CZTALK: APPLYING INFORMATION VISUALIZATION TECHNIQUES TO ANALYZE ONLINE DISCUSSIONS

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ABSTRACT

The widespread use of Computer Mediated Communication (CMC) applications has meant that almost anyone can communicate using, and benefit from, online discussions. However, research reveals that heavily text-based interfaces provide limited support for users wishing to understand such spaces more. This indicates a need for a new tool which will address this concern.

This study is an investigation of CMC usage problems and solutions. Our goal is to apply information visualization techniques to help users, particularly post-secondary instructors, to better understand structured, course-based discussions to facilitate discussion evaluation. The solution we present is CZTalk, a multi-view visualization tool. CZTalk provides a network display of discussion messages which helps instructors understand individual messages, the context in which they occur, and various quantitative and qualitative measures of student performance in discussions. The results of our user study suggest CZTalk is more useful in evaluating course-based online discussions than traditional text-based discussion environments.

DEDICATION

To my parents, who always give me love and support.

ACKNOWLEDGEMENTS

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CHAPTER 1: INTRODUCTION

With the advance of computer technology, most people can now communicate with the rest of the world easily by using different types of Computer Mediated Communications (CMC) applications. CMC has been defined by Hiltz and Turoff (1985) as the "use of computers and telecommunications networks to compose, store, deliver, and process communications." After its first appearance in the late 1960's, the rate of growth of various types of CMC applications, whether they are synchronous (Instant Messaging, Internet Relay Chat) or asynchronous (E-email, Usenet newsgroups), has become phenomenal.

CMC applications have produced a significant impact on the field of education. Online discussion forums allow students to work together on projects in small groups, and to participate in on-going discussions about course content. Further, they enable students to "present" group project products to other students in the class (Markel, 2001).

Despite the many advantages groups of people gain when they interact through computer networks, enough poor-quality messages flood newsgroups and similar public discussions that finding the valuable content typically proves too difficult to be worthwhile (Fiore et al., 2002). Thus, it becomes increasingly important for users to be able to identify the quality of messages submitted, such as their relevance to the on-going discussion, or whether they can inspire others to contribute new topics to discussions. This knowledge should make it easier and quicker for users to filter irrelevant messages and target only the appropriate authors for further interaction.

The evaluation of messages posted in online discussions is particularly important in education. Proper evaluation will give recognition to students' time commitment to a discussion. In addition, assignments may stimulate students to revisit earlier study and motivate them to engage in in-depth analysis of the subject matter of their course (Godsell and Miers, 1994).

Fiore et al. (2002) conducted a user study aimed at defining the metrics which help users to identify the quality of messages posted. They reported that in discussion spaces, behavioural metrics, particularly the longevity and frequency of an author's participation and the amount of interactions occurring between the author and the rest of the participants, were important for subjects to evaluate authors' online behaviours and the informational value of their messages. In order to help users evaluate messages in online discussions, three aspects of a discussion are required: who the participants are and their posting histories, how they interact with each other at both thread and discussion levels, and when all these interactions develop over time.

Heavily text-based user interfaces typical of online discussion forums only provide limited support for users wanting to better understand online discussions. It is difficult to identify and follow the messages posted by a given participant of an online discussion because the names of the authors are only represented as a text string embedded in an already-cluttered screen space. As a result, such information can easily be overlooked. As well, the flow and development of a discussion, usually represented by strings of subject line text organized into threads, cannot be easily detected in text-based interfaces - this forces user to resort to mental reconstruction of the relationships between messages. Finally, although some online discussion forums allow users to sort

messages according to time of posting, threads and authors, contextual information will often be lost when a user tries to switch between these different displays (Donath et al., 1999).

It becomes clear that the lack of visual support in today's text-based discussion interfaces is a source of many of the usability problems in these tools. Therefore, a solution to some of these usability problems seems to lie in presenting the information in a more visually useful manner, to allow users to gain better insight into the discussion and interact with the discussion more easily. These requirements correspond to the general research goal in the field of information visualization.

Information visualization is defined as the use of computer supported, interactive, visual representation of non-geometric data in order to gain insight into information (Card et al., 1999). Techniques in information visualization have been applied to a number of domains and have resulted in different research sub-areas ranging from one-dimensional text-based data visualization, to visualization of networks consisting of many multi-dimensional data items. The application of information visualization techniques to online discussion environments began in the 1990's and continues to be an active research area in information visualization.

There are two major categories in discussion visualization. Research in the first category attempts to depict the characteristics and behaviours of authors in online discussions. The second category focuses on revealing the contextual information of a discussion, such as the flow and the development of threads.

1.1 Goal of the Thesis

Our goal is to apply information visualization techniques to help users, particularly course instructors, better understand the relationships between messages and the overall patterns and trends of discussions in course-based online discussion evaluation. Our research has led to the development and implementation of CZTalk.

The original design of CZTalk, developed by an undergraduate student at SFU, focused on visualizing open, unstructured discussion environments. It did not provide tools to allow users to analyze and evaluate individual contributions in team-based, collaborative discussions found in structured environments like online courses. After a series of meetings with several course instructors at Simon Fraser University, we felt that CZTalk could be transformed into an analysis tool for instructors who need to evaluate student performance in course-based online discussions. New capabilities have been added to CZTalk based on the recommendations and requirements identified in these discussions.

Enhancements have been made to several aspects of CZTalk. The ability to download and display discussions from different sources (various online discussion formats and Email messages) allows instructors to visualize the interactivity occurring in individual discussions. Further, instructors can also download messages from multiple discussions and display them in one CZTalk session. This should further help them perform cross-discussion analysis. Colour-encoding of message attributes in a visual overview of the discussion allows instructors to detect trends and patterns while retaining the context of the discussion. The addition of a dynamic query filter (Ahlberg and

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Shneiderman 1994) allows instructors to query the temporal characteristics of a discussion. Rearranging and presenting the various statistical summaries of a discussion in different formats provides instructors with an overview of the discussion while reading messages of interest in more detail. CZTalk's capability to open multiple messages simultaneously provides instructors with an easier inter-message comparison. Finally, message annotation and prioritization allow instructors to comment on, and categorize, messages based on different qualitative measures.

To evaluate the usefulness of CZTalk by instructors who wish to evaluate student performance in online discussions, a qualitative user study was designed and conducted with five instructors at SFU. The results of the user study suggest that CZTalk displays four major strengths relative to typical text-based discussion interfaces: the multi-view approach, the continuous display of a visual overview of the discussion, direct query formulation and manipulation, and the ability to display relevant details on demand.

1.2 Outline of the Thesis

This thesis is organized as follows. Chapter 2 provides background information on computer-mediated communications (CMC). The chapter investigates related research on the problems, suggested solutions, and reviews of different approaches intended to improve online discussion environments. Chapter 3 states the problem we have focused on and describes the design and implementation of CZTalk. Chapter 4 describes the motivation for, and experimental design of, a qualitative user study to evaluate CZTalk. A discussion of the user study results and their implications are

presented in Chapter 5. Finally, Chapter 6 presents the conclusion and possible future research directions for CZTalk.

CHAPTER 2: VISUALIZING COMPUTER MEDIATED COMMUNICATIONS (CMC) DISCUSSIONS

2.1 History of CMC

Computer Mediated Communications (CMC), as defined by Hiltz and Turoff (1985), "use computers and telecommunications networks to compose, store, deliver, and process communications." CMC first appeared in the late 1960's, as part of the ARPANET project (the predecessor to the Internet). It allowed universities, military installations and government labs to exchange files and communicate in the form of electronic mail (email) (Comer, 1988).

To the surprise of its developers, electronic mail quickly became the most frequently used application on ARPANET (Licklider and Vezza, 1978). Other forms of CMC also emerged, including computer discussion groups in the late 1960's (Quarterman, 1990), Usenet newsgroup in 1979 (Zakon, 1994), and chatting in 1981 as part of the BITNET project (Oberst and Smith, 1986). In 1986, Eric Thomas wrote Listserv, a program for BITNET, which can redistribute emails to lists of configurable email addresses (Stewart, 2000). Using Listserv, people with similar interests from all over the world can easily form group discussions.

With exponential growth in recent years, CMC now commonly supplants the use of both postal and fax services (Junge, 1999). The rate of growth of various types of CMC applications is also phenomenal. During year 2000, it was estimated that more than

2 billion instant messages were exchanged each day on the AOL network, and 0.7 billion on the MSN network (Smith et al., 2000). During the same year, there were more than 30 million Listserv subscribers, delivering more than 20 million messages each day over the Internet (Stewart, 2000). In 2001, approximately 27,000 active Usenet newsgroups existed, and more than 675,000 messages were posted by people around the globe each day (Dodge, 2001). Over the years, different CMC mechanisms have emerged, targeting users with different communication needs and requirements.

2.2   Common CMC mechanisms

CMC can be classified into 2 major categories. Synchronous CMC is a form of CMC mechanism in which the interactions between the communicating parties take place in real-time through computer networks. In contrast, asynchronous CMC does not occur at the same time; participants can participate in discussions whenever they like. Common applications of both mechanisms are discussed in the following section.

