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# R-U-Typing-2-Me? Evolving a Chat Tool to Increase Understanding in Learning Activities

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**Abstract** Very often, when using a chat tool where more than one participant is talking simultaneously, it is difficult to follow the conversation, read all the different messages and work out who is talking to whom about what. This problem has been dubbed "Chat Confusion." This article investigates this problem in debate sessions in an online university course. Chat Confusion has been singled out as the main limitation to using chat in educational activities. Confusion needs to be reduced for understanding to increase, making it easier to track what is being discussed during a learning activity. This study investigated the phenomena responsible for causing this confusion. A version of the Mediated Chat tool was developed for each problem identified and was subsequently tested in online courses. This article describes the Mediated Chat development process, the problems identified, and the results obtained from the experiments.

Q2 **Keywords**

## Introduction

Chat tools have achieved widespread popularity and are increasingly used in activities that extend beyond socialization and recreation. The research project presented in this article investigated the development of a chat tool for hosting educational debates. We take an iterative, design-based approach to developing

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educational software: introducing a new software feature, trying it out in a naturalistic setting, analyzing the resulting interactions and then redesigning the technology for a next iteration (Collins, Joseph, & Bielaczyc, 2004).

Chat tools can be found in many collaborative learning environments. Collaborative learning relies on successful communication that occurs when collaborators understand each other's contributions (Mühlpfordt & Wessner, 2005; Lonchamp, 2005). However, in a chat session with various participants talking at the same time, situations occur that prevent the conversation from being followed with ease. This problem has been dubbed "Chat Confusion" (Pimentel, Fuks, & Lucena, 2003; Thirunarayanan, 2000) and is referred to in the literature as "chaotic flow of conversation," "interactional incoherence" or "lack of coherence and mutual understanding" (O'Neill & Martin, 2003; Cornelius & Boos, 2003; Herring, 1999; McGrath, 1990).

The aim of this research is to identify the source of the problems of Chat Confusion and the mechanisms that can be implemented to prevent these problems from taking place. To achieve this objective, chat tools are analyzed on the basis of information found in the literature on groupware. Chat Confusion is investigated during the use of the Mediated Chat tool to hold debates in an online course. The article presents the versions of Mediated Chat that were developed to lessen identified Chat Confusion problems.



## Chat Tools

Chat tools are analyzed in this section based on groupware literature. The following topics are discussed: the 3C Collaboration Model, the differences between chat tools and other types of synchronous communication tools, and the analysis and classification of the main elements based on the 3C Model.

### Groupware and the 3C Collaboration Model

The term *groupware*, coined by Johnson-Lentz and Johnson-Lentz (1982), refers to computer applications designed to support collaborative work. Developing groupware requires an understanding of collaboration. Collaboration, from the Latin *co* [together] + *labore* [labour] + *action*, means the action of working together, the accomplishment of common tasks undertaken by two or more people. Collaboration has been investigated in this research based on the 3C Model, which highlights that a group has to establish adequate communication, coordination and cooperation in order to collaborate.

Communication, *communicare* [to make common] + *action*, means the action of making common, to exchange messages for the purpose of mutual understanding, to converse, to dialogue. During collaboration, members of a group normally communicate towards action: they negotiate, make decisions and reach agreements (Winograd, 1989). A group contains people with different viewpoints who can supplement individual understanding (Gerosa, Pimentel, Fuks, & Lucena, 2005).

Coordination, *co* [together] + *ordinare* [order] + *action*, means the action of disposing of something according to a particular order and method, to organize, to arrange. The coordination of collaborative work aims at organizing the members of

the group so that the agreements reached through negotiations are realized in the right order and timescale, reaching their objectives within their anticipated limitations. It also aims at ensuring that the effort put into communication and cooperation is not wasted (Raposo, Pimentel, Gerosa, Fuks, & Lucena, 2004).

Cooperation, *co* + *operare* [operate] + *action*, means the action of operating together. Members of the group act in conjunction on shared objects within a shared space to perform tasks defined and organized during coordination. In cooperating, individuals need to communicate to renegotiate and make decisions on unforeseen situations, reinitiating the cycle of collaboration.

The 3C Collaboration Model, originally proposed by Ellis, Gibbs, and Rein (1991), has been used to analyze, classify, and develop groupware (Ellis, 2000; Baker, Greenberg, & Gutwin, 2001; Laurillau & Nigay, 2002). Groupware applications can be classified according to the degree of support given to communication, coordination and cooperation, as can be seen in the triangle illustrated in Fig. 1 (Borghoff & Schlichter, 2000; Teufel, Sauter, Mühlherr, & Bauknecht, 1995).

As shown in Fig. 1, the applications closest to the communication vertex are classified as Communication Tools—applications that aim at establishing the exchange of messages among members of a group with a view to argumentation, negotiation, decision making, etc.

## Chat and Other Synchronous Communication Tools

Communication tools can be organized into two large groups according to the time in which communication is established: synchronous, when the sent message is received instantly; and asynchronous, when the sent message is received at a later moment (DeSanctis & Gallupe, 1987). Lately, the expression "quasi-synchronous," coined by Garcia and Jacobs (1999), has been used to distinguish 'true' synchronous dialogue, such as face-to-face conversation, and full-duplex phone conversation and



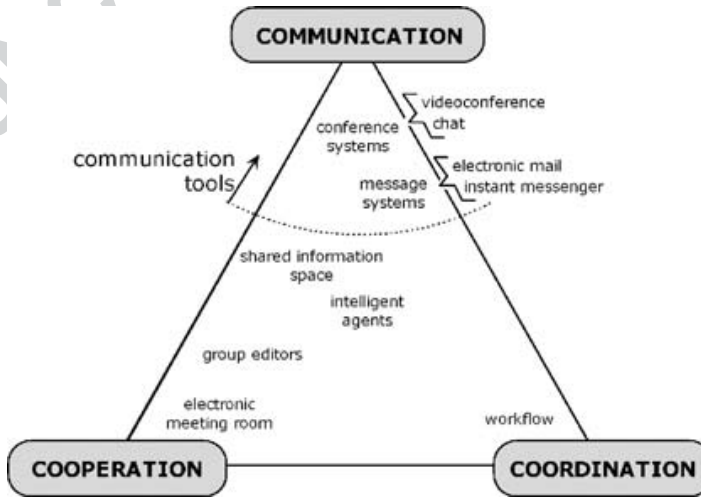


**Fig. 1** Classification of groupware applications according to the 3C Collaboration Model (based on Borghoff & Schlichter, 2000; Teufel et al., 1995)

videoconference from typed-text conversations, such as chat and instant messaging (Zemel, 2005; O'Neill & Martin, 2003). For the remainder of this text, synchronous stands for both: synchronous and quasi-synchronous.

Synchronous communication tools can be organized into four main classes, which are listed with examples in Table 1.

Chat is a synchronous communication tool in which some participants are grouped together in order to exchange textual messages (although some tools enable text formatting, including small images and even the addition of sound effects to the messages). IRC (Internet Relay Chat), developed in 1988, was the first chat system on the Internet and became a standard communication protocol (Oikarine, 1993). Chat tools were adapted for the Web, called web-chats, and quickly grew in popularity as they became available on countless sites.

