint. The music that is made  
12 up of counterpoint can also be called polyphony, or one can say that the music is polyphonic  
13 or speak of the polyphonic texture of the music." (Polyphony, 2005).

14 In polyphonic music, the melodic, linear dimension is not disturbing the differential,  
15 vertical harmony. Moreover, for example, in Bach's fugues, the voices inter-animate each  
16 other. The main theme is introduced by a voice, reformulated by the others, even contradicted  
17 sometimes (e.g. inverted) but all the voices keep a vertical harmony in their diversity.

18 Starting from Bakhtin's ideas, we extend these ideas to collaborative learning. Therefore,  
19 we will further describe how polyphony may arise in collaborative learning and we will  
20 propose ways of supporting it in learning environments.

21 An important question for design and implementation of supporting tools is how we must  
22 consider multiple voices in the context of chat conversations and how this perspective allows  
23 us to enhance the learning process? In any conversation there are several participants, each of  
24 them emitting utterances with his/her own voice. In our perspective, by *voice* we understand  
25 not the physical attributes of a given participant in a dialogue but, rather, *an event of emitting*  
26 *an utterance that becomes a recurrent idea, that is heard, reminded, discussed and have*  
27 *influence on the utterances of the other participants.*

## 28 **THE POLYPHONY OF COLLABORATIVE LEARNING CHATS**

29 Computer and communication technologies offer now new possibilities for collaboration, by  
30 virtualizing classroom group interaction. New types of artifacts, like hypertext, the World  
31 Wide Web, chats or forums of discussions, are changing the classical learning scenarios. In  
32 addition to classical sheets of paper or blackboards for drawing diagrams and writing formulas  
33 and sequences of problem solving steps, computer animations, simulations or even virtual  
34 participants in the dialog (artificial agents) may be used now for collaboration. It is extremely  
35 important to analyze the particularities of discourse in this new context. A good example is  
36 the fact that in chats we can much more easily use a multiple threaded discourse, similar to  
37 contrapuntus in classical music, than in face-to-face conversations.

38 In the next sections, two experiments for computer supported collaborative learning using  
39 chats are presented and analyzed. The first one considers mathematical problem solving in K-  
40 12 and the second analyzes CSCL in human-computer interaction at university level. Both  
41 examples will be used for emphasizing the ideas of polyphonic collaborative learning.

1

## 2 Polyphonic inter-animation in collaborative mathematics problem solving

3 Let us consider the following problem:

4 Three years ago, men made up two out of every three Internet  
 5 users in America. Today the ratio of male to female users is  
 6 about 1 to 1. In that time the number of American females  
 7 using the Internet has grown by 30,000,000, while the number  
 8 of males who use the Internet has grown by 100%. By how much  
 9 has the total internet-user population increased in America  
 10 in the past three years? (A) 50,000,000 (B) 60,000,000 (C)  
 11 80,000,000 (D) 100,000,000 (E) 200,000,000

12 This problem was one of a set of eleven problems that were used for an experiment in  
 13 VMT. A group of students had to solve these problems first individually and after that  
 14 collaboratively, using chat. It was one of the two that were not solved individually by any  
 15 students but it was solved collaboratively.

16 Let us now consider a chat excerpt that includes the main utterances that contributed to the  
 17 finding of the solution (see figure 1).

<p>350 Mic how do we do this..          351 Mic Without knowing the total number          352 Mic of internet users?          ....          357 Dan it all comes from the 30000000          358 Mic did u get something for 10?          359 Dan we already know          360 Mic 30000000 is the number of increase in          american females          361 Mic and since the ratio of male to female          362 Mic is 1 to 1          363 Mic thats all i got to give. Someone finish it          364 Mic Haha          365 Cosi haha you jackass          366 Mic Haha          367 Dan Hahaha          368 Mic u all thought i was gonna figure it out          didn't          369 Mic U          370 Mic huh?          371 Hal it would be 60,000,000          372 Mic Hal          373 Mic its all u          374 Mic See          375 Mic i helped</p>	<p>376 Cosi ok, so what's 11 – just guess on 10          ....          386 Mic lets get back to 5          387 Cosi i think it's more than 60,00000          388 Mic way to complicate things          389 Cosi haha sorry          390 Mic life was good until you said that          391 Mic :(          392 Cosi they cant get higher equally and          even out to a 1 to 1 ratio          393 Cosi oh, no wait, less than that          394 Cosi 50000000          395 Cosi yeah, it's that          396 Cosi im pretty sure          397 Mic Haha          398 Mic how?          399 Cosi because the women pop had to grow          more than the men in order to even out          400 Cosi so the men cant be equal (30)          401 Mic oh wow...          402 Mic i totally skipped the first sentencw e          403 Cosi therefore, the 50,000,000 is the only          workable answer          404 Dan very smart          405 Cosi Damn im good</p>
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18