2.2.1   Synchronous CMC

Synchronous CMC provides a rapid, spontaneous exchange that occurs in real time (Junge, 1999). Since messages are exchanged in real time, the communicating parties are required to be on the network at the same time (Abrams, 1998). Because of its fast turn-taking nature, it is suitable for an environment where a quick response is required. Examples of synchronous CMC applications include Internet Relay Chat (IRC)

and Instant Messaging (Figure 2-1). Furthermore, this form of communications is usually

not persistent, i.e. messages exchanged during one conversation session are removed by

the application when the communicating parties have closed their connections with each

other.
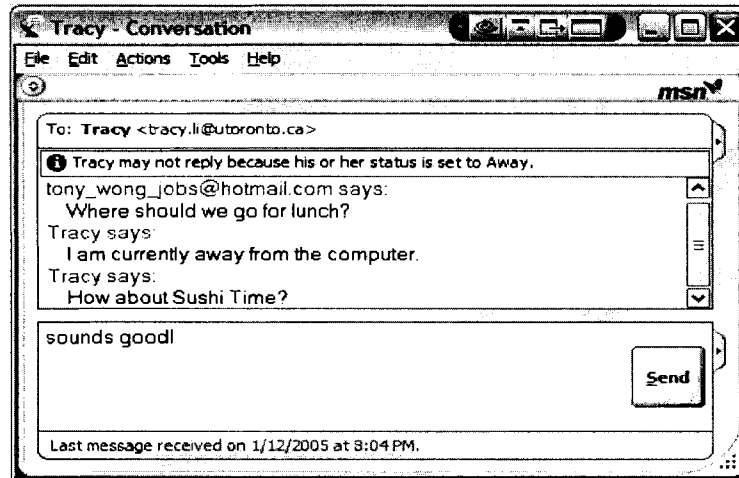
Figure 2-1 Microsoft MSN Messenger, a typical Instant Messaging application (Screenshot reprinted by permission from Microsoft Corporation)

2.2.2 Asynchronous CMC

In contrast to synchronous CMC, asynchronous CMC defers interactions and

allows a time-lag between correspondences (Abrams, 1998). As a result, the

communicating parties do not need to be on the network at the same time. Since the time

constraint is removed, it is suitable to environments where discussions are maintained

over a longer period of time. Examples of asynchronous CMC applications include email

(Figure 2-2), Usenet newsgroups and online discussion forums (Figure 2-3). To allow

discussion participants to recall the content, messages generated by these applications are

persistent, i.e. messages will either be stored at both the sender's and receiver's computers (such as in email), or they will be stored at a central location (for example, Usenet and discussion forums).
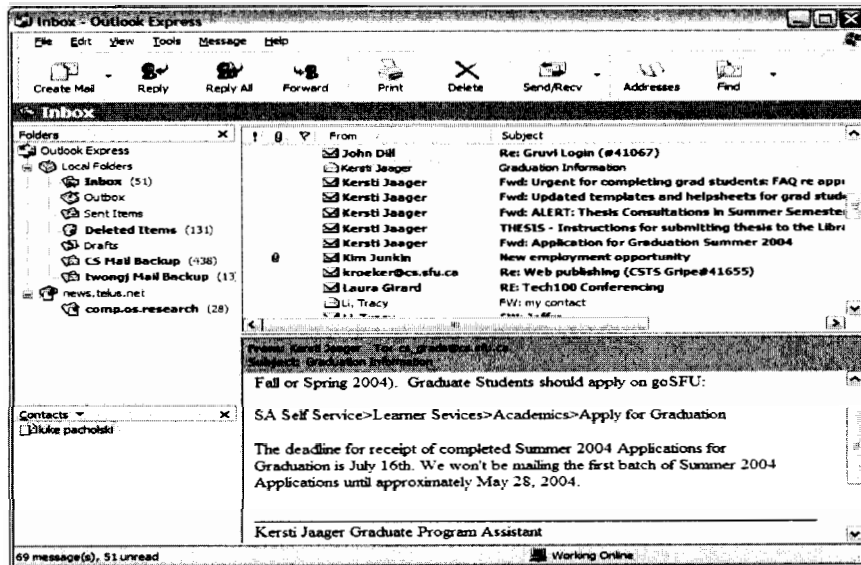
Figure 2-2 Microsoft Outlook Express, a typical email client (Screenshot reprinted by permission from Microsoft Corporation)
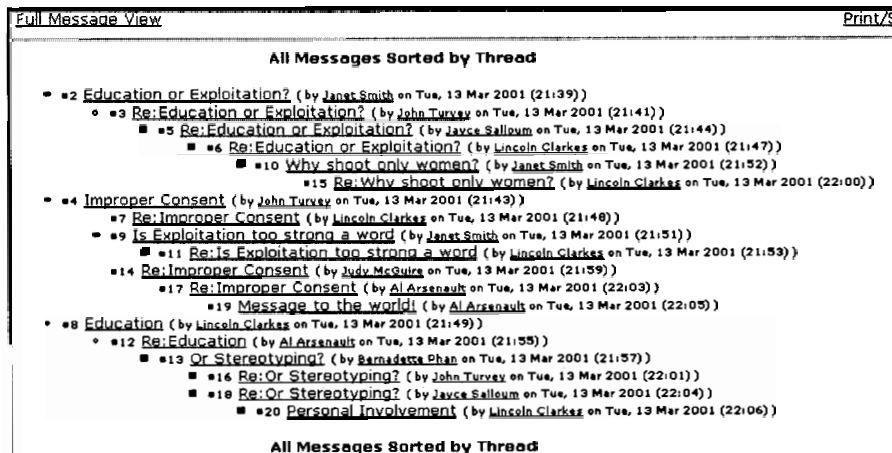
Figure 2-3 VirtualU GEN forum, a typical online discussion forum interface (Used with permission from SFU)

2.2.2.1 Threading

Threading is a special means of organizing messages in CMC. In email and Usenet newsgroups, a message may either denote a new conversation, or may be a reply to a single prior message, thus continuing a conversation (Venolia et al., 2003). The "reply-to" relationships between messages allow them to branch out and form conversational trees, or threads (Venolia et al., 2003). Smith and Fiore (2001) conceptualized a thread as an n-ary tree with the initiating message at the root. Figure 2-3 shows an example of a threaded discussion. The root message of the thread is located at the top of a thread, and all the subsequent replies are located below it.

Threading appears in all forms of CMC applications. Fisher and Moody (2001) observed that one third of the messages in the mailboxes of 76 users were threaded. In a survey of 42,000 email messages found in subjects' email databases, Kerr (2003) found that 62% of these messages belonged to threads. Threading in Chat and Instant Messaging (IM) systems, despite not being supported explicitly, is a common practice. Although the thread structure is not supported in chats, users often organize messages, mentally, into different discussion threads. A study conducted by Issacs et al. (2002) quantified the frequency of threading in IM and found that it occurred in 32% of the conversations overall, and in 41% for heavy IM users. This suggests that the adjacency of the messages appearing in those systems does not always reflect the structural organization adopted by users. Similar observations were made by Herring (1999), who stated that cases where adjacent messages within the same chat session are unrelated "are the rule rather than exception" in chat-like communication systems. Threading is explicitly supported in Usenet newsgroups and online discussion forums to organize

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messages via indentations, which are used to represent the reply sequence between messages within the same thread.

2.3 CMC in Education

For the past ten years, CMC has been seen as a revolutionary tool to support instruction (Kang, 1998). Among the various CMC applications, online discussions have significantly impacted the field of education. In this section, we describe why online discussions have produced such a great impact in today's educational environment. We will also look at how the unique characteristics of this communication medium can promote the quality of education.

Online discussion possesses a number of unique characteristics and advantages. One such advantage is that it removes the time and location constraints of learning. With a computer and a network connection, students can connect to a discussion forum and participate in different course projects and class discussions at a time that is convenient to them. This characteristic is also particularly welcomed by students enrolled in distance education programs because such students are typically located in different geographic locations. Thus, online discussion has been seen as one of the applications of technology with the most far-reaching implications for teaching and learning in distance education (Garrison, 1997).

Online discussion also encourages interaction among students. The objective of many online discussions is to group students into teams, and to allow students to complete team-based collaborative projects. Students are required to learn how to

communicate with each other effectively during online discussions because in order to develop a real collaborative project. it is first necessary to establish communication, or in other words to interact (Santoro et al., 2004). Such interactions between students are seen by educational theorists such as Vygotsky (1978), as being fundamental to the development of cognitive skills because through discussion and interaction, students can learn from each other's scholarship, skills and experiences.

All the messages exchanged between students are stored by conference servers to allow individuals to review and reflect on the discussion content at a later time. The persistence characteristic of online discussion provides an opportunity for students to read carefully and critically, write reflectively, and logically order their supporting evidence (Markel 2001). In addition, when participant comments are logged, they can be reused later as an instructional tool to model expected answers and discourse patterns as well as provide a lasting class or group legacy (Hara et al., 2000).

With an increased amount of time to contribute to discussions about the course content, along with the opportunities to interact with other students in different collaborative group projects, online discussions allow students to engage in generative processing of information. Generative processing, as described by Jonassen (1998), constitutes "deeper information processing [which] results from activating appropriate mental models, using them to interpret new information, assimilating new information back into those models, reorganizing the models in light of the newly interpreted information, and then using those newly aggrandized models to explain, interpret, or infer new knowledge." Knowledge acquisition now becomes a constructive process, rather than a reproductive one which only allows students to learn passively from their teachers.

2.4 Evaluating the quality of CMC discussions

As more and more people become involved in CMC discussions, along with the ever increasing number of messages being exchanged each day, online discussion spaces like Usenet newsgroup have become a great resource for conversations on virtually every topic; they have also become a place where one can find answers to almost any question (Viegas and Smith, 2004).

Although it seems possible that everybody can now find the information of their interest from such spaces, it does not mean that they can find such valuable content easily. Because of their openness, discussion environments like Usenet have become the targets of abuse and pollution. Flooded with spam, as well as off-topic and low quality messages, Usenet has become an increasingly frustrating system for many users (Xiong et al., 1998). The quest for valuable content has now become too difficult and cumbersome to pursue (Viegas and Smith, 2004).

To allow users to find useful information in such voluminous spaces, evaluation of the qualities of the messages posted by individual authors becomes increasingly important. Evaluation of authors can help users to navigate and seek useful content in two ways. First of all, knowing the message qualities of each author can help users filter low quality messages quicker, allowing them to search for information faster. This information also allows users to quickly identify the appropriate author for further interaction, according to measures such as posting history and the perceived values received by the others through the interactions among them.

Evaluating the quality of messages posted in online discussions is particularly important in an educational or instructive setting. Having the ability to evaluate the quality of messages enables instructors to recognize each student's time commitment to a discussion. In addition, assignments and team-based projects that can be facilitated by online discussions will stimulate students to revisit earlier studies and motivate them to engage in in-depth contemplation of the subject matter of the course (Godsell and Miers, 1994). It is not until students start to work on their assignment that they know whether or not they have learned from their studies (Thorpe, 1998).

Different models used for evaluating the quality of online discussions have been proposed. Howell-Richardson and Mellar (1996) introduced the "activity graph," a visual representation of electronic conferencing which facilitates the understanding of the structure and the flow of online discussions. A number of content analysis models have also been proposed which focus on evaluating discussions according to message content. One such model, developed by Henri (1992), has been applied to a number of research studies (Hara et al., 1997; McKenzie and Murray, 2000). Henri's model suggests dividing messages into "units of meaning" and classifies these units into five categories which cover both quantitative and qualitative aspects of the messages. These five categories are participation, interaction type, social cues, cognitive skills and mega-cognitive skills, and knowledge (Henri, 1992).