Messenger programs are tools used to exchange messages that are also usually text-based, but in contrast to chat tools, they aim at enabling communication between just two people (one-to-one). ICQ, created in 1996, was one of the first messenger programs to gain widespread popularity.

Videoconferencing enables the transmission of audio and video between several people at the same time (all-to-all). Given the increasing processing capacity of personal computers, the integration of multimedia resources, cheaper videoconferencing equipment, and the expansion of broadband services, computer-based videoconferencing systems are becoming increasingly used—CU-SeeMe was one of the first videoconferencing products to become popular.

Graphical-chat is a tool in which each participant uses an avatar to interact in a virtual world. There are a few ways of graphically representing a participant, ranging from the circle as used in Chat Circles (Viegas & Donath, 1999) to the use of virtual reality as used in Body Chat (Vilhjálmsson, 2003; Vilhjálmsson & Cassell, 1998).

Although this definition of classes of communication tools helps in analysis and characterization, the borders between classes are becoming ever more blurred. For example, ICQ, a synchronous communication tool, also establishes asynchronous



**Table 1** Classes and examples of synchronous communication tools

| | |
|---|---|
| **Chat** | mIRC (http://www.mirc.com) |
| text-based all-to-all communication | WebChats |
| **Messenger** | ICQ (http://www.icq.com) |
| text based one-to-one communication | MSN Messanger (http://messenger.msn.com) |
| | Yahoo!Messenger (http://messenger.yahoo.com) |
| **Videoconference** | CUSeeMe (http://www.cuworld.com) |
| video and audio based communication | iSpQ (http://www.ispq.com) |
| | PalTalk (http://www.paltalk.com) |
| | Skype (http://www.skype.com) |
| **Graphical-Chat** | Chat Circles (http://chatcircles.media.mit.edu) |
| participant represented by an avatar | Hannes Vilhjálmsson Projects (http://www.isi.edu/~hannes), for instance, Situated Chat (http://www.media.mit.edu/gnl/projects/situchat) |
| | Comic Chat (http://www.comic-chat.com) |
| | Sulake communities (http://www.sulake.com), for instance, Habbo Hotel (http://www.habbohotel.com) |

communication because it enables messages to be sent to disconnected participants (the messages are delivered when the participant next logs on). The main messenger programs establish communication between various participants, meaning they also function as a chat tool. Likewise, they also establish communication via video and audio, meaning they function as videoconference tools.

Communication tools are now being adapted to perform specific activities. For example, some sites (especially those associated with specific television programs) possess chat tools for carrying out interviews. In this article, the adaptation of chat programs to host educational debates is discussed.

## 3C Elements of Synchronous Communication Tools

Analyzing a typical chat tool (Fig. 2), three main components can be identified: an area used to type the message, enabling the user to communicate with other participants (a Communication support); a list of participants, indicating who is connected and available for conversation (a Coordination support); and an area presenting a record of sent messages (a Cooperation support).

Despite the fact that it contains coordination and cooperation elements, the chat tool is classified as a communication tool because its main objective is to allow the exchange of messages among the members of a group. Coordination and cooperation elements are used to organize and register the communication.



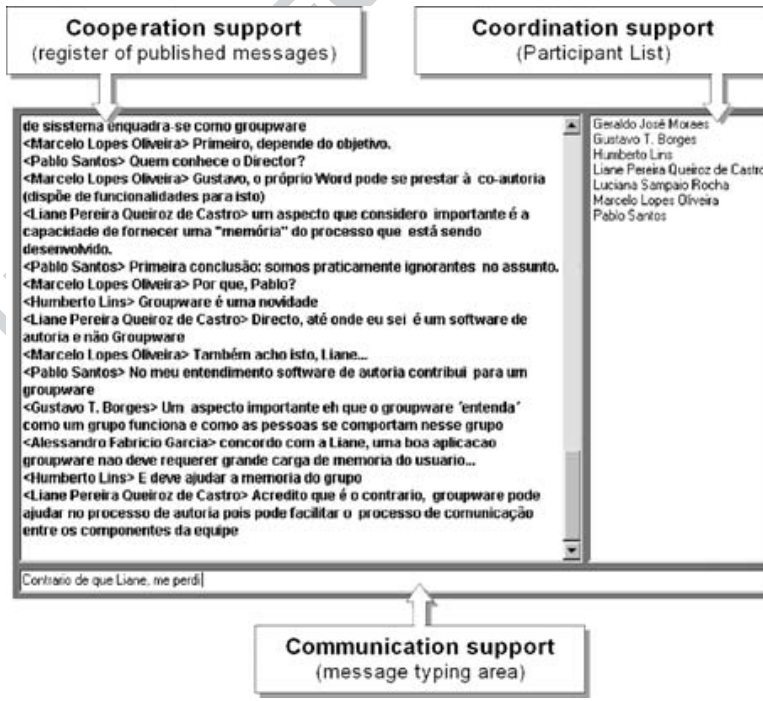


**Fig. 2** Typical chat tool interface

Following this type of analysis, Table 2 presents a framework of the main communication, coordination, and cooperation elements identified in synchronous communication tools.

The framework presented in Table 2 is based on analysis of some synchronous communication tools, primarily those listed in Table 1. The aim is not to provide an exhaustive survey but to produce a catalog of the main elements, mapped in the 3C dimensions, for use in the analysis and design of new tools. The use of this framework is exemplified in the development of the Mediated Chat that is discussed below.

**Table 2** 3C Framework of the main elements of synchronous communication tools

| | | |
|---|---|---|
| **Communication** | Language | Languages generally used to establish communication: textual, spoken (audio), pictographic (images and animations) and gestures (video and avatars). |
| | Transmission | Message transmission is intermittent (after the sender formulates the entire message) or continuous (continuous transmission of video and audio, or character-by-character as the message is being formulated). |
| | Size and Quality | Restrictions on the size of the message limiting the quantity of characters (text) or the message's duration in seconds (video and audio). Video and audio quality is reduced for transmission in the Internet. |
| | Dialogue structure | A linear dialogue structure is usually adopted in synchronous communication tools: one message presented after the other in chronological order. Other forms of structuring the discussion: hierarchical (tree, threads) or in network (graph, maps). |
| | Categorization | Labels for characterizing the messages, such as: type of speech (whisper, speech, cry, question, reply, agree, disagree etc.); type of discourse (direct or indirect), type of emotion (happy, normal, angry) etc. |
| **Coordination** | Topic | Topic to be discussed |
| | Session | Length of time for duration of chat |
| | Access | Who and how many people can take part in the chat |
| | Availability | Availability of participant: connected, absent, busy, etc. |
| | Roles | Definition and attribution of roles: Operator, Mediator, Moderator etc. |
| | Turn to speak | Who can speak at a given moment |
| | Message frequency | Limit to the quantity of messages in an interval of time |
| | Message visibility | Public (visible to all participants) or private (restricted to two participants) |
| | Addressing | Indication of message recipient |
| | Indication of turn-in-progress | Information that the participant is formulating the message (before its transmission as one block) |
| | Evaluation | Qualification of messages, participants or session |
| **Cooperation** | Session record | Storage, recovery and display of published messages |
| | Pre-formulated messages | Messages that are pre-formed and shared by participants to be exchanged during the conversation |

## Chat Confusion

Chat Confusion is the problem that occurs in situations where it becomes difficult to follow the conversation—with various participants conversing at the same time, it is often difficult to identify who is talking to whom about what. In this research, the occurrence of Chat Confusion during debate sessions that were part of a university-level distance-education course was investigated using the Mediated Chat tool from the AulaNet learningware.