19

Fig. 1. An excerpt illustrating the collaborative solution construction

20 Discourse begins with Dan’s idea of starting from the 30000000 number specified in the  
 21 problem statement (line 357). It continues with Mic’s problem solving buffoonery (lines 360-  
 22 364, 366 and 368-370), remarked by Cosi (line 365) and Dan (line 367): Mic seems to start  
 23 writing a reasoning but he only fakes, writing fragments of the problem statement linked by a  
 24 typical phrase “... and since ...”. However, this fake discourse fragment seems to belong to a  
 25 mathematics speech genre but it is a pastiche. In this context, Hal continues the dialogue by  
 26 extrapolating the 1:1 ratio from the present (as stated in problem) to the whole 3 years and  
 27 advances 60000000 as a solution (line 371).

28 Mic continues the buffoonery (lines 372-375). After about one minute, Cosi’s (incorrect)  
 29 utterance “i think it's more than 60,00000” appears as a critique or as an intuition of  
 30 something wrong, of some kind of an “unsuccessful story”. Nevertheless, after less than

1 another minute, she realizes that her own supposition is wrong because the ratio cannot be 1:1  
2 or bigger.

3 The collaborative discourse enabled Cosi to solve the problem. She didn't solve it in the  
4 first phase, when they had to solve it individually. However, when she listened to the  
5 discourse proposing a solution (correct in the case of Dan's beginning proposal, fake at Mic  
6 and wrong at Hal), she felt the need to put herself on a different position. Therefore, the  
7 discourse acted as a tool, as an artifact that enabled Cosi to find the correct answer.

8 Discourse in chat collaborative problem solving has an obvious sequential, longitudinal,  
9 time-driven structure in which the listeners are permanently situated and in which they emit  
10 their utterances in a threaded manner. In parallel with this linear threading dimension, the  
11 participants situate themselves meanwhile also on a critical, transversal (or differential)  
12 position. For example, in the excerpt considered in this section, Dan's theme was continued  
13 by Mic's buffoonery, continued itself by Hal and then contradicted by a first theme of Cosi  
14 that was eventually totally changed, in its opposite. We could say that the critique of Cosi  
15 appeared as a need to bring the harmony of a correct solution.

16 In this longitudinal-transversal space, voices behave in an unity-difference manner. This  
17 phenomenon is not specific solely to chats. It appears also to polyphonic music: "The  
18 deconstructivist attack (...) – according to which only the difference between difference and  
19 unity *as an emphatic difference* (and not as a return to unity) can act as the basis of a  
20 differential theory (which dialectic merely claims to be) – is the methodical point of departure  
21 for the distinction between polyphony and non-polyphony." (Mahnkopf, 2002).

22 The unity and difference trends take different shapes in chat problem solving. We can  
23 include in the unity category cumulative talk (Mercer, 2000) or collaborative utterances  
24 (Sacks, 1992):

25  
26 "Joe : (cough) We were in an automobile discussion,  
27 Henry : discussing the psychological motives for  
28 Mel : drag racing on the streets"  
29 (Sacks 1992, pp.144-5)

30  
31 Repetitions play also an important role in creating coherence in a discourse. Tannen (1989)  
32 considers that repetitions may be seen as a kind of rhythm making. The following example  
33 and the repetitions in figure 2 exemplify these ideas:

34  
35 1:21:53 Teacher And you don't have anything like that there?  
36 1:21:56 Steven I don't think so  
37 1:21:57 Jamie Not with **the same** engine  
38 1:21:58 Steven [ No  
39 Jamie [ Not with **the same**  
40 1:21:59 Teacher With the same engine ... but with a different (0.1) ... nose cone?=  
41 1:22:01 Chuck [=the same=  
42 Jamie [=Yeah,  
43 1:22:02 Chuck These are both (0.8) **the same** thing  
44 1:22:04 Teacher Aw [ right  
45 1:22:05 Brent [ This one's different  
46 (Stahl, 2006)

47  
48 Socialization or jokes are also a way of unity making. For example, many times participants in  
49 chats feel the need to joke, probably for establishing a closer relation with the other  
50 participants, in order to establish maybe a group flow state (Csikszentmihalyi, 1990). In fact,

1 in all the chats we examined there is a preliminary socialization phase, inter-animation  
2 appearing not immediately after the beginning of chats.

3 Difference making has a crucial role in chats for collaborative learning, role which may be  
4 best understood from a polyphonic, musical perspective. The possibility of contemplating  
5 (listening), from a critical position, the ideas (melodies) of other peoples and entering into an  
6 argumentation (polyphony of voices), enhance problem solving and enables learning through  
7 a trial-error process. Such processes appear also in individual problem solving (we can say  
8 that thinking is also including multiple inner voices) but the presence of multiple participants  
9 enhance both the possibility of developing multiple threads and, meanwhile, of differences  
10 identification. The inter-animation of the multiple perspectives of the participants, the  
11 opposition as result of contemplation and the presence of a third opinion in case of conflict,  
12 and sometimes the synthesis it brings are a better asset to success than a multi-voiced  
13 discourse performed by an individual (as inner thinking), that is inherently much less critique.  
14 Evidence that participants permanently keep a differential position is also provided by the  
15 statistics of personal pronouns usage in chat sessions. For example, in a corpus of chats  
16 recorded in May 2005, “I” was used 727 times, much more than the usage of “we”, with 472  
17 occurrences. First person “me” was used 84 times comparing to “us”, used only 34 times.  
18 However, the second person addressing is very well represented by 947 uses of “you”.

### 19 **Polyphonic multi-threaded inter-animation**

20 A second experiment was performed with computer-science students in the final year at the  
21 Human-Computer Interaction course in “Politehnica” University of Bucharest. In each group  
22 were four participants, each of them playing the role of a company manager promoting a  
23 collaboration technology in a talk in interaction using an instant messenger (chat) system. The  
24 four collaboration technologies in discussion were chat, blog, wiki, and e-mail forums. The  
25 chat system used in the session was ConcertChat  
26 ([http://www.ipsi.fraunhofer.de/concert/index\\_en.shtml?projects/chat](http://www.ipsi.fraunhofer.de/concert/index_en.shtml?projects/chat)), which allows the  
27 referencing of previous utterances (Holmer, Kienle and Wessner, 2006) and offers also a  
28 whiteboard. The students were encouraged to use the referencing facility as much as they  
29 consider.

30 For illustrating the weaving of several threads in the considered chat fragment and their  
31 inter-animation, we will consider one of the chats in the experiment described above. The  
32 participants were “Catalin.Ionita” (supporter of chats), “Gabi.V” (devotee to blogs),  
33 “irina\_chirita” (fan of wikis), and “Irina.Bulciu” (adherent to e-mail forums). In order to  
34 support their technologies, each of the participants (without being told to do so), chose some  
35 arguments: information sharing, the need to synchronize meetings and the role of the  
36 technology in problem solving.

37 Each of the four participants may be considered as a distinct voice, which speaks for the  
38 technology they adhere to. Each participant utters new themes by emitting a key word, or  
39 iterates an already uttered theme, using his/her own voice (that means from the perspective of  
40 his/her technology) in relation to the theme’s key word. For example, Catalin introduces the  
41 theme of information sharing (the key word “information” being surrounded by rectangles in  
42 figure 2) from his chat perspective. This theme is considered by irina\_chirita followed by  
43 Irina.Bulciu and again Catalin. The same happens with the problem solving facilitation theme  
44 (ovals in figure 2): It is introduced by Gabi, followed by irina\_chirita, Catalin, Irina.Bulciu  
45 and again Gabi. The third theme illustrated in our example, the synchronization constraints  
46 (circles in figure 2) is introduced by Gabi and continued by the two Irinas.