Searching for the appropriate means to evaluate online discussions is not restricted to researchers in the field of education. In a research study aiming to define the metrics which can be used to evaluate the authors of Usenet newsgroup, Fiore et al. (2002) reported that an author's tenure in a newsgroup and level of interactivity with

other authors serve as reliable predictors of subjective evaluations of the author's social and informational value.

Through different research efforts, it is clear now that in order to evaluate message qualities of online discussions, it is necessary to understand 3 aspects of a discussion. Users need to know who the participants are and their posting history so as to understand the role and position of each author. Users also need to know how the authors interact with others so as to understand what others will think about the messages posted by an author. Finally, knowing when all of these interactions occur and develop over time allows users to understand the periods of activity of each author. The time aspect of a discussion is particularly important in collaborative discussions in which participants are required to complete team-based projects within a fixed amount of time.

2.5   Usability Issues in today's CMC applications

As discussed in the previous section, to understand online discussions and to evaluate and seek useful content, a person needs to know who, how and when the interactions take place in such environments. Unfortunately, researchers have noted that the user interfaces of all existing CMC tools have not improved from the design from when CMC tools were first invented, and thus, are unable to meet the demands of today's users. Ducheneaut and Bellotti (2001) commented that despite our reliance on email, the existing tools for handling emails have failed to keep pace, suggesting that definite possibilities exist for improvement. Smith and Fiore (2001) have further criticized the current Usenet interfaces as counterintuitive. Similar observations have been reported by

Smith et al. (2000) on chatting programs, who stated "chat has not evolved much in the past twenty years and remains poorly suited for holding complex discussions."

Almost all of the current CMC discussion tools are text-based (Donath, 1995). Text-based tools have a number of advantages such as their simplicity and their high adaptability. Given a basic alphanumeric keyboard, anyone can assemble a discourse and discussion on any topic (Donath et al., 1999). However, text-based discussion tools are lacking in terms of visual appeal. This obscures many of the cues that aid social interaction (Donath, 2002). In the following sections, the usability problems of today's CMC discussion tools and their consequences will be discussed in detail.

2.5.1 Difficulty in understanding the past and present participation

CMC deprives its participants of the many natural cues and inputs of a face-to-face conversation; therefore participants have lost the shared experience of seeing one another as they are mutually engaged in conversation (Churchill et al., 2003).

In face-to-face communications, our senses enable us to quickly and easily identify the speakers, fellow participants, and bystanders, through a variety of cues. Such cues include views of others' faces, bodies, and actions (Kraut et al., 2003). In an online environment, however, the author's name is usually the only cue provided, in a display cluttered with other text, such as the message body itself. Subjects of Fiore et al.'s (2002) user study commented that an author's name is not "particularly memorable," demonstrating the inadequacy of online discussions as compared to face-to-face communication. Because users easily forget names, it becomes more difficult for them to

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understand each author's background and position in a discussion. Information learnt during the discussion then becomes less meaningful, since users are unable to easily associate authors with their posting histories.

Not knowing who the participants are and their posting histories result in a number of problems. First of all, not being able to identify the participants deters trust and encourages unsociable behaviours (Preece, 2001) because people do not feel that they need to be responsible for their behaviours when their identities remain unrevealed. Moreover, the difficulty users have constructing participants' histories undermines their ability to assess one another, develop trust, and cultivate common goals (Smith and Fiore, 2001).

The situation worsens in a synchronous environment because if a participant does not respond quickly enough, his/her name (and the messages posted) is quickly replaced by other participants' messages. Participants in chat systems have to type messages constantly just to maintain their presence, even when they have nothing to contribute to the discussion (Donath et al., 1999).

2.5.2   Difficulty in understanding the flow and development of discussion

Interfaces of existing online discussion spaces do a poor job of representing the structure and temporal development of conversation threads (Neustaedter et al., 2003). In most online discussion environments, replies to messages are located immediately below the messages to which they respond, and they are indented to represent the "in-reply-to" relationship. However, because the only cue for users to understand the development of

threads are strings of subject-line texts with different levels of indentation, users may have to jump between multiple text strings in order to follow the flow of the discussion. Readers can experience difficulties in maintaining the context when there are frequent shifts in the relevant predecessors (signaled by different levels of un-indents) (Newman, 2002).

The time information of a message is, again, displayed as a text string, usually located immediately after the subject-line of a message. As a result, temporal relationships between messages are lost because they are arranged according to the reply sequence and not according to the times of response. It becomes very difficult for users to uncover the temporal patterns of different threads, making it difficult to retrieve information such as the daily contribution of individual authors, and peak submission periods for different threads.

Another problem in existing discussion interfaces is that they provide inadequate support to help users understand the discussion as a whole. In many instances, discussion threads can lead off to different threads and sub-threads that are interrelated; however, such relationships between threads are not displayed in current interfaces. The only way to understand the entire discussion context, then, is to study the information embedded in the body text of the messages, making it very difficult to do so. The problem is heightened when a number of threads and sub-threads develop simultaneously, which would force users to jump back and forth between threads if they wish to understand the development of the discussion.

Since threads are displayed as individual entities on a screen without any indication of how they are related to each other, existing online discussion environments

present discussions in a fragmented manner. This causes confusion and limits the utility of the channel for complex discussions (Neustaedter et. al., 2003). Again, this situation is worse in synchronous CMC tools because they can only display messages sequentially, based on their time of arrival to the server, but not in order of turn and response in which they were constructed (Smith et al., 2000). A research study conducted by Garcia and Jacobs (1998) reported that a significant number of message turns (as much as 40%) were used to clear up confusions caused by misunderstood messages in prior turns. Without any means of organizing chats messages, logs of chats read much like unedited transcripts of speech (Donath et al., 1999).

2.5.3 Difficulty in preserving contextual information during context switching

Current interfaces typically allow users to choose only a single organization for messages: sort by date, sort by author, or sort into threads. This limits the ability of users to determine the multiple characteristics of the relationships of a given message to the larger discussion simultaneously. Another problem of allowing only one organization at a time is that contextual information will often be lost when one tries to switch between different displays (Donath et al., 1999). Figure 2-4 displays the same discussion in Figure 2.3, but it is now sorted by date. It can be seen clearly that the context of the discussion is lost completely after switching the organization criterion. Moreover, no matter which display is chosen, users of current interfaces are still required to reconstruct the various relationships between threads mentally. Since these reconstructions are performed independently between participants, the audiences' mental picture of the

discussion may not coincide with that of the speaker. Sharing of knowledge becomes

difficult when participants cannot adequately share their mental pictures of the

discussion.

#	S	Subject: 📄	Author: ✉	Date:
		All Messages Sorted by Date		**Top**
2	R	Education or Exploitation?	Janet Smith	Tue, 13 Mar 2001 (21:39)
3	R	Re:Education or Exploitation?	John Turvey	Tue, 13 Mar 2001 (21:41)
4	R	Improper Consent	John Turvey	Tue, 13 Mar 2001 (21:43)
5	R	Re:Education or Exploitation?	Jayce Salloum	Tue, 13 Mar 2001 (21:44)
6	R	Re:Education or Exploitation?	Lincoln Clarkes	Tue, 13 Mar 2001 (21:47)
7	R	Re:Improper Consent	Lincoln Clarkes	Tue, 13 Mar 2001 (21:48)
8	R	Education	Lincoln Clarkes	Tue, 13 Mar 2001 (21:49)
9	R	Is Exploitation too strong a word	Janet Smith	Tue, 13 Mar 2001 (21:51)
10	R	Why shoot only women?	Janet Smith	Tue, 13 Mar 2001 (21:52)
11	R	Re:Is Exploitation too strong a word	Lincoln Clarkes	Tue, 13 Mar 2001 (21:53)
12	R	Re:Education	Al Arsenault	Tue, 13 Mar 2001 (21:55)
13	ᴿᴼ	Or Stereotyping?	Bernadette Phan	Tue, 13 Mar 2001 (21:57)
14	ᴿᴼ	Re:Improper Consent	Judy McGuire	Tue, 13 Mar 2001 (21:59)
15	ᴿᴼ	Re:Why shoot only women?	Lincoln Clarkes	Tue, 13 Mar 2001 (22:00)
16	ᴿᴼ	Re:Or Stereotyping?	John Turvey	Tue, 13 Mar 2001 (22:01)
17	ᴿᴼ	Re:Improper Consent	Al Arsenault	Tue, 13 Mar 2001 (22:03)
18	ᴿᴼ	Re:Or Stereotyping?	Jayce Salloum	Tue, 13 Mar 2001 (22:04)
19	ᴿᴼ	Message to the world!	Al Arsenault	Tue, 13 Mar 2001 (22:05)
20	ᴿᴼ	Personal Involvement	Lincoln Clarkes	Tue, 13 Mar 2001 (22:06)
		All Messages Sorted by Date		**Top**

Figure 2-4 The same discussion as in Figure 2.3, but is sorted by date (Used with permission from SFU)

Lacking the ability to organize messages, synchronous CMC tools are a worse

choice in conducting discussions than thread-based discussion tools. As stated by Hiltz

and Turoff (1978), "of all the communication forums and conditions permitted by

computerized conferencing, the synchronous discussion seems to cause the most

difficulty and feelings of confusion."

Of the usability problems which have been discussed, it seems clear that the lack

of visual support in discussion interfaces has resulted in difficulties and confusion for

users trying to better understand online discussions. To address these problems, research

in this area has mainly focused on providing users with better visual support. These

research efforts will be presented in the next section.

2.6 Research Efforts in CMC Visualization

We have discussed some of the usability issues associated with the current synchronous and asynchronous CMC discussion tools in the previous section. It is obvious that the lack of visual cues in text-based tools has contributed many of the problems. Therefore, a solution that presents discussions more visually and allows users to gain insight into, and interact with, the discussion more easily indicates a promising research direction. These requirements are the general research goal in the field of information visualization, which is defined as the use of computer supported, interactive, visual representation, of non-geometric data, in order to gain insight into the information (Card et al., 1999). In the following sections, a brief history and the current research efforts on applying information visualization techniques to CMC tools will be summarized and discussed.