### Mediated Chat of the Debate Service of the AulaNet Environment

Q3 AulaNet (Filippo, Fuks, & Lucena, 2005; Lucena et al., 1998) is an environment based on a groupware approach for teaching/learning on the Web that has been being developed and redeveloped since June 1997 by the Software Engineering Laboratory of the Catholic University of Rio de Janeiro (PUC-Rio). The AulaNet environment is freely available in Portuguese, English, and Spanish versions at http://groupware.les.inf.puc-rio.br.

AulaNet provides services to be selected and configured by the teaching staff when setting up the course and can be accessed by students via remote control. These services are classified according to the 3C Collaboration Model (Fuks, Raposo, Gerosa & Lucena, 2005; Gerosa Pimentel, Raposo, Fuks, & Lucena, 2005). The communication services provided by AulaNet include the Debate service, which contains the Mediated Chat tool shown in Fig. 2.

In this research, the occurrence of the Chat Confusion is investigated in the debate sessions of the online course described below.

### Educational Debates During the ITAE Course

The AulaNet development team offers the Information Technology Applied to Education (ITAE) course (Fuks, Gerosa, & Lucena, 2002). The course is run by the Computer Science Department of PUC-Rio, and has been conducted online since 1998.2 (second semester of 1998). The course provides a real environment for carrying out investigations relating to AulaNet's development. On average, 12 learners take part on the ITAE course (undergraduate and postgraduate students) along with two or three mediators (AulaNet researchers and lecturers).

The ITAE course is organized into two stages: in the first, learners study and discuss course topics; in the second, the learners, organized into small groups, build new contents for the course.

In the first stage of the course, a topic is studied and discussed each week. The learners must read the available content for each topic on the Lesson service and then carry out their own deeper research. They then take part in an asynchronous, 50-hour seminar held by the Conferences service, where three specific questions on the topic under study are discussed. The week of studying the topic concludes with the learners participating in a synchronous one-hour debate using AulaNet's Debate service.

During course debates, a learner pre-selected by the mediators performs the role of moderator, assuming co-responsibility for coordinating the debate sessions. The moderator has the task of ensuring the debate dynamics, proposing topics for

discussion, coordinating participants, maintaining order, and ensuring that the pace of debate is neither too fast nor monotonous.

## Chat Confusion in the Educational Debates

Over the six years (12 semesters from the first semester of 2000 to the second semester of 2005) in which the Mediated Chat tool has been used to hold debates in the ITAE course, participants frequently demonstrate their enthusiasm for this "different and interesting" activity, although they also often find the conversation to be confusing. It is interesting to note the terms used by participants to describe the problem: "confusion," "a mess," "turmoil," "babble," "chaos," "pandemonium," "a frenzy," "an uproar," and so on (the texts transcribed in this article were originally produced in Portuguese and translated into English—the originals can be obtained from the authors).

Interviews were conducted with learners from the 2002.1 ITAE course in order to identify the potential and limitations of using the chat tool as an educational resource. Potential educational uses of the chat tool (Werry, 1996; Baron, 1984) were identified by realizing that the informal conversation enabled by this kind of tool afforded learners a clearer perception of themselves and others as belonging to the group. The tool also provides a space for exhibiting emotions, which lessens the feelings of depersonalization and isolation typical of distance learning courses. The debates also allow new educational models to be explored in a space with a high degree of dialogue, the absence of expositive content and the de-characterization of the teacher as a repository of knowledge. These are the features that, for many learners, make the debates the course's most interesting activity. The continuous and integrated use of chat tools in educational activities is a way of keeping learners motivated and engaged, thereby ensuring the successful continuation of distance learning courses.

When asked about problems encountered in the debates, all interviewed learners mentioned Chat Confusion. The main factors pointed out by interviewees for the sources of this confusion were: the large number of posted messages and continuous screen scrolling, which made it difficult to read all of the messages; the excessive number of learners and mediators (an average of 19 people were involved in each debate); and parallel conversations mixing up messages on different topics and leading to participants "missing plot lines." Learners stated that the confusion meant extra attention was needed to follow the debates and, more negatively, declared that they felt disorientated, anguished, anxious, and tired.

Learners also reported developing strategies to follow the debate, such as: focusing on messages sent by the moderator and mediators, by oneself, and by preferred interlocutors; trying to focus on one subject at a time; and trying not to repeat what others had already said, etc. The use of these strategies shows that, over time, participants acquire experience and improve their participation, making it possible to navigate, and somehow tolerate, the confusion. It seems that, in the literature, Chat Confusion is overrated, given that in many papers it is not taken into account that participants are aware of the potential for misunderstandings and therefore develop strategies to manage turns and threads, thereby producing a coherent conversation. Participants actively adapt their communication behavior to

avoid being the passive victims of technology (Cornelius & Boos, 2003; O'Neill & Martin, 2000; Herring, 1999).

On the other hand, having to actively adapt to the technology demonstrates that there is extra participant effort that could be avoided if the confusion had not occurred in the first place. Rather than requiring participants to develop strategies to deal with Chat Confusion, ideally the problem shouldn't be there in the first place. Participants should feel excited and interested without also feeling disorientated, anguished, anxious, and tired.

This research seeks to identify the phenomena responsible for generating Chat Confusion, which was identified as the main limitation to the educational use of chat tools. After a problem is identified, its causes and consequences are investigated and a mechanism is implemented in the Mediated Chat tool in order to reduce the occurrence of the problem. The new version of the tool is then used in the ITAE course debates in order to determine whether the proposed mechanism alleviates the identified problem. Each new version generates a deeper insight into confusion and the design of chat tools.



## Mediated Chat Versions

The following subsections present the successive versions of the Mediated Chat tool developed to avoid problems related to Chat Confusion. The description for each version includes the problem identified, the solution proposed, the mechanism implemented, the analysis of the results obtained from a conducted case study, and the conclusion for each version.

### "Hello, Anybody There? :-)" Mediated Chat 1.0: Communication Channels Framework

In AulaNet version 1.0, the Debate service used a commercial tool. From AulaNet 2.0 onwards, Mediated Chat version 1.0, shown in Fig. 2, was developed and distributed. This first version is a typical chat tool that was not developed to solve any problems related to Chat Confusion. Then, the objective was to produce a computational structure capable of supporting synchronous exchange of text messages among participants in an AulaNet-hosted course. The developed structure was titled "Communication Channels Framework" (Ferraz, 2000).