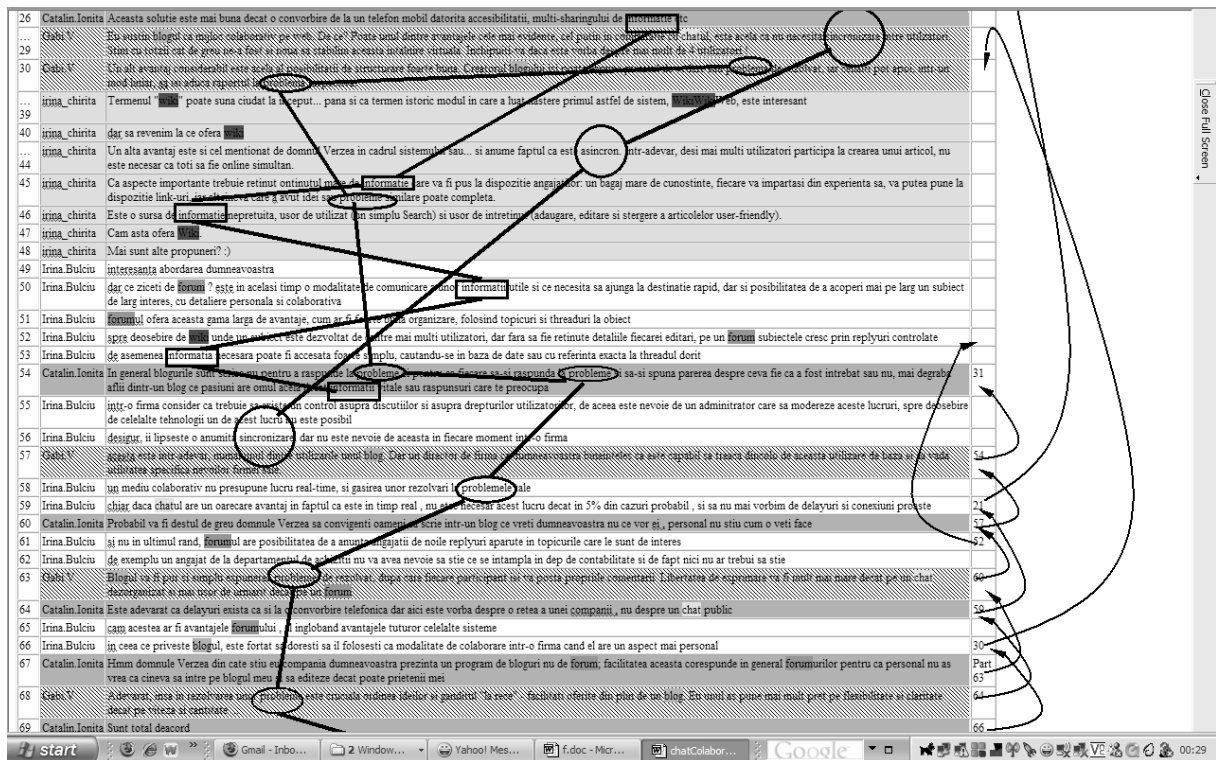


Fig.2. Two types of threads in the chat

As it may be seen, in figure 2 are two types of threads. A first type includes the above-mentioned, implicit chains of semantically related arguments, centered on key words, which may be seen as themes. The second type of threading (represented by rounded arrows in the right part of figure 2) is explicitly marked by the chat participants using ConcerChat's referencing facility. What is interesting is that this second type of links is generally not corresponding to the first one.

In figure 3 is represented the participation of the four voices (students) in the development of above three threads. Time flows from left to right and the same representation of the themes (rectangles, ovals and circles) is kept. In addition to the sequential dimension of themes development, in the same figure are represented also (by thick arrows) two interactions between themes, which may be considered as a transversal interaction between themes.