2.6.1 Brief History of CMC Visualization

The first research project done on applying visualization techniques to CMC was the Visual Who project (Donath, 1995). Using data such as mailing list subscriptions, Visual Who created a spring-based visualization to depict the patterns of affiliation within a community. A few years later, Donath proposed two other research prototypes, Chat Circles and Loom, which visualized Internet Chats and Usenet newsgroups (Donath, 1999).

This work soon caught the attention of different research communities, particularly in the field of sociology. Sociologists are interested in gaining insights into

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different social attributes embedded in CMC. Examples of such attributes include participants' (or the entire groups') activity, structure of conversations, interconnection between participants, and the content of messages (Smith and Fiore, 2001). As a result, a new sub-field in information visualization, social visualization, emerged. Social visualization involves the visualization of social information for social purposes (Donath, 1999). Many research projects and prototypes appeared in the years following, all of which provided visualizations of different types of CMC mechanisms. These include chat (Erickson et al., 1999; Donath et al., 1999; Popolov et al., 2000; Smith et al., 2000), email (Rohall et al., 2001; Kerr, 2003) and Usenet newsgroups (Xiong and Donath, 1999; Sack, 2000a; Smith and Fiore, 2001; Viegas and Smith, 2004; Perry and Donath, 2004; Xiong et al., 1998; Neustaedter et al., 2003).

2.6.2 Proposed Solutions

Information visualization techniques have been applied in various degrees to CMC tools and it seems to be a promising direction. There are two major categories in this area. Research projects in the first category attempt to depict the characteristics and behaviours of authors in online discussions. The second category focuses on revealing contextual information of discussions, such as the flow and the development of threads. A summary of the suggested solutions is presented below.

2.6.2.1 Visualizing Participation

As discussed, one of the major usability problems in current CMC discussion tools is the lack of visual support for participants involved. Without visual support, participants cannot see how many people are participating, nor can they see where the attention of the group is directed. Participants also cannot discern, at a glance, the presence of others, if any, in the conversation (Donath, 1995).

To help participants get an idea of who is present, many systems list the names of all active participants in a separate window (Smith et al., 2000; Erickson et al., 1999; Popolov et al., 2000; Viegas and Smith, 2004; Smith and Fiore, 2001). Some systems take the step further of showing the non-active participants in the current discussion session. Examples include Thread Chat (Smith et al., 2000) and Babble (Erickson et al., 1999).

Some researchers have also been interested in representing participants using different graphical forms. Systems such as Babble (Erickson et al., 1999), Newsgroup Crowds and AuthorLines (Viegas and Smith, 2004), Netscan Dashboard (Smith and Fiore, 2001) and Chat Circles (Donath et. al., 1999) use simple shapes, like circles and dots, to represent participants of a discussion. Differences in size, location on the screen, and colours of the circles are used in the Newsgroup Crowds and AuthorLines system (Viegas and Smith, 2004) to visualize an author's posting pattern in a particular newsgroup and in the entire Usenet.

The Newsgroup Crowds system graphically represents the population of authors in a particular newsgroup (Viegas and Smith, 2004). Each individual participant is

represented by a circle and the placements of these circles depend on the number of posts by the author (x-axis), and the number of days a participant has been active during a time period of one month (y-axis) (Figure 2-5). The size of each author's circle represents the amount of posts this person has contributed to the discussions. The colour of each author's circles reflects how recently this person has posted to the discussion - the brighter the circle, the more recent the posting activity (Viegas and Smith, 2004).
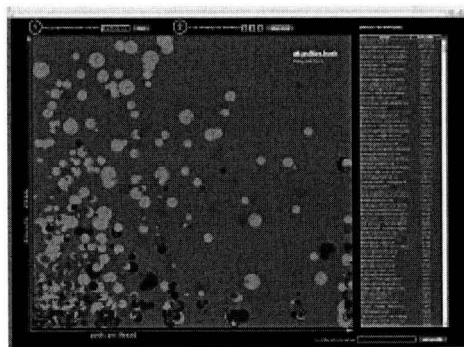
Figure 2-5 Newsgroup Crowds (Viegas and Smith, 2004 © 2004 IEEE)

In AuthorLines, the posting history of an individual over the entire Usenet within a period of one year is shown in a diagram similar to a histogram (Figure 2-6). Using circles in different colours provides users a quick visual means to compare the posting activities among the authors. However, screen cluttering soon becomes a problem when both the number of authors (i.e. the number of individual circles) and the number of their individual posts (i.e. the size of each circle) increase. For example, overlapping of those various-sized circles at the bottom left corner of Figure 2-5 makes it difficult for users who would like to identify each author. A user study has been conducted for these tools and similar results were reported by their subjects. The subjects reported that the tools helped them to view the dynamics of the newsgroup at a glance. However, the subjects

also revealed the major weaknesses of these tools, including the overlapping of circles

and the inability to read individual messages within the visualizations.
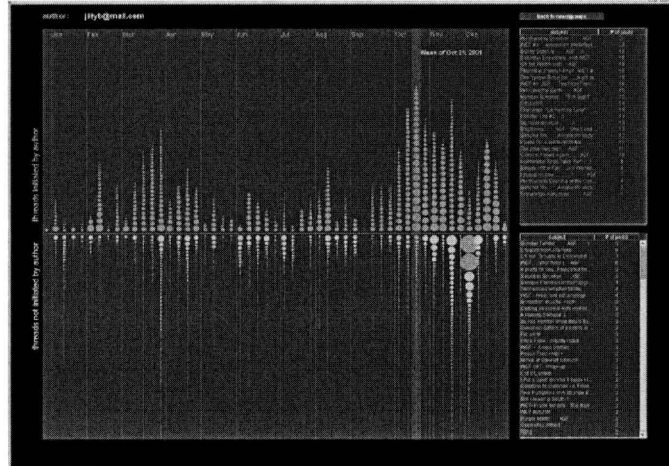
Figure 2-6 Author Lines (Viegas and Smith, 2004 © 2004 IEEE)

Beyond showing the presence of the participants, Babble (Erickson et al., 1999)

uses animations on individuals' circles to represent the interactions between users and the

system (Figure 2-7). Babble is a chat-like communication tool built on client/server

architecture (Erickson et al., 1999). It is composed of 4 panes: a pane showing a list of

all connected users, a pane showing a graphical representation of users' activities called

"social proxy," a pane showing all the discussion topics, and a message pane showing the

messages posted in the current topic.

In the social proxy view, each participant is represented by a coloured circle.

Whenever a user interacts with the system, his/her circle will quickly move towards the

centre of the proxy - this allows participants to view other members' current status (the

middle window in Figure 2-7). A 6-month field study was conducted in the hopes of

understanding the adoption and use of Babble (Bradner et al., 1999). The field study

showed that the adoption of such a new system is a complex process, even for business

groups within the same organization (Bradner et al., 1999). The study concluded that the

local culture of the user group played a major role in effective adoption.
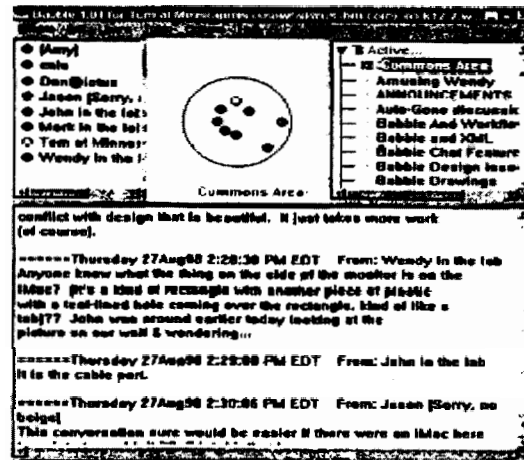
Figure 2-7 Babble (Erickson et al. © 1999 ACM, Inc. Used by permission)

Two (out of the three) visualization tools in the Netscan Dashboard system

proposed by Smith and Fiore (2001) are designed to help users understand the

participation and interactivity among authors of Usenet discussions. The first tool

proposed to use a piano roll display (a variant of the histogram) to list all the participants,

along with their contributions to the thread (label 'B' in Figure 2-8). Network diagrams

were used to visualize the interpersonal connections between participants (label 'C' in

Figure 2-8). In the diagram, participants are represented as circles. Their locations on

the diagram are based on the number of messages sent (x-axis) and the number of replies

received (y-axis). Lines connect those authors who have exchanged messages with each

other, and the thickness of the lines varies directly with how many replies each pair has

exchanged.

The tree visualization of Netscan Dashboard is used to show the structural information of a thread (label 'A' in Figure 2-8). The y-axis of the tree view is divided into gray bands that represent each calendar day during which messages have been posted within the thread's lifetime (Smith and Fiore, 2001). A problem associated with this thread visualization, however, is that the number of the gray bands will increase whenever a message is posted on a date which is not included in the current tree visualization. As a result, in order to accommodate these new gray bands, the shape and the presentation of the thread tree may be different in different runs.