### "I'm Lost, What are you Talking About?" HyperDialog: Conversation Threading to Avoid Co-Text Loss

Co-text Loss occurs when a participant is unable to establish the thread of the conversation; when a participant is unable to identify the earlier message to which a particular message is responding. "Co-text" designates surrounding text written before or after a statement, and provides elements towards understanding it. It differs from "context," which designates textual and extra-textual factors, such as the situation in which the text is produced or the reader's presuppositions (Crystal, 1985).

Message 31 of the debate excerpt transcribed in Text 1 exemplifies this problem: the participant Humberto declares that he has lost the thread of the conversation as he does not understand what Liane is counter-arguing (in the texts transcribed in this article, the original names of the participants have been replaced by pseudonyms).

Text 1. Co-text loss manifested in message 31, debate 1, ITAE 2000.1. This debate involved 9 participants who produced 289 messages (sequentially ordered).

In the example shown in Text 2, Liane's declaration in message 166—"I agree"—could be in response to a number of previous messages. Marcelo is unable to work out the thread and expresses his loss of co-text in the following message.

Text 2. Co-text loss manifested in message 167(ITAE 2000.1, debate 1, 9 participants, 289 messages)

By tallying these situations, an estimate for the frequency of the problem can be obtained. Figure 4a presents the frequency of co-text loss situations manifested in the debates on two ITAE course editions (not every loss of co-text is manifested textually; the manifestations serve as indicators of a cognitive phenomenon that are presumed to occur much more frequently).

This research into co-text loss is based on hypertext literature. The identification of the problem and the design of the solution were inspired by the analogy between the non-linearity of a chat session and the non-linearity of a hypertext and the related "Lost in hyperspace" problem (Conklin, 1988). Analyzing the organization of the conversation in the debates of the ITAE 2000.1 edition, where Mediated Chat version 1.0 was used, it was found that the text resulting from these sessions is predominantly non-linear: only 20% of messages refer to the immediately preceding message and, on average, the messages continue a conversation with a message located 5 or 6 positions earlier. The topics are also not discussed linearly, since the subjects are discussed in parallel, tackled alternately in the sequence of messages with topical confluence taking place (Pimentel et al., 2003). The low level of linearity in the chat session was identified as one of the main causes of Co-text Loss.

In order to reduce the problem of Co-text Loss, the HyperDialog tool was developed (Pimentel, 2002), (Fig. 3). In this tool, before sending a new message, the user explicitly tags the message to which he or she is replying, producing a hierarchical structure to the discourse. Hypothetically, this mechanism should avoid Co-text Loss as it enables the linear sequence of the message threading to be visualized and recovered.

In the case study conducted in 2001.1, the HyperDialog tool failed to lessen Co-text Loss, as Fig. 4b shows. In part, losses continued to occur because participants committed too many mistakes in establishing the thread between messages (7.5% of messages were either not threaded or wrongly threaded).

Although message threading has the potential to solve the problem of Co-text Loss, the mechanism implemented in the HyperDialog tool introduces new problems in the group's communication, coordination, and cooperation. In terms of communication, the conversation becomes unsuitably more formal, since the

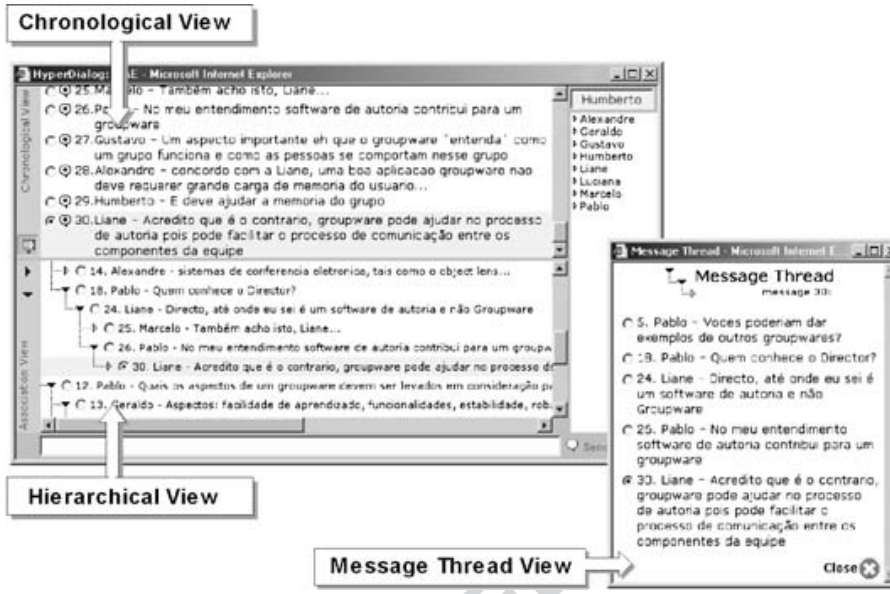


**Fig. 3** HyperDialog and message threading

participant has to make explicit the message to which he or she is replying. In terms of coordination, the message tree disperses the focus of the participants along different conversational branches, making coordination of the debate even more difficult. And in terms of cooperation, the display of messages in two main views (chronological and associative) and the recovery of the message's thread in a separate window make the HyperDialog interface much more complex, introducing

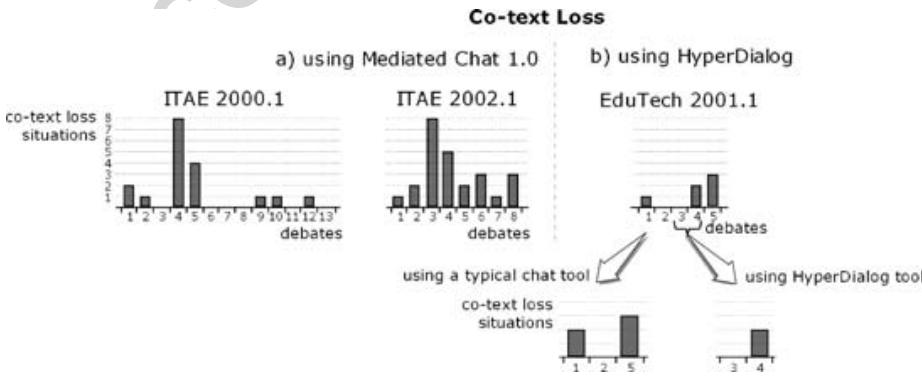


**Fig. 4** a) Frequency of co-text loss situations occurring in the debates on two ITAE course editions. In the ITAE 2000.1 edition, 13 debates were held involving, on average, 7 participants and 336 sent messages per debate. In the ITAE 2002.1 edition, 8 debates were held involving, on average, 19 participants and 622 sent messages per debate. b) Co-text losses in the debates in the EduTech 2001.1 course, part of the Masters Degree in Computer Science of the Federal University of Rio de Janeiro (NCE-UFRJ). The debates on this course were based on the ITAE course debates. On average, 11 participants were involved, producing 210 messages per debate

problems in the shared space. The results obtained from the use of HyperDialog corroborate the results obtained with the use of the Threaded Chat tool (Smith, Cadiz, & Burkhalter, 2000), whose users declared it to be worse than a typical chat tool. On the other hand, the preliminary findings with the use of Academic Talk (McAlister, Ravenscroft, & Scanlon, 2004) showed that the argumentation process was more coherent than when using a non threaded chat tool.