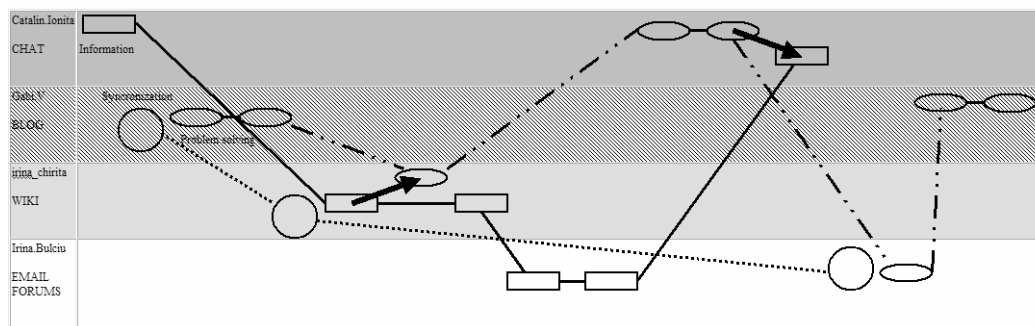


Fig.3. Two types of threads in the chat

According to Bakhtin's perspective, we may consider that the themes, during their development, are filled with the overtones of the voices of the contributors. In addition to their sequential intertwining, voices interact transversally, they inter-animate, the themes weaving like in a musical polyphonic contrapuntus.

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For using the identification of voices in CSCL chat conversations, Computational Linguistics is needed. Linguists consider discourse, as a structure beyond sentence level. Starting from Bakhtin’s perspective, discourse may be considered from a novel perspective, as a inter-animation of a community of voices. Therefore, in our approach, we identify chat topics followed by an analysis of the voices and their influences. This analysis permits to compute the strength of any utterance: An utterance is powerful if it is including many influent voices. Graphical representations are used for visualization and assessment of CSCL sessions.

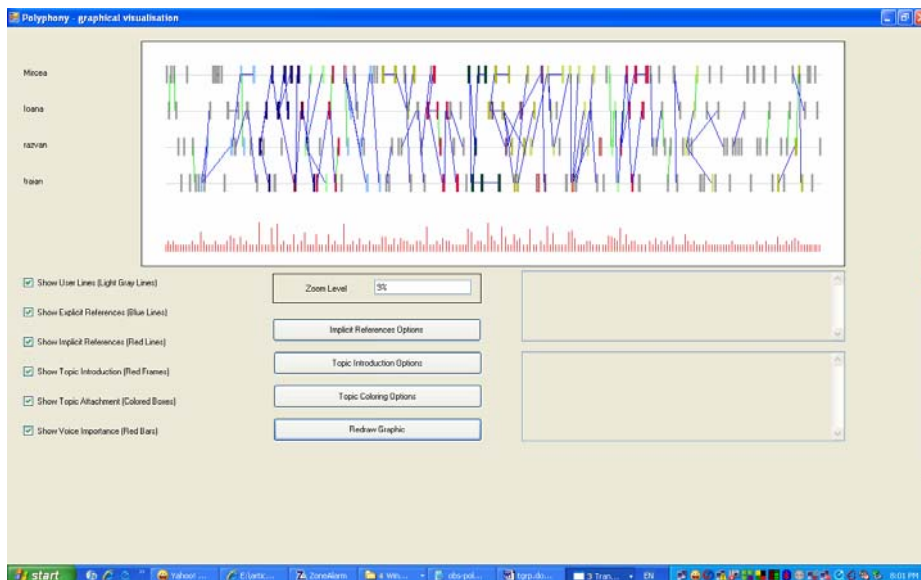
## 10 A GRAPHICAL REPRESENTATION OF THE CONVERSATION THREADS

11 A graphical representation of chats was designed to facilitate an analysis based on the polyphony theory of Bakhtin and to permit the best visualization of the conversation. For each participant in the chat, there is a separate horizontal line in the representation and each utterance is placed in the line corresponding to the issuer of that utterance, taking into account its positioning in the original chat file – using the timeline as an horizontal axis (see figures 12 4,5,7,8,9). Each utterance is represented as a rectangular node having a horizontal length 13 proportional with the textual length of the utterance. The distance between two different 14 utterances is proportional with the time passed between the utterances (Trausan-Matu et al., 15 2007).

16 The explicit references between utterances, indicated by the user through the ConcertChat 17 environment are depicted using blue connecting lines, while the implicit references, (deduced 18 using the method described in Trausan-Matu et al., 2007) are represented using green lines.