The Netscan Dashboard user study concluded that the perceived usefulness of the application varied among subjects depending on their purposes of using newsgroups. For example, only those using newsgroups for socialization and discussion would find the interpersonal connection component interesting - subjects who used newsgroups merely to buy and sell items did not find this feature useful (Smith and Fiore, 2001).
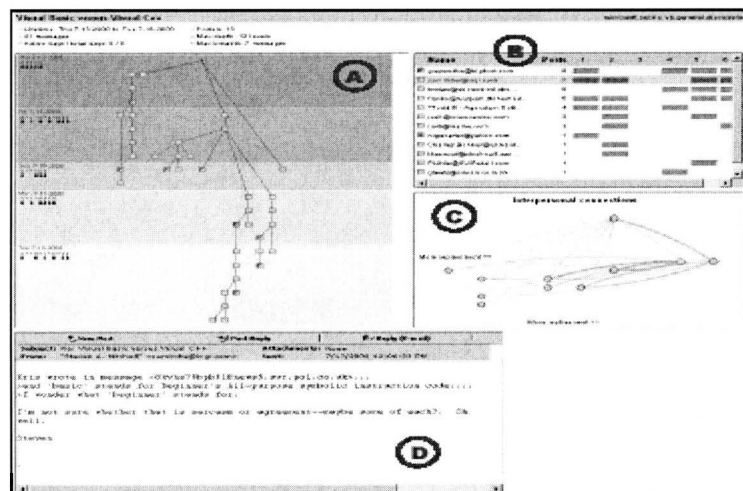
Figure 2-8 Netscan Dashboard (Smith and Fiore © 2001 ACM, Inc. Used by permission)

Some researchers have attempted to depict the online characteristics and behaviours of each participant using novel graphical representations. Two examples are PeopleGarden (Xiong and Donath, 1999) and Anthropomorphic Visualization (Perry and Donath 2004). PeopleGarden (Xiong and Donath, 1999) uses a "flower and garden" metaphor to visualize the participants and their roles in discussion groups. Each participant in the system is represented as a flower. The height of the stem represents how long a participant has been in the discussion. The petals of each flower represent the number of postings of each participant, so a participant with many postings is represented as a widely opened flower. Each discussion group is visualized as a "garden of flowers", with the numbers and shapes of flowers representing the social characteristics of the discussion. For example, the "garden" in Figure 2-9 shows a group with one dominating author (the flower which is fully opened). No user study has been performed on this visualization so its validity as a useful visualization tool is not clear. Furthermore, because the names of the authors are not available, users do not have any ways to identify the identities of each author in the application.
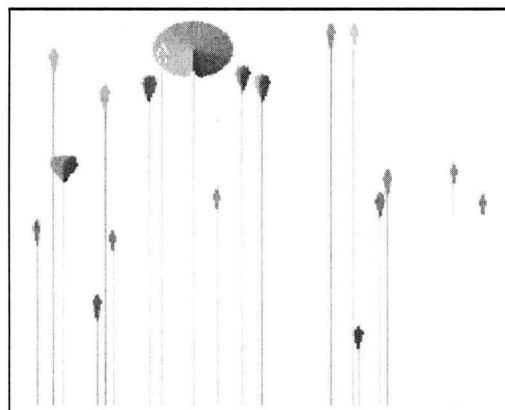
Figure 2-9 PeopleGarden (Xiong and Donath © 1999 ACM, Inc. Used by permission)

Anthropomorphic Visualization is a tool which presents historical information about participants in online spaces. The graphical visualization takes the form of humans called "Anthropomorphs," as the basis for the visualization (Perry and Donath, 2004). The facial expressions of each anthropomorph represent the average emotional tone of each participant, and the size of each anthropomorph's torso represents the total number and the types of posts a participant has written (Figure 2-10). Although the average emotional tone of each participant is visualized, without the capability of displaying the actual messages, this system is probably still hard for users with respect to determining the quality of messages posted by different authors. No user study has ever been conducted for Anthropomorphic Visualization (nor for PeopleGarden), however, and the evaluations of users remain unknown.
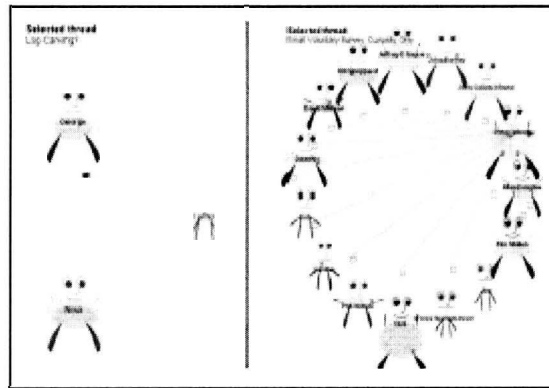
Figure 2-10 Anthropomorphic Visualization (Perry and Donath © 2004 ACM, Inc. Used by permission)

2.6.2.2 Visualizing Discussion

Threading appears in almost all CMC applications, whether it is supported explicitly or implicitly. Unfortunately, visual support of threads is extremely limited, and

most interfaces only use folders and indentations to organize and identify threads. As already noted, the lack of visual support may impede the flow of communication and force users to reconstruct discussions mentally. The following section discusses the research efforts focused on providing better support and visualization of threads in synchronous and asynchronous environments.

The order of messages generated in synchronous CMC applications is based on the time of their arrival to the discussion servers. This means that synchronous CMC applications will not provide users with structural information about the discussion, causing users to easily lose a conversation's context. To alleviate this problem, a number of research prototypes have been developed to help users visualize the flow of discussion in synchronous CMC environments. These include Conversation Space (Popolov et al., 2000) and Chat Circles (Donath et al., 1999).

Conversation Space is a tool which allows users to participate in synchronous conversations (Popolov et al., 2000). The "remarks" pane of this tool allows users to review and create new messages. The main pane is a network diagram visualizing the structure and flow of the conversation - the x-axis represents time and the y-axis represents the generational depth of the discussion. Each node in the diagram contains the entire message and nodes are linked by arrows (Figure 2-11). The main weaknesses of this tool include cluttering and wasting of screen space, especially when messages get longer.
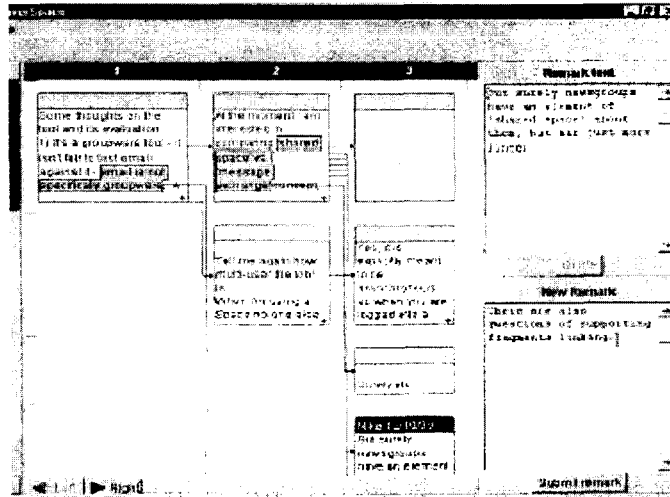
Figure 2-11 Conversation Space (Popolov et al. © 2000 ACM, Inc. Used by permission)

Chat Circles (Donath et al., 1999) is a chat visualization tool which utilizes animations to visualize the flow of a chat session (Figure 2-12). Each participant is represented by a coloured circle. When a person is typing a message, the circle representing him/her grows to make room for the message. The circle also brightens to notify other participants a new message has arrived. After certain amount of time of inactivity the person's circle fades and diminishes and the message disappears, but the circle still remains visible as long as the participant is connected to the system. Viewed over time this system creates a visual record of conversational patterns for a particular chat room (Donath et al., 1999). However, since the messages will disappear after a certain time, users are forced to remember the content of the messages in order to continue the discussion with the others.
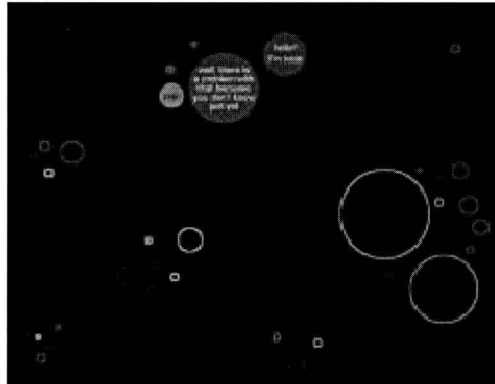
Figure 2-12 Chat Circles (Donath el al., 1999 © 2004 IEEE)

Many researchers agree that threading is a great means to help users manage their communications. Whittaker and Sidner (1996) commented that threading provides users with the context, history and status of a thread. Venolia et al. (2003) found that a threaded email client provides a better local context of messages, as well as a greater global context by collecting messages into threads. Different prototypes have been developed to provide support and visualization of threads in various CMC environments.

Threaded Chats (Smith et al., 2000) is a tool that tries to incorporate the concept of threading into a synchronous chat environment (Figure 2-13). All chat turns in Threaded Chats are structured as a tree, similar to the directory structure found in Microsoft Windows Explorer (Smith et al., 2000). Users can place their messages into any thread. Subjects in the Threaded Chat user study disliked the system because messages could appear in any thread at anytime. Consequently, the system did not provide them with a single point of focus for locating new messages. As a result, subjects were faced with confusion and reported that they could not follow the discussion (Smith et al., 2000).
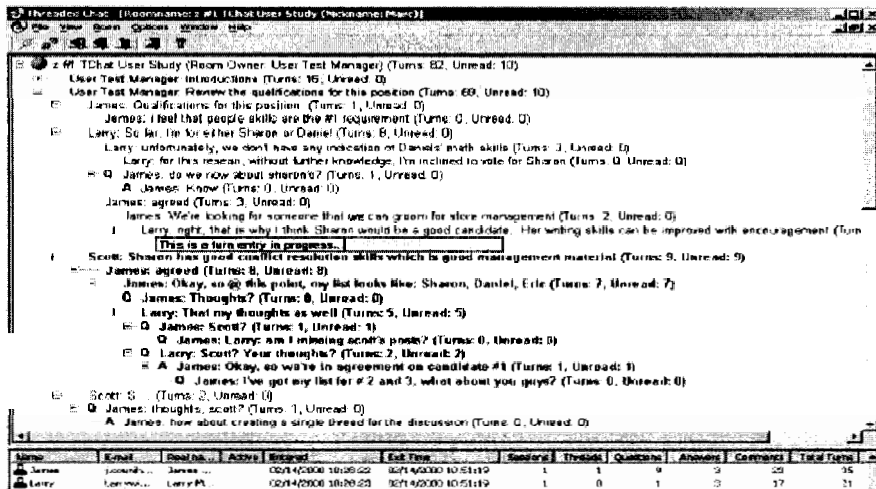
Figure 2-13 Threaded Chat (Smith et al. © 2000 ACM, Inc. Used by permission)

A number of research prototypes focus on visualizing the conversation threads within email messages. In particular, tree-node diagrams (used in ReMail (Rohall et al., 2001)) and Thread Arcs (Kerr, 2003) have been designed to visualize email threads.