In order to carry on using threads without introducing coordination and cooperation problems, the revised proposal is similar to the one implemented in ConcertChat (Mühlpfordt & Wessner, 2005). The mechanism implemented in Mediated Chat 6.0 only shows the chronological view displaying arrows between related messages.

## "May I Talk Now?" Mediated Chat 2.0: Conversation Techniques to Avoid Interruptions

In the ITAE course debates, a pre-selected learner performs the role of moderator and is responsible for coordinating the debate. Until the ITAE 2002.1 edition, the moderator's main function was to present topics related to the seminar to be discussed by the learners (Fig. 5). Based on an analysis of the records of these debates and interviews with participants, it became apparent that the moderator frequently has difficulties in coordinating the conversation. When the moderator is unable to conduct the debate adequately, the discussion may become highly confused, appearing unproductive and pointless.

With the aim of facilitating and systemizing coordination, a social protocol was defined in which more structured stages are established for the ITAE course debates (Fig. 5). In this dynamic, the debate is organized into three parts, each one discussing a question previously addressed in the course's seminar. The moderator presents the question and each learner, in alphabetical order, sends a comment on the question. All the learners then choose a comment to be discussed freely. After discussion of the selected comment, the learners close the discussion, presenting their conclusions about what was discussed. This dynamic is repeated for each



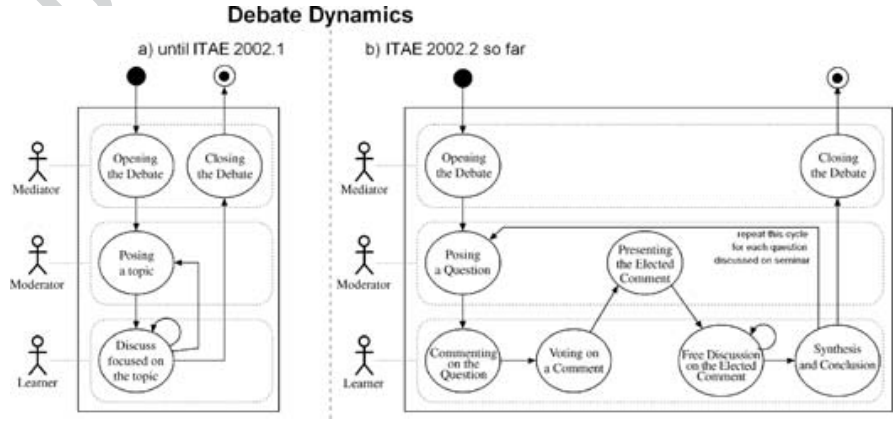


**Fig. 5** Evolution of the dynamics of the ITAE course debates

seminar question. Overall, this format allows a clearer definition of the debate's objectives and how the participants should be coordinated in order for these objectives to be attained (Pimentel, Fuks, & Lucena, 2004).

This dynamic was implemented from the ITAE 2002.2 edition onwards. Comparing this edition with the preceding ones, it was observed that manifestations of Co-text Loss were cut by half. This result indicates that, by itself, the use of a more structured dynamic makes the conversation much less confused.

The implementation of the more structured dynamics lead to the observation that some messages are inappropriate to the stage of conversation under way, defined in this research as "Interruptions." For example, in Text 3, messages 9, 10, and 11 were not anticipated by the new format and were identified as interruptions: unnecessary messages that obstruct the flow of the dynamic.

Text 3. Messages 9, 10, and 11 are interruptions(ITAE 2002.2, debate 1, 11 participants, 399 messages)

The number of interruptions provides an indication of the ease or difficulty in coordinating a debate session—in a well-coordinated debate, few or no interruptions are expected. However, the Mediated Chat 1.0 tool, as well as the other typical chat tools, lack specific mechanisms for supporting coordination.

The Mediated Chat 2.0 tool was developed (Rezende, 2003), as seen in Fig. 6, with a set of conversation techniques for specifying who can speak at any given moment (turn to speak): *Free Contribution*, in which all the learners can speak at any time; *Circular Contribution*, in which learners are organized into an ordered queue and allowed to send one message a piece; *Single Contribution*, where each learner can send just 1 message and there is no specific order; and *Blocked*, where only the mediators can send messages while learners cannot.

Like in other structured chat tools, rules for the interaction process are implemented for improving coordination and coherence (Lonchamp, 2005). The use of these conversation techniques should lessen the occurrence of interruptions and enable improved coordination of the debate and understanding of the conversation.



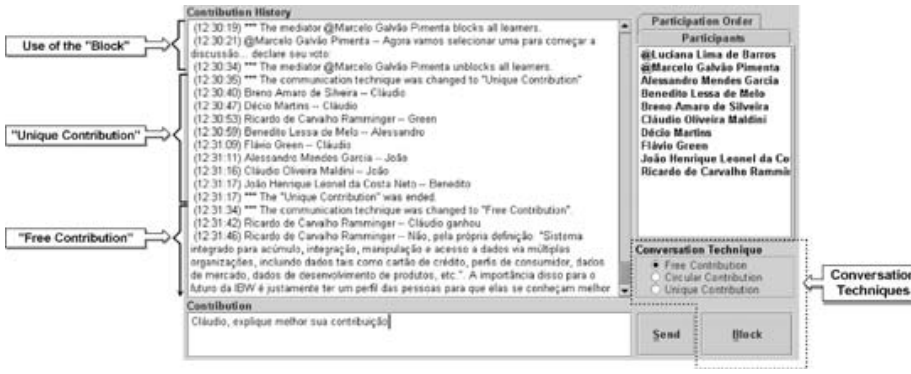


**Fig. 6** Mediated chat 2.0 and conversation techniques

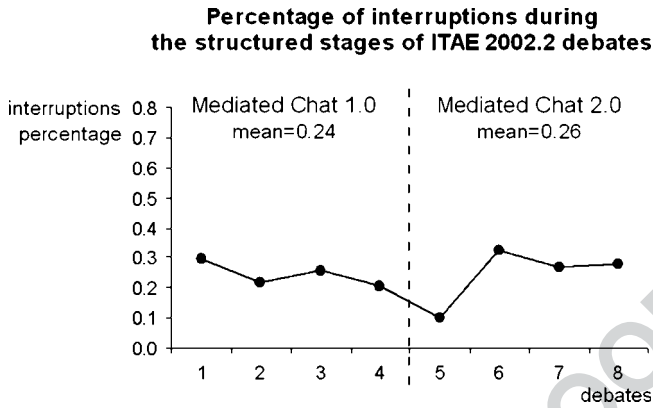


**Fig. 7** Percentage of interruptions during the structured stages of the ITAE 2002.2 debates

The case study conducted in the ITAE 2002.2 edition showed that the number of interruptions remained practically unchanged when Mediated Chat version 2.0 was used, as Fig. 7 shows.

Based on an analysis of these sessions, modifications to the conversation techniques were identified that could reduce the occurrence of the interruptions that were still taking place (Pimentel et al., 2004). The need was identified to overcome exceptional situations that occur during the implementation of techniques—for example, in *Circular Contribution*, the need was identified to skip the turn of those participants who had no messages to send. The need to implement new techniques was also identified, such as in *Mediated Contribution*, in which the mediator authorizes or cancels the publication of sent messages.