19 The graphical representation of the chat has a scaling factor that permits an overview of the 20 chat, as in figure 4, as well as an attentive observation of the details in a conversation (as in 21 figure 7).

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**Figure 4.** A conversation with equilibrated participation

Viewing the whole conversation graph gives an idea of the global participation of the learners. For example, in figure 4, all the participants have an equilibrated contribution. This



1 is not the case in figure 5, where one participant has almost no participation; another student  
2 leaves earlier the chat session.  
3



4  
5 **Figure 5.** A conversation with a non-equilibrated participation

6 At the bottom of the graphical representation of the conversation, after the line  
7 corresponding to the last participant in the chat, there is a special area that represents the  
8 importance of each utterance, considered as a chat voice, in the conversation (Trausan-Matu et  
9 al., 2007).

## 10 **Discovering the implicit voices in an utterance**

11 We consider that each chat utterance is a potential chat voice that may have a certain  
12 influence in the development of the conversation. Obviously, each utterance may contain  
13 more than a single voice, as it may include, in addition to the current voice and probably at  
14 least one other, alien voice, to whom it refers, as an answer to a question, an elaboration, a  
15 disagreement, etc. By transitivity, voices may accumulate during a conversation. The emitter  
16 of the utterance implicitly can note the presence of alien voices in an utterance, when he  
17 explicitly refers a previous utterance by the ConcertChat referencing facility.

18 Nevertheless, because users are seldom in a hurry or simply not attentive enough, part of  
19 the utterances do not have any explicit references. Thus, it is necessary to find a method for  
20 discovering the implicit references in an utterance; in this way, identifying more relationships  
21 between the utterances in the chat. The method proposed in (Trausan-Matu et al., 2007) is  
22 similar to the one used by us for determining the introduction of new chat topics, based on  
23 text mining techniques (Manning & Schutze, 1999) and patterns.

## 24 **Determining the influence of a voice**

25 An utterance that constitutes a voice is considered strong if it influences the future of the  
26 conversation. Therefore, the strength of an utterance depends on the strength of the utterances  
27 that refer to it. If an utterance is referenced by other utterances that are considered important,  
28 obviously that utterance also becomes important.

1 By using this method of computing their importance, the utterances that have started an  
 2 important conversation within the chat, as well as those which begin new topics or mark the  
 3 passage between topics, are more easily emphasized. If the explicit relationships were always  
 4 used and the implicit ones could be correctly determined in as high a number as possible, then  
 5 this method of calculating the importance of a voice would be successful (Trausan-Matu et al.,  
 6 2007).

## 7 An example of a collaboration moment

8 In figure 6, a fragment of a chat transcript is presented (time and day colons were omitted, as  
 9 well as the texts in the references). This fragment contains a sequence of utterances where the  
 10 participants collaborate intensively (it may be considered as a “collaboration moment” - Stahl,  
 11 2006), fact revealed from the relations graph (figures 7-9) and from the big number of explicit  
 12 and implicit relations between utterances 122 and 136.  
 13