An on-going research effort on email visualization is the Reinventing Mail (ReMail) project (Rohall et al., 2001), which is led by a research group at IBM Research. This tool uses a tree structure, combined with timelines (#5 in Figure 2-14) to visualize the relationships among messages in a thread and among people involved in the conversation (Rohall et al., 2001). Once selected, the node of the tree is replaced by a reduced-resolution overview of the message (#6 in Figure 2-14). As well, all the messages which belong to the current thread are highlighted (#8 in Figure 2-14), while the message in focus is highlighted with a brighter colour (#7 in Figure 2-14). In one user study, subjects were invited to use a test email client for about two weeks. In general, the subjects found the interface, and especially the threading and message overviews, useful (Rohall and Gruen, 2002).
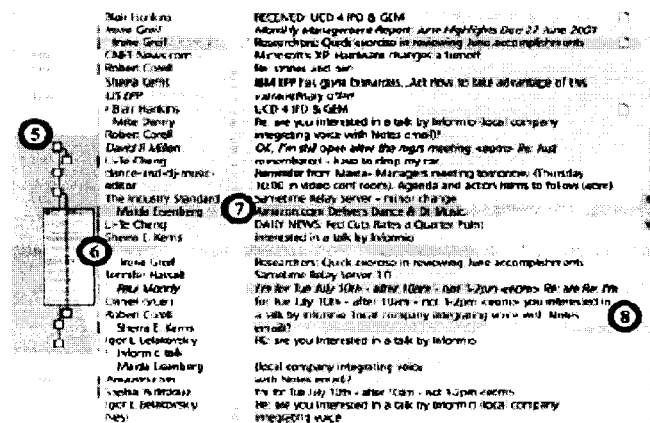
Figure 2-14 ReMail (Rohall et al., 2001 © 2004 IEEE)

Thread Arcs (Kerr, 2003) is a visualization technique designed to help people understand the thread structure found in email messages. Nodes are located from left to right in chronological order in a linear layout. The structural relationships between messages are visualized by the "reply-to" arcs connecting them (Figure 2-15). This technique has been incorporated into an email client prototype and compared to two other email threads visualization techniques (Tree Tables found in Venolia and Neustaedter, 2003 and Tree Diagram found in Rohall et al., 2001). The results of the user study proved Thread Arcs to be more stable, compact, and supportive of chronology visualization. The presentation of the Thread Arcs is compact. However, two problems may arise when the number of email messages increases. The temporal order of the messages is indicated by their location in Thread Arc's linear layout. However, if the length of the layout exceeds the screen's width (due to a large number of messages), it then becomes more difficult for users to follow such ordering. Similarly, it becomes more difficult to read and understand the "reply to" arcs with a large number of email messages.

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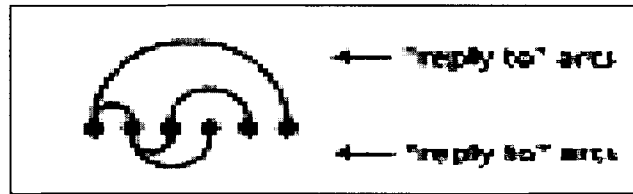
Figure 2-15 Thread Arcs (Kerr, 2003 © 2004 IEEE)

In addition to the Netscan Dashboard (Smith and Fiore, 2001) system mentioned

earlier, there are also a number of systems which help users understand the structural

information of Usenet discussions through visualization of discussion threads. Two such

systems are Conversation Map (Sack, 2000a) and Grand Central Usenet (Neustaedter et

al., 2003).

Conversation Map is a content-based Usenet newsgroup browser/reader which

utilizes computational linguistics in analyzing messages in a discussion group (Sack,

2000a). Each of the threads of the discussion are displayed as a "spider web" in the

lower pane of Figure 2-16. When a thread is selected, the details of the thread are

displayed in the upper pane. These details include: a social network depicting the

relationships among authors (the left window in the upper pane of Figure 2-16), a list of

"discussion themes" that are frequently used (the middle window in the upper pane of

Figure 2-16), and a semantic network representing the relationships between the major

terms being discussed in the group (the right window in the upper pane of Figure 2-16).

Conversation Map does not provide the temporal orders of messages.

Figure 2-16 Conversation Map (Sack © 2000 ACM, Inc. Used by permission)

Grand Central Usenet (Neustaedter et al., 2003) applied the visualization

techniques which were originally used in a thread-based email client prototype (Venolia

and Neustaedter, 2003) to visualize conversations in Usenet newsgroups. The application

uses a thread tree visualization to help users understand both the reply structure and the

temporal order of a thread (nodes are arranged chronologically with the newest message

appearing at the bottom of the tree). The thread tree is displayed in two levels of details:

a schematic overview (#5 in Figure 2-17) and a detailed view with the actual messages

inside the nodes of the tree (#6 in Figure 2-17). A user study concluded this application

was more effective than Outlook Express in helping subjects gain a high level

understanding of a thread. Screen overloading and lack of text search function were the

major shortcomings reported by subjects.

Figure 2-17 Grand Central Usenet (Neustaedter et al., 2003, used with permission from the author)

The Usenet Collaboration Visualization, a tool developed by Xiong et al. (1998),

provides visualizations of Usenet discussions from a different perspective. It is designed

to visualize the interaction context between authors in Usenet, in multiple levels of details

(Xiong et al., 1998). This application displays collaborative information between authors

in 4 different views: the Inter-Group View (Figure 2-18) displays all newsgroups linked

by cross-postings, the Inter-Thread View links the threads within a newsgroup sharing

the same authors, the Thread-to-Poster View connects all the authors who have

contributed to a particular thread, and the Inter-Poster View (Figure 2-19) links the

authors who have replied to each other.
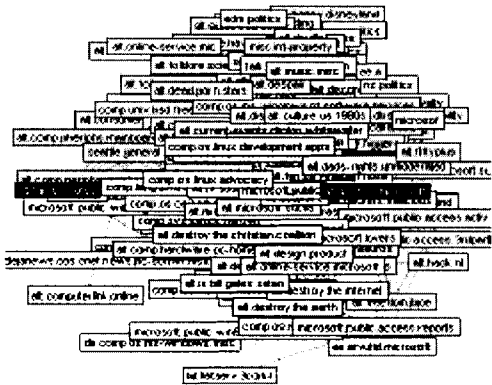
Figure 2-18 The Inter-Group View (Xiong et al., 1998, used with permission from the author)
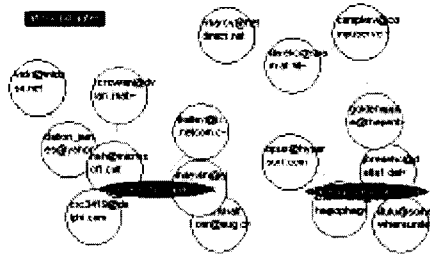
Figure 2-19 The Inter-Poster View (Xiong et al., 1998, used with permission from the author)

A unique characteristic of this application is that it provides users with visualizations which allow them to understand the relationships among threads and between newsgroups. This capability is not found in most of the discussion visualization applications which focus on visualizing a single thread at any given time.

A number of usability problems in current text-based discussion interfaces have been identified in this chapter. These problems, including the limited support provided to assist users understand who, when and how interactions take place in the discussions, and the loss of discussion context due to frequent switching, have prevented users from gaining a better understanding of discussion spaces. Current researches (e.g. Sack,

2000a; Smith and Fiore, 2001 and Viegas and Smith, 2004) focus on providing better visual support to allow users to understand the participation and development of the discussions, pointing to a promising research direction. However, all existing tools we were able to find are designed to support general browsing through discussion spaces, which differs from our purpose of providing course instructors with tools to analyze and evaluate structured, course-based discussions. Our target users, the discussion environments they work with, and their needs and requirements, will be presented in the next chapter.

CHAPTER 3: CZTALK: OUR SOLUTION

3.1 Evolution of CZTalk

The research goal of this thesis is to develop tools which help users, in particular

course instructors, better understand the relationships between messages and the overall

trends and patterns of structured, course-based discussions. The research prototype for

this project, CZTalk, was originally designed and developed by Heidi Lam, an

undergraduate student at SFU (Lam, 2001).

CZTalk is based on another research prototype called CZWeb (Figure 3-1). It is a

graphical tool to facilitate navigation of the World Wide Web by automatically

generating a flexible map of the web sites which have been visited by users. A unique

feature in CZWeb is the implementation of a multi-focus fisheye zooming algorithm

called the Continuous Zoom algorithm (Bartram et al., 1995). It is a distorted view

method for displaying hierarchically-organized, two-dimensional networks. Organizing

the top page of a web site as a container node and the subsequent web pages as nodes

contained within the container node, CZWeb allows users not only to expand and

collapse the container nodes for easier navigation, it also helps preserve the context of the

map so the entire web navigation history is always available to the users.
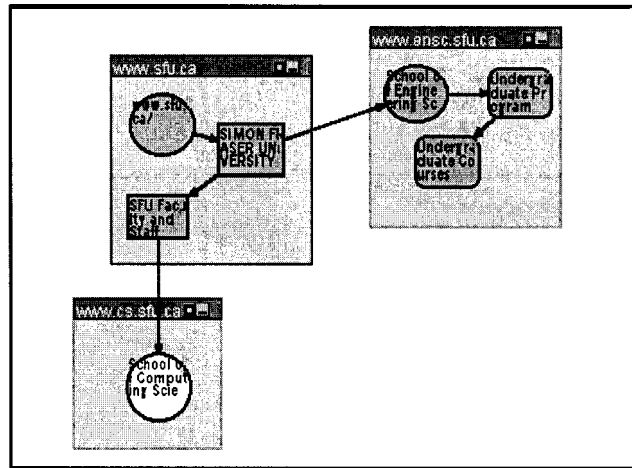
Figure 3-1 CZWeb Interface (Used with permission from the author)

Concepts and features of CZWeb were later adapted as the basis of CZTalk, a research prototype which attempts to provide a better visual support for online discussion forums (Lam, 2001). The discussion environments focused on were open, unstructured discussions where everyone could contribute to any discussion topic at anytime. The tool was targeted for causal discussions by the general public. Its focus was to convey relational and structural information to users during their navigation of the discussions.

During discussions with groups at SFU, it became apparent that there was significant potential for further developing CZTalk as a more specialized tool to help course instructors better understand course-based online discussions and evaluate student performances in such spaces. The target audience of the current CZTalk project is described in the next section.

3.2 Target Audience

CZTalk was originally designed as a general-purpose online discussion visualization tool and did not have any specific targeted audiences. However, after a few demonstrations of CZTalk to the eLearning Innovation Centre (eLINC) research group at Simon Fraser University's Surrey Campus, the tool caught the attention of course instructors responsible for the Foundations of Teamwork and Communications (FTC) courses taught at SFU's Surrey campus. The objective of these courses is to allow the students to understand basic concepts and practices in developing effective teamwork and communication skills.