The conclusion of this experiment was that the use of a well-structured dynamic organizes the debate and thereby considerably reduces Chat Confusion. However, the social protocol alone is incapable of implementing the dynamics adequately, since many interruptions still occur. Conversation techniques need to be used to force the implementation of the dynamic, but the implementation of these techniques should be sufficiently flexible to overcome exceptional situations.

## "One At a Time, Please!" Mediated Chat 3.0: Publication Queue to Avoid Message Overload

One of the problems frequently cited by participants of the ITAE course is the difficulty in reading all the messages during the debate. The problem occurs when several messages are sent in a short period of time, which makes reading all the messages impossible, causing anxiety and generating the possibility of Chat Confusion. Identified in the research, this phenomenon was called Message Overload and can be seen in the declarations made by participants during interviews, such as "I find it difficult to keep up with the speed of the debate. I don't think I'll ever adapt;" "I only know that I can either read or write. By the time I formulate a reply, the subject has already changed;" "We can see that ideas are lost during the flood of messages. A question, statement or reply can go unnoticed and the learner loses the rhythm and his or her line of reasoning, affecting the person's performance."

The label for the problem was based on the "Information Overload" phenomenon, a term coined by Toffler (1970) to designate the problem that occurs when the subject receives more information than the brain is capable of assimilating and processing. The Message Overload problem can be defined as a specific case of Information Overload, as it occurs when several messages are sent in a short period of time, exceeding the amount of text that the participant is capable of reading in that time.

Compared with spoken conversation, Message Overload is similar to Overlapping Voices, a phenomenon that occurs when two or more interlocutors are speaking at the same time. In spoken conversation, the social protocol "only one speaker at a time" is used to avoid or get around this problem. However, the overlapping voices phenomenon does not occur in chat tools since the messages are presented all at once, masking the process of production and making the use of the social protocol "only one speaker at a time" unviable as a means of organizing the turn to speak (Herring, 1999). The lack of visibility of the turn-in-progress (Smith et al., 2000; Viegas & Donath, 1999; Garcia & Jacobs, 1998) is identified as one of the causes for Message Overload, but not as the underlying problem. Even where the turn-in-development is perceived, various messages can still be sent in a short period of time, thereby generating Message Overload. The same happens in spoken conversation, since the social protocol "speak one at a time" does not always prevent Voice Overlapping from occurring.

Another problem related to Message Overload is the Flood problem, described in the literature on IRC (Oikarinen & Reed, 1993). This problem occurs when a single participant sends several messages in a short time interval. The difference between the Flood problem and Message Overload is that the Flood problem is defined by a high number of messages being sent by a single participant within a short time, while Message Overload refers to a high number of messages from all participants being displayed in a short amount of time.

The Mediated Chat 3.0 tool (Fig. 8) was developed to avoid Message Overload. After publishing a message, the chat server waits a period of time before publishing the next message (an interval of time, estimated to be sufficient for reading the previous message, based on its number of characters). During this interval of time, the new messages sent by participants are queued on the server for later publication. This mechanism distributes the publication of messages over time so that the participants manage to read all the messages without being taken by surprise by message bursts (several messages published over a short period of time).

In the Participants List, a grey bubble can be seen pulsating next to the participant's name while he or she is typing. After the participant sends the message, a black bubble is displayed next to the name indicating that the participant has already sent a message that is now in the queue waiting to be published. While the message is in the queue, its publication position queue is displayed to the sender, the typing area is blocked, and the sender has the option to cancel publication of the message. When a message is published, the black bubble blinks for a period of time, indicating that the participant is 'speaking' at that moment. Messages sent by mediators receive a higher priority for publication.

A similar mechanism is implemented in the Chat Circles tool, where a circle remains pulsating while the participant is typing the message; after being sent, the message is displayed for an interval of time considered sufficient to read it, and then the message disappears from the screen. However, the Chat Circles tool does not use message queuing or any other mechanism to prevent various messages being displayed simultaneously, which means Message Overload can still occur.

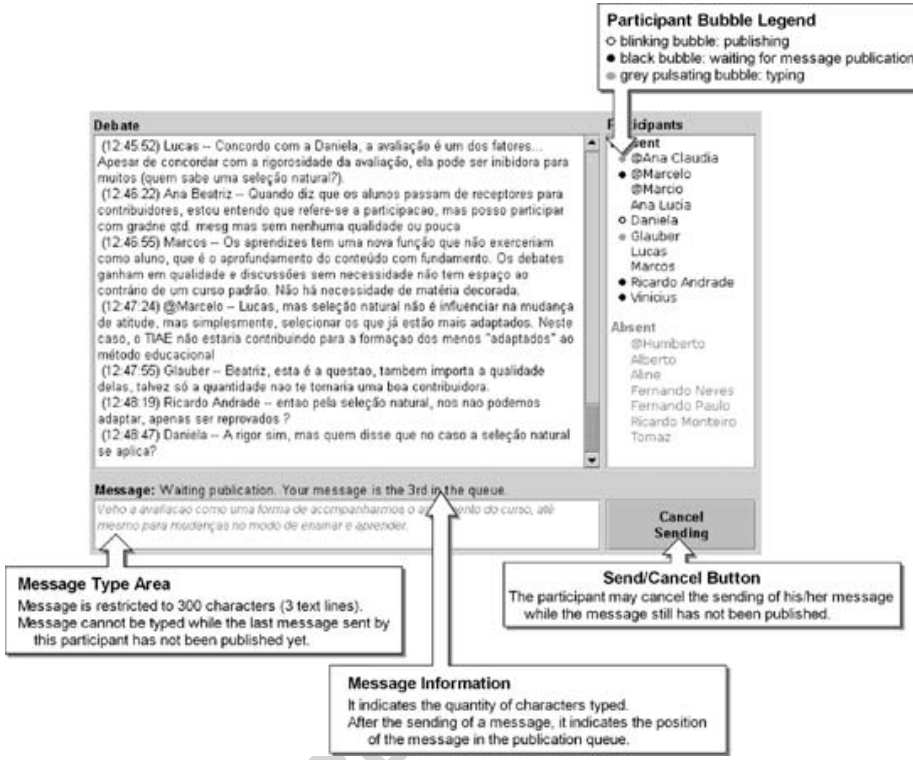


**Fig. 8** Mediated chat 3.0 and the message queue

A queuing strategy is implemented in the PalTalk tool—not for sending messages, but for ensuring that only one participant can use the shared audio channel at a time. In the PalTalk tool, participants wishing "to speak at the microphone" must "raise their hand." The participants are organized in the Participants List according to the queue for using the audio channel: the top of the list is occupied by the participant in control of the audio channel (who is speaking at the microphone at that instant), followed by those who requested control of the audio channel (ordered according to their entry in the queue); the end of list contains the remaining participants who do not currently wish to use the audio channel. When a participant ceases using the audio channel, her or his name is removed from the top of the list and all those in the queue move up one position. While in the queue, the participant can desist from using the audio channel and leave the queue. PalTalk also features operators who, among other responsibilities, work to coordinate the queue, blocking or unblocking the use of the audio channel by participants. The queuing strategy implemented in PalTalk can be defined as a specific conversation technique for coordinating control of the audio channel before the message is issued. In Mediated Chat 3.0, on the other hand, queuing occurs after the message is sent and is independent of the conversation technique in use.