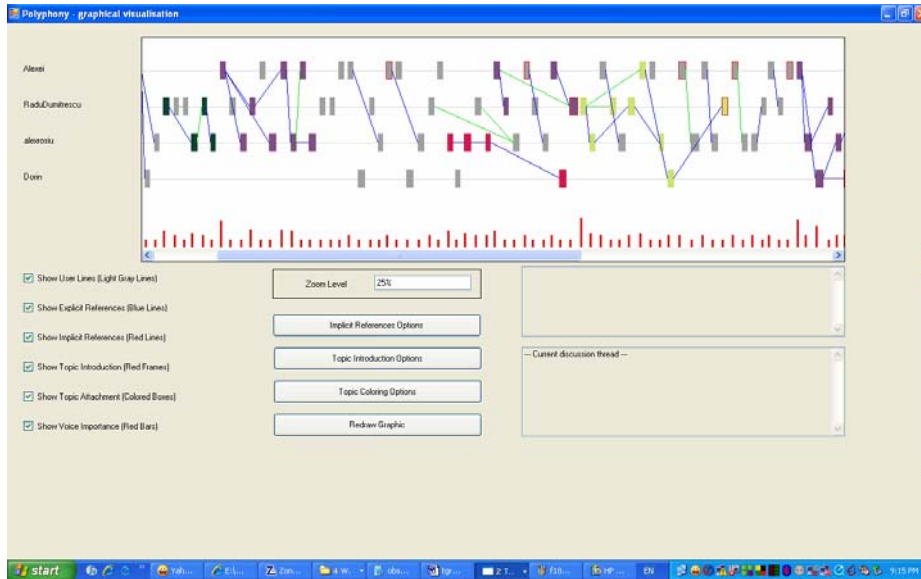
122	RaduDumitrescu	also the application allows the user to describe the topic of the meeting	
123	Alexrosiu	yes, and furthermore, several topics should be defined	Reference to message No. 122
124	Alexei	yes, that would also help an automatic application to parse the chat	Reference to part of the message No: 122
125	RaduDumitrescu	so everybody must know what are the meeting is all about	
126	Alexrosiu	maybe even some users could be waned if they are offtopic... but this is a rather sci-fi feature, i guess :)	Reference to message No. 124
127	RaduDumitrescu	and at the end the application should specify if all the topics were covered.... what do you think?	Reference to message No. 123
128	Alexei	yes, i agree, but I think it can be done if the user is going too "offtopic"	Reference to part of the message No: 126
129	Alexei	yes, maybe some percentage of coverage...	Reference to part of the message No: 127
130	Alexrosiu	Correct	Reference to message No. 127
131	Dorin	this feature implies a rather advanced natural language processing engine, though	Reference to message No. 128
132	Alexei	so, about the reminders - when a user leaves the conference for some reason, he should be reminded about the missed parts of the conversion	Reference to part of the message No: 121
133	Alexrosiu	maybe some kind of reminders should be set for future conferences... meaning that all people invited to the conference should be reminded to attend	
134	Alexei	a problem that i've also noticed here is the rather unsynchronized way of talking	
135	Alexrosiu	well, this would be solved by using the tree view i was talking about earlier	Reference to message No. 134
136	RaduDumitrescu	i think the users can check the topics, no need for natural language processing	Reference to message No. 131

14 **Figure 1** A fragment of a chat transcript

15 In figure 8, the explicit (from the ConcertChat facility) and implicit (shown also separately  
 16 in figure 9) relations are shown as graphical representation.

17 From the figure 7, we can see that the voice of RaduDumitrescu at the utterance nr. 122  
 18 (see also figure 8) has a high strength (an oval shadow was manually added in figure 8 for  
 19 emphasizing it). This fact is also observable by the large number of relations following  
 20 utterance 122 (see figures 7-9).

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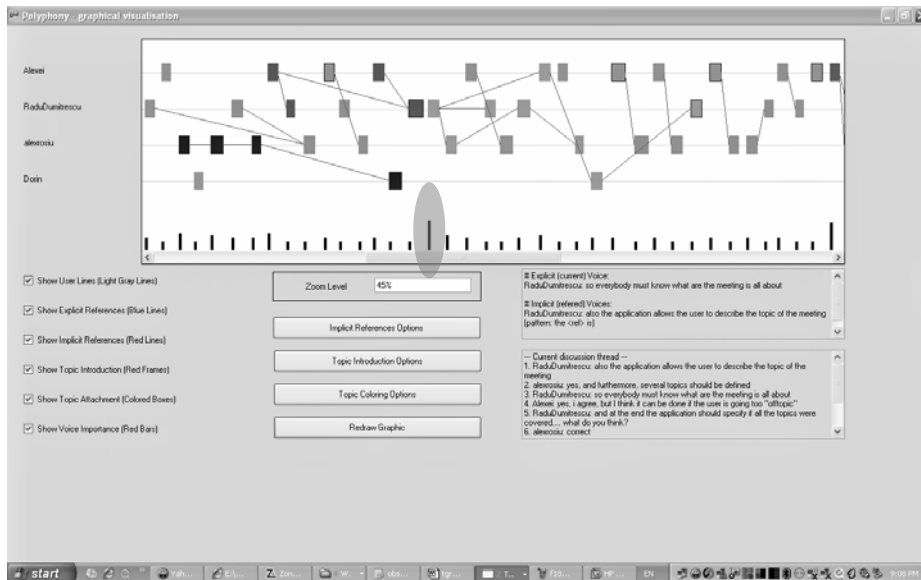