The delivery model for these courses is a mixed collaborative learning model, which means classes alternate between weekly face to face and online sessions. Face to face sessions last 1 hour and 50 minutes and typically contain a short, informative lecture, followed by team-based, collaborative exercises. Online conferences are operated as a task-based team discussion that runs from Tuesday to Friday every other week. The instructor typically acts as coach and moderator, providing guidance and help when needed, but primarily allowing students to participate in, and run their own conferencing sessions.

These courses enjoy a high enrolment, with an average of 350 students enrolled every semester. Due to the large class sizes, these courses are usually managed and administered by a number of course instructors and teaching assistants. For example, the Tech100 (Foundations of Teamwork and Communication I) course had a class size of 445 students in the Fall semester of 2004, and was administered by 3 course instructors

and 4 teaching assistants. Currently, course instructors use an online discussion system

called Course Management System (CMS) (Figure 3-2) to facilitate online discussion

sessions.
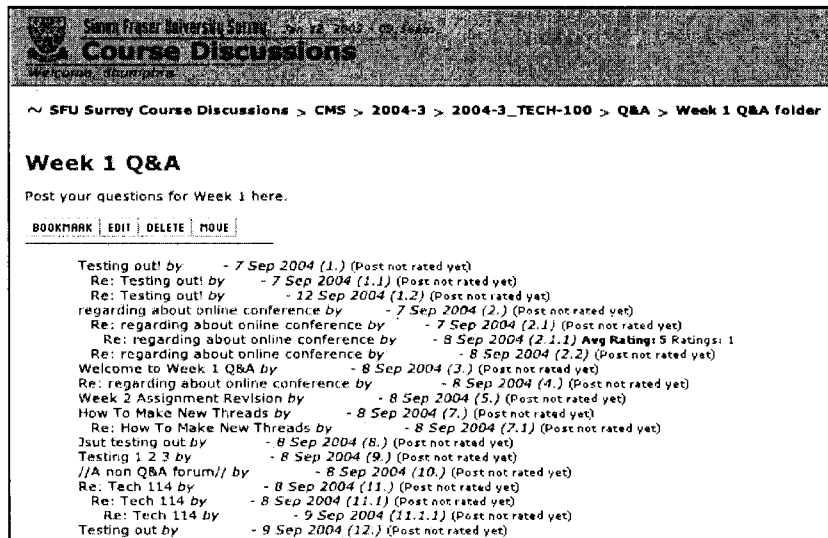
Figure 3-2 Course Management System interface (Used with permission from SFU)

After a few formal and informal meetings with instructors, we discovered that

they were interested in a tool which would allow them to gain insight and perform

analysis and evaluation of student conferences. Recognizing a match between CZTalk

and their needs, we have decided to work together to create a tool which would perform

their desired functions. By inserting additional functionalities and features to CZTalk, we

hope that it will become a useful visualization tool for course instructors to analyze

messages in online discussion forums within the context of a classroom environment.

To better understand the activities that would be performed by course instructors

who are trying to evaluate student performances in online discussions, a requirement

analysis was conducted with course instructors, using various formal and informal

discussions. The activities identified and their implications for the design of our visualization tool are presented in the next section.

3.3 Requirement Analysis

Through a number of discussions with the course instructors, six activities were identified as essential functions performed by course instructors for the purposes of evaluation. These essential functions include participation analysis, interaction analysis, time analysis, keyword search, annotating messages and prioritizing messages.

Activity 1: Participation Analysis

Perhaps the most important aspect of a classroom discussion is the participation of students. Without students' participation, an online discussion forum is nothing but an empty page. As a course instructor, it is very important to understand students' rate of participation because it allows instructors to attain a better understanding of each individual's contribution to the discussion. A visualization tool should support this at two levels:

- It should allow an instructor to understand students' overall participation within the entire discussion. With this capability, a course instructor will be able to identify the frequent contributors to the discussion as well as those whose participation is low.
- The tool should also allow an instructor to analyze participation levels within each individual discussion topic. With the help of this tool, the instructor should be

able to tell which students are involved in a particular thread, and which of those students are the most active.

Activity 2: Interaction Analysis

In addition to knowing which students have made the most contributions, it is also important to see how students respond to posted messages. A visualization tool should help an instructor understand the interaction between students in two ways:

- The type of interaction - In some cases, messages receive responses in a reply pattern, with each message being posted in reply to a previous message. Another possible pattern is a star-based reply pattern, where only a few messages receive the majority of responses. A visualization tool should allow a course instructor to identify the reply pattern visually.

- Number of replies received by each participant - A course instructor is also interested in knowing the number of replies received by each participant. By comparing and contrasting these numbers between students, a course instructor will be better able to sort out which participant's postings attract more attention by other students.

Activity 3: Time Analysis

One of the characteristics specific to a classroom discussion is its emphasis on time. For example, on the day before a midterm examination is to take place or an assignment is due, a discussion forum will usually be flooded with related messages. It is important for a course instructor to be able to identify students who have submitted the

requirements before the deadline and those who have not. To assist a course instructor in doing this time-based analysis, a visualization tool should provide mechanisms for the instructor to select a range of time dynamically, and then perform other analyses over that time range. An example of such analysis is to understand the posting history of each student over a specified period of time.

Activity 4: Keyword Search

There are times when an instructor would want to identify messages that discuss only a few key concepts. A tool that supports searching message content for specified keywords should help instructors quickly identify messages containing such words and allow them to examine the results in detail later.

Activity 5: Annotating Messages

Instructors often discover interesting postings which he/she would wish to annotate for subsequent review. A tool supporting annotation with visual marking can help instructors to identify and view the annotations easily.

Activity 6: Prioritizing Messages

Often, a visual way to categorize messages according to the message's importance would be helpful to an instructor facing a large number of messages. A tool which allows instructors to prioritize messages can thus be very useful.

3.4 Problem Statement

In this section, we state the problems that we are aiming at, as well as the solutions we believe could help to resolve them. Analysis and discussion of the CZTalk design and development will be presented in the following sections.

Existing text-based discussion interfaces have many usability problems. These problems lead to confusion and difficulty for users trying to understand their discussion spaces. Of the solutions that have been proposed to address usability problems, it is evident that a better visual support to provide users with contextual and structural information through thread visualizations would be of interest to users and researchers alike. Results from various user studies also suggest that better visual support enable users to understand discussions with more clarity and in more detail.

Understanding the relationships between messages and the overall patterns and trends of the entire discussion is particularly important for instructors who need to evaluate student performances; this is especially important for course-based online discussion environments. Based on the requirement analysis conducted with instructors, a number of activities which would be performed by instructors during discussion evaluations have been identified.

Instructors need to perform analyses of student participation, interactions among them, and the time aspects of discussions. This suggests that a tool should allow instructors to understand the context and the history of the interactions which take place in such environments. Mechanisms to allow instructors to search, annotate and prioritize

messages are also necessary for instructors to understand and evaluate the qualitative aspects of the discussion messages.

Our goal is to design and develop a visualization tool that provides not only contextual information about discussions, but also tools for instructors to access both quantitative and qualitative measures of student performance in course-based online discussions. We wish to display the content of messages in detail, while preserving both the contextual overview and presenting the relationships among messages. We have designed and developed CZTalk, a research prototype which illustrates the approaches we have developed to address the problem.

CZTalk is designed as a new multi-view user interface that helps instructors understand the relationships between messages and the overall patterns and trends of all the messages posted in online discussions. It renders a graphical, detail-in-context, network display of discussion messages, showing both the contextual information and conversation history of a discussion visually. Colour-encoding of message attributes offers a visual overview of the discussion, permitting users to filter messages and detect patterns while retaining the overall context of the discussion. We have developed a dynamic time slider which lets users query on the temporal characteristics of a discussion. The various statistical summaries of a discussion, available in numerical, tabular and graphical formats, will provide users with quantitative overviews of the discussion. The ability to open multiple messages simultaneously will help instructors compare and contrast messages generated by students within the same discussion and across multiple conferences. CZTalk also allows instructors to search, annotate and prioritize messages according to their content. This helps instructors comment on and

categorize messages with regards to the qualitative aspects of messages. Our purpose is to help course instructors gain better insight into a discussion so that evaluations can become a more efficient and effective experience for them.

3.5 CZTalk System Overview

CZTalk is a standalone application developed using the Microsoft Visual C++ language. It is an online discussion visualization tool which can accept a number of different message formats and display them in its environment.

The original implementation of CZTalk focused on visualizing open, unstructured discussions and it did not have good support for evaluation of messages in the team-based collaborative environment found in structured discussions. The primary focus of the current implementation of CZTalk is to provide course instructors an analysis tool with better visualizations of the discussion so they can gain better insight into the discussions and interact with the information in a simpler manner.

CZTalk is a multi-view application composed of 3 major views (Figure 3-3). The Discussion Map view displays a graphical overview of the entire discussion. Users can choose to display the structural relationships or the temporal order between messages in this view. They also have the option to display both relationships simultaneously. The Participant Window view lists all discussion participants. The statistical summaries of individual contributions (including the total number of messages posted and the average length of messages composed by each participant) displayed in this view allows users to

easily obtain quantitative information. The Message Window view displays the content