The Mediated Chat 3.0 tool was tested in the ITAE 2004.1 edition. Hypothetically, the message publication queue should lessen Chat Confusion by allowing all the

messages in the debate to be read. The results, however, were inconclusive. The interviews conducted with participants revealed that many did not have an adequate understanding of the message queue and some even thought that the tool had become slower because the messages took time to be published (the messages were actually waiting in the queue, but they did not perceive or understand the mechanism). To avoid this problem, the message publication queue will be represented directly in the Participant List through the ordering of participants, as implemented in the PalTalk tool. By making the queue more visible, the mechanism can hopefully be better understood and its impact on reducing Chat Confusion re-investigated.

On the other hand, the participants rapidly understood the indicator about who was typing (pulsating grey bubble next to the typing person's name on the Participant List). In the interviews, they declared that this mechanism helped in the coordination of the debates, particularly in their decision about when to write or send a message during the debate (self-coordination of their participation). An analysis of the session record shows that interruptions caused by the lack-of-visibility-of-the-turn-in-progress problem (Garcia & Jacobs, 1998), as illustrated by message 20 of the debate in Text 4, were avoided.

Text 4. Interruption in message 20 caused by the lack of visibility of the turn-in-progress. (ITAE 2002.2, debate 1, 11 participants, 399 messages sent)

In this debate excerpt, the moderator, Joana, calls on each learner to send his or her contribution on the question under discussion in turn. Flávio takes longer to send his contribution and the moderator, unaware of whether Flávio was going to respond or not; Joana calls on him again, interrupting the dynamic. This type of interruption no longer occurred after the Mediated Chat 3.0 tool was used.

The conclusion of this case study was that the turn-in-progress indicator is useful, since it helps coordinate the conversation and avoids a specific type of interruption to the dynamics. On the other hand, although message queuing prevents Message Overload by forcing an interval of time between the posting of messages, its implementation needs to be modified to make the queuing more self-evident and understandable.

## "Who Said What?" Mediated Chat 4.0: Helping Message Writing and Reading

The Mediated Chat tool interface has been gradually modified over its successive versions. However, there had been no systematic investigation of the impact of the interface on Chat Confusion—the objective of Mediated Chat version 4.0, Fig. 9.

The interface modifications introduced in this version aimed at facilitating the processes of reading and writing messages during the debate. The typing area comprises 3 lines of visible text instead of a single line, which helps the process of revising and editing before sending the message. To help the reading process, text formatting was used to clarify the moment when the message was published (dimmed time-stamp); visually differentiate the sender from the content of the message (sender in bold and content in normal font style); differentiate participants' messages from system messages (alerts to participants entering and leaving are displayed in gray); and better differentiate the limits of each message (indented margin for the first line of each message and a small extra space after the last line of

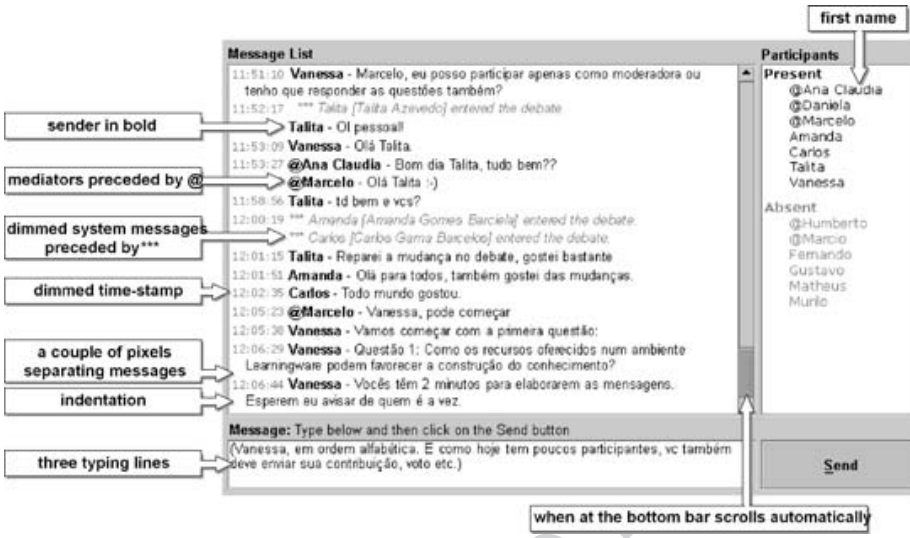


**Fig. 9** Mediated chat 4.0

each message, increasing the separation between messages). Only the first name of the participants is displayed instead of the whole name, reducing the amount of text needed to identify the sender. The scroll bar only scrolls automatically if located at the foot of the page, a situation that occurs when the participant is following the most recent messages, and stops scrolling when the participant changes the position of the bar to read the messages that are no longer visible on the screen (automatic scrolling makes reading earlier messages difficult).

These modifications should reduce Chat Confusion by easing the processes of reading and writing. Mediated Chat version 4.0 was used on the ITAE 2004.2 edition. In the first session in which this version was used, the participants quickly identified the modifications and they spontaneously expressed their satisfaction. Text 5 is an excerpt of conversation that preceded the debate.

Text 5. Conversation preceding debate 4 on ITAE 2004.2

After all the debate sessions had been held, during which Mediated Chat version 1.0 (Fig. 2) and Mediated Chat version 4.0 (Fig. 9) were used alternately, interviews were conducted with the learners asking them to make comparisons between the versions. It was found that all the learners (a total of 6) approved of all the modifications implemented, as exemplified by Talita's declaration: “in summary: everything about this interface is better.” The modifications introduced improved aesthetic factors, but primarily they facilitated the process of reading and recovering messages. As Amanda underlined:

> The look of this new version is far better than that of the previous version in terms of motivating the reader to read and understand what is happening. Before it seemed like a single block. Now it’s easier to find one reply among others.

> Comparing the two versions next to each other meant we could see the difference in quality, and for me this new version appears more functional.

The participants found the conversation less confusing due to the changes made in the chat register, as the declaration made by Carlos exemplifies:

> One thing that I found is that the tool helps considerably towards the success of the debate. The interface of the first debates made things more complicated. Every text seemed packed and difficult to read. It was difficult to keep track when that flood of messages began. This interface improved things a lot.

The learners suggested new modifications, which were implemented in Mediated Chat 6.0, such as differentiating messages sent by mediators and moderators in order to help coordination of the debate.

What was concluded, based on the case study, is that improvements to the presentation of the message can effectively reduce Chat Confusion by easing the reading and message-finding process.

## "What Have You Been Talking About?" Mediated Chat 5.0: Session Register to Avoid Decontextualization

Whenever a participant enters in the middle of a debate session, whether because of late arrival or loss of internet connection, the other participants are already engaged in discussion and the participant may encounter difficulties in entering the conversation—in the present research, this problem was called Decontextualization. Sometimes the dynamic of the ITAE debate was interrupted to contextualize the participant, as the situation documented in Text 6 exemplifies.