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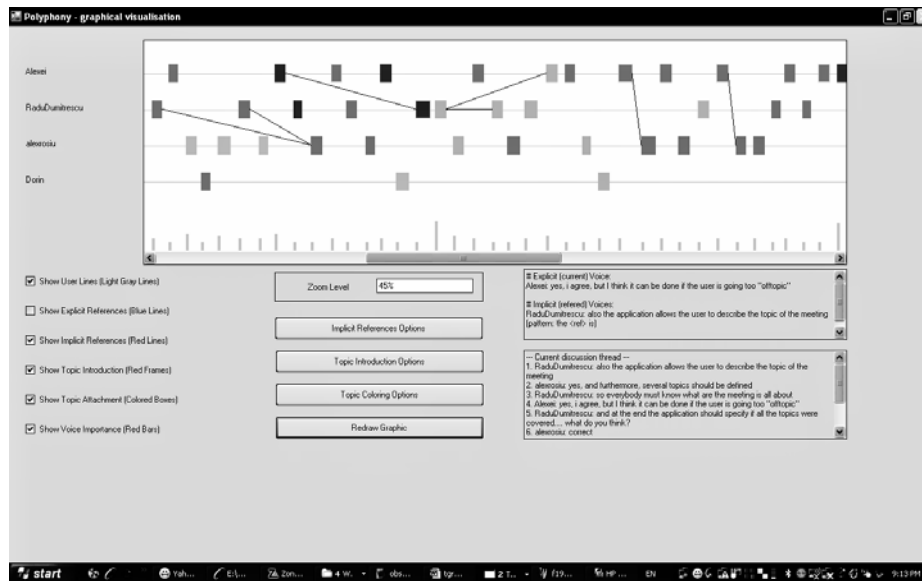
Figure 2 Utterances 122-136 are linked with many relations



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Figure 3. Explicit and implicit relations



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2

**Figure 4.** Implicit relations

### 3 CONCLUSIONS

4 Discourse in chats implies an inter-animation of multiple voices along two dimensions, the  
5 sequential, utterance threading and the transversal, differential one. These two dimensions  
6 correspond to a unity-difference (or centrifugal-centripetal, Bakhtin, 1981) basic feature of  
7 polyphony. The unity directed dimension is achieved at diverse discourse levels by  
8 repetitions, collaborative utterances, socializing and negotiation discourse segments.

9 The second, differential dimension could be better understood if we consider discourse as  
10 an artifact that, taking into account that every participant in collaborative activities has a  
11 distinct personality, is a source of a critical, differential attitude. Even if individual, inner  
12 discourse may be multi-voiced, difference and critique are empowered in collaborative  
13 contexts, in a community of different personalities.

14 A consequence of the sequential-differential perspective for the design of CSCL  
15 environments is that they must facilitate inter-animation not only on the longitudinal  
16 dimension, through threading but also the transversal, differential, critical dimension. Tools  
17 that may enter in this category should be able to provide abstractions or summarizations of  
18 previous discourse, in order to facilitate differential position taking. They should also allow  
19 the participants to emphasize the different proposed themes and to relate them in threads,  
20 polyphonically.

21 Wegerif also advocates the use of a dialogic framework for teaching thinking skills by  
22 inter-animation: “meaning-making requires the inter-animation of more than one perspective“  
23 (Wegerif, 2005). He proposes also that questions like “‘what do you think?’ and ‘why do you  
24 think that ?’ in the right place can have a profound effect on learning” (Wegerif, 2005).  
25 However, he did not remark the polyphonic feature of inter-animation.

26 The paper presents also an application that visualizes the influences of the voices of the  
27 participants on chat conversations, following Bakhtin’s ideas. Diagrammatic representations  
28 are used for viewing the influence of a given speaker’s voice and of the comparative evolution  
29 of the contribution of the learners.

30 The application may be used for inspecting what is going on and in what degree learners are  
31 implied in a forum discussion or a chat conversation. Moreover, the contribution of each

1 participant may be measured, that means that learners may be assessed in collaborative  
2 learning on the web.

3 The visualization application described here will be extended to consider more aspects  
4 related to the polyphonic, contrapuntal features of chat conversations.

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