> Text 6. Messages 6, 11, and 12: Interruptions arising from decontextualization. ITAE 2004.2, debate 1, 8 participants, 217 messages produced

Some chat tool mechanisms designed specifically for dealing with the Decontextualization problem have been found in other systems. Some Web chats display the most recent messages (for example, the last 10 messages published), since these are probably the texts to which the messages that immediately follow are related, thereby providing the immediate context for the participant to understand the current conversation and engage in it more easily. In other tools, such as the main messenger programs, the complete history of the conversation is registered and can be recovered by the participant. In the solution implemented in the chat tool of the Groove groupware, the chat history is always stored and displayed to the participant on connecting. Any participant can clear the chat history at any time.

The registration of the session debate was implemented in Mediated Chat version 5.0 to deal with the decontexualization problem. After the mediator begins the debate session, the posted messages are stored on the server. When a participant enters in the middle of the debate session, all the stored messages are displayed to him or her (the history of the session in progress). After the mediator finalizes the debate session, the server ceases storing the messages. When a participant logs on

after this point, the old messages are not displayed. The interface of this version is the same as Fig. 2, the only addition being a button for the mediator to start and end the session register in the Debate service window.

Mediated Chat version 5.0 was investigated on the ITAE 2005.1 edition. To assess the impact of the implemented mechanism on Chat Confusion, from the 3rd debate onwards, the connection of some learners was deliberately broken during the debate. In debate sessions 3, 4, and 7, the session was not registered and when the participant connected in the middle of the session no access to earlier messages was available. In debate sessions 5, 6, and 8, the session was registered and once reconnected the participant had access to all the messages from the start of the debate session. The objective was to investigate the behavior of learners with and without the session register: how long it took them to become engaged in the conversation and whether they caused interruptions.

In relation to the time taken to engage in the chat, two premises had been formulated: provided with the register of the complete session, the participant would rapidly become contextualized and would engage into the conversation; or the opposite would occur, and the participant would lose more time reading the previous messages in order to become contextualized and take longer to engage in the conversation. Analyzing the interval of time between the participant's re-entry and the posting of their first message engaged in the conversation, it was found that message registration had no influence on the participant's engagement in the conversation: it neither helped (reducing the time interval) nor hindered (increasing the delay). At least in this edition, no impact on the learner's participation was identified in terms of his or her disconnection and reconnection in the debate.

In relation to interruptions, no learner manifested decontextualization after reconnecting to the debate, even in the absence of the session history. The absence of interruptions could be explained in many ways: learners are instructed to avoid interrupting when they arrive late (social protocol); the short time interval between disconnection and re-entry (few seconds) does not generate any decontexualization (context remains in the learner's memory); and learners were only disconnected during the free conversation stage to avoid upsetting the dynamics of the debate given that it is easier to engage in conversation during this stage.

The impact of adding a session history was evident in just one situation: disconnecting the moderator at a critical moment when he or she has to find an earlier message for displaying the elected comment (after the voting stage). The moderator of debate 7, in which the session was not being registered, had to interrupt the debate and receive help from the other learners in order to continue the debate as shown in Text 7. The moderator of debate 8, on the other hand, had access to the entire session upon reconnecting and was able to continue the debate as though nothing had happened.

Text 7. Interruptions arising from decontextualization of the moderator (ITAE 2005.1, debate 7, 9 participants, 283 messages)

This case study showed that the session register provides the conversational context without increasing the time needed by the participant to engage in the conversation. The register is useful mainly in critical conversation situations, avoiding the occurrence of interruptions that potentially lead to Chat Confusion.

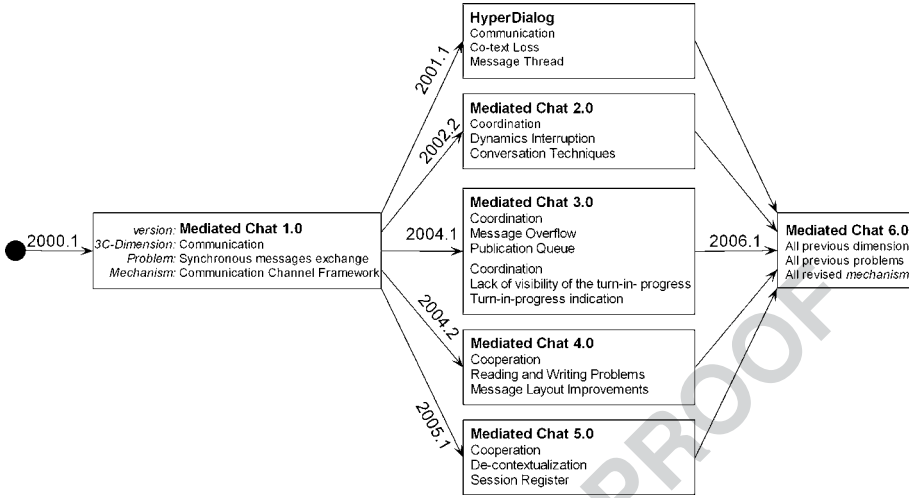


**Fig. 10** Mediated chat development process

## Mediated Chat 6.0: Revisions and Integration

In the current stage of this research, an initial investigation into all the problems so far identified as potential sources of Chat Confusion has already been undertaken: Co-Text Loss, Dynamics Interruption, Message Overload, Lack-of-visibility-of-the-turn-in-progress, Difficulties in the reading, and Decontextualization. For each of these problems, a solution was investigated, a new version of Mediated Chat was implemented, and a case study was undertaken that allowed a better insight into the problem and the proposed solution. The next stage of this research is to integrate the solutions in the Mediated Chat 6.0 version, Fig. 10 (Pimentel, Fuks, & Lucena, 2005).




**Fig. 11** Mediator interface of mediated chat 6.0

It should be emphasized that the integration of the revised mechanisms, implemented in Mediated Chat 6.0 (Fig. 11), will not necessarily solve the Chat Confusion adequately. It is not clear how the new devised mechanisms will mutually influence each other.

Based on the results obtained previously, fewer manifestations of co-text loss and fewer interruptions to the dynamics are expected. It is also anticipated that the interviewees will state that the Mediated Chat 6.0 tool made the chat much less confusing and allowed a clearer understanding of the debate. This version will be investigated in the ITAE 2006.1 edition.

## Conclusion

The level of understanding of chat tool conversations needs to be increased in order for their use to become more applicable to learning activities. Chat Confusion is not a simple problem, though as it arises from the overlapping of a number of phenomena. This article has presented the problems that have already been identified and investigated during this research project: Co-text Loss, Dynamics Interruption, Message Overload, Lack-of-visibility-of-the-turn-in-progress, Difficulties in the reading, and Decontextualization.

Successive versions of the Mediated Chat tool have been developed with the aim of analyzing and solving problems relating to Chat Confusion. At the current stage of research, earlier solutions have been revised and integrated into Mediated Chat version 6.0. The results obtained previously with the use of intermediate versions indicate that the most recent chat version will be better understood and, consequently, more suitable for hosting educational debates.

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