of selected messages.
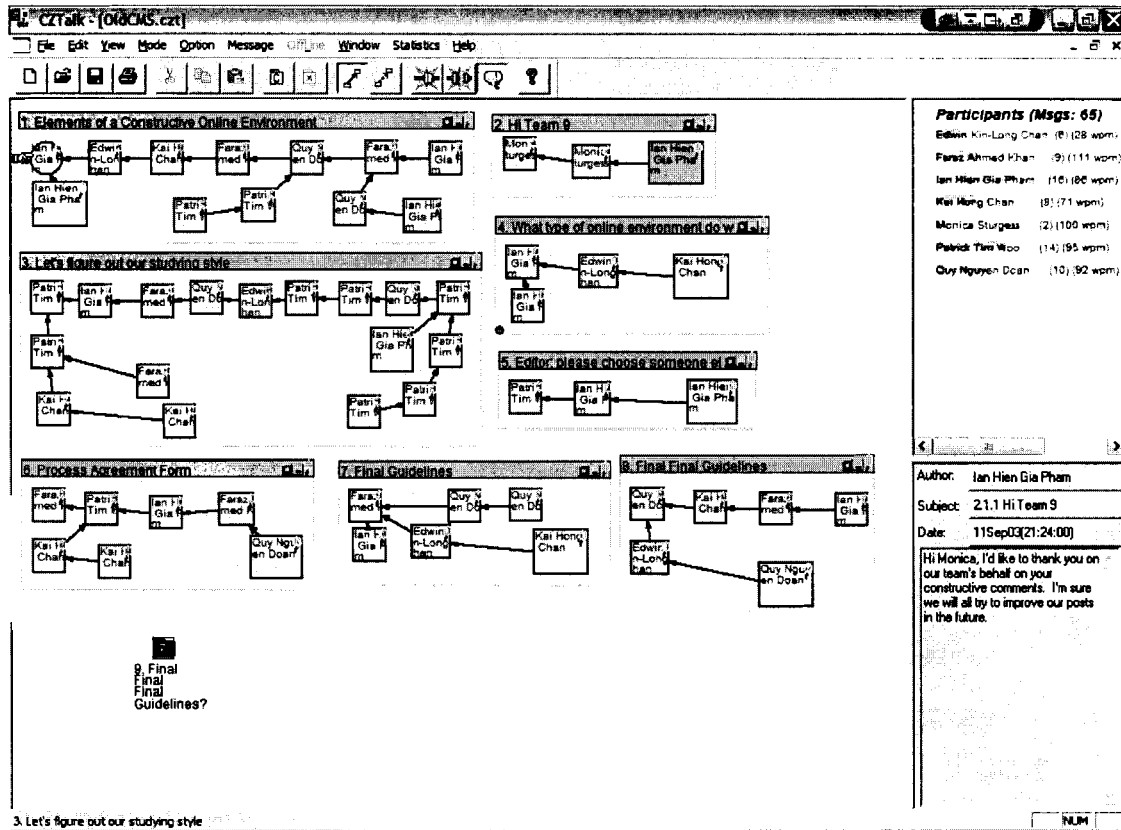
Figure 3-3 CZTalk Interface

Two additional panels are available for each discussion thread in the Discussion

Map view. The Thread Interaction Table view displays the number of replies that have

been sent and received by each participants of a thread. The Thread Statistics view

displays the same statistical summaries of individual contributions found in the

Participant Window view, but is restricted to the current thread only. In addition to using

the Message Window view to display a single message, users can also double click on

messages of interest and they will be displayed in separate Modeless Message Window

views. Users can also open the Annotation view and create an annotation on either a message or a thread.

Five highlighting options are available in CZTalk to allow users to formulate queries based on different message attributes. The Participant Highlighting option allows users to highlight all the messages posted by a particular participant. By highlighting all the messages that are within the same thread, users can quickly recognize the contributors of any thread. Users can use the Dynamic Time Slider control to highlight all the messages which have been posted within a certain time period. The remaining 2 highlighting options focus on the content of the discussion messages. The Keyword Search function on the message's content allows users to quickly identify messages that contain the same keyword(s). CZTalk also provides users the capability to highlight messages based on their priority. With this highlighting option, users can categorize messages based on their levels of perceived importance.

The capability of sending and receiving email messages has also been incorporated into CZTalk. This function allows users to conduct discussions through the use of email discussion services like listserv. Combined with the tools and features which have been implemented for analysis and evaluation of discussions, CZTalk is then a complete communication tool which provides visual support at both message generation, and discussion analysis and evaluation stages.

3.6 Data Source

The original version of CZTalk was only capable of downloading and displaying GEN online discussions, a format developed by SFU students. To cope with the increasing popularity of other online discussion formats used by course instructors at SFU, changes to CZTalk have been made so that it is now able to accept 2 other commercially available message formats, WebCT and Web Crossing (CMS) discussions.

In addition to downloading and displaying discussion threads in a single discussion, CZTalk supports downloading individual threads from multiple conferences and displaying them in a single CZTalk session. This capability allows users to compare and contrast not only the messages within a discussion, but also threads across multiple discussions. Instructors can thus perform cross-conference analyses on discussion messages.

The ability to send and receive email messages has transformed CZTalk into a "live" tool. This new feature will help instructors in 2 ways. Firstly, instructors can now send email to individual students instead of sending a reply to the discussion which would be visible to all participants, enabling more personalized comments and suggestions to students which may not be suitable for general reading. The ability to communicate with the outside world also creates new opportunities for CZTalk to become a complete communication tool. For example, by connecting all the participants of a discussion with the same listserv email address, both the students and the course instructor can generate and read discussion messages within the CZTalk environment.

Implementation details on the enhancements of CZTalk and their implications in course-based online discussion evaluations are given in the following sections.

3.7 CZTalk Views

3.7.1 Discussion Map View

The Discussion Map view (Figure 3-4) is the main view of CZTalk, as it is the main area of display and user interaction. The thread structure of a discussion is represented in CZTalk by a "messages in containers" metaphor: threads (with label 'a' in Figure 3-4) are represented as rectangular containers and the messages (with label 'b' in Figure 3-4) which share the same thread are contained within the same containers. Messages are connected by arrows which represent the "in-reply-to" relationship between messages. The container nodes (threads) can shrink into a folder icon when the user clicks on the minimize button at the top right corner of each container node (an example of a folder icon appears at the lower left hand corner in Figure 3-4). Hiding unnecessary threads should help users focus on the threads of current interest.

Figure 3-4 Discussion Map View

In addition to "reply-to" arrows, CZTalk can show temporal order between

messages through the use of "time" arrows. With the direction running from the oldest to

the newest messages, these arrows allow users to quickly understand the order of arrival

of the messages in a discussion. In order to distinguish between them, the "reply-to"

arrows and the "time" arrows are represented in different colours (blue and red

respectively) and in different line shapes (solid and dotted lines respectively). Users can

display both arrows simultaneously to obtain both structural and temporal information

about the discussion (Figure 3-5).

Figure 3-5 "Reply-to" (blue) and "Time" (red) arrows

The "time" arrows are particularly useful if the reply sequence of a thread is not

linear, i.e. where there is at least one message in the thread which has received more than

one reply. For example, unlike the linear reply sequence in Figure 3-5, messages with

labels 'b' and 'c' are both replies to the message 'a' in Figure 3-6. Clearly, it is not

possible to determine whether message 'b' or 'c' is the first reply to message 'a' by only

following the "reply-to" arrows. The "time" arrows then become very helpful because

they allow the instructors to quickly see the temporal order of messages.
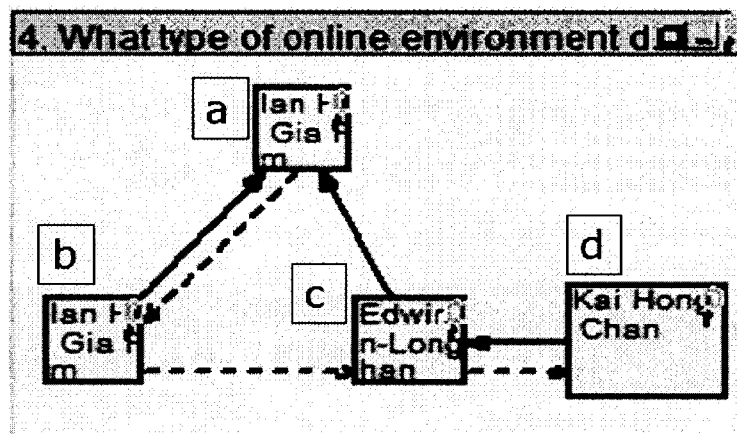
Figure 3-6 Temporal order between messages in a thread with a non-linear reply sequence

We also added new tooltip boxes to display the attributes of a message (subject,

author, and the time posted) whenever users hover the cursor over a message, providing

users with a quicker access to the message attributes.

With the visual overview of the discussion, the instructors can see the flow of the

discussion and the development of each thread visually. The visual overview of the

discussion helps instructors avoid to the need to mentally reconstruct the discussion and

saves a significant amount of mental effort (Ho, 2002). This display also helps

instructors identify threads which draw more attention than others quickly (i.e. threads which contain more message nodes). Furthermore, because the reply sequences between messages are displayed visually with "reply-to" arrows, instructors can easily identify reply patterns exhibited by each thread. For example, the clear distinctions between a thread with a long sequence of replies and a thread whose discussion is focused on a few key messages should provide instructors an overview of the nature of the interactions between students. The temporal arrows between messages present instructors with an overview of how threads evolve over time.

Four auxiliary views are available from the Discussion Map view: the Annotation view, the Thread Interaction Table view, the Thread Statistics view and the Modeless Message Window view. They are described below.

3.7.2 Annotation View

Users can open the annotation view after right clicking on either a message or a container node (thread) and choosing the corresponding option from the context menu (Figure 3-7). Once annotation text has been typed in and the window is closed, a green annotation mark will appear at the bottom left hand corner of the corresponding node to remind the user that the node has been annotated (Figure 3-7).
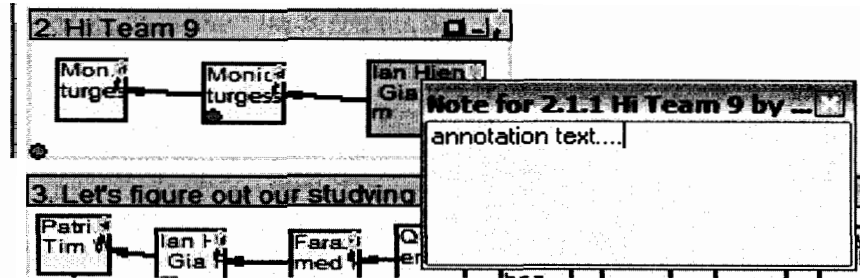
Figure 3-7 Annotation View and Annotation Marks (on both message and container nodes)

Message annotation serves several functions for course instructors. First, it allows instructors to write comments on messages which show, for example, a deep understanding of the subject matter. The annotation an instructor has made can also serve to remind him/her of each message's contribution when conducting evaluations at a later time. Furthermore, annotation can also remind an instructor of the important issues found in a discussion which should be revisited during regular classroom sessions. Annotation therefore is not only a personal reminder for instructors, but also a communication tool between the instructors and the students.

3.7.3   Thread Interaction Table View

The Thread Interaction Table is a new feature in CZTalk. It displays the number of replies which have been sent and received by each student participating in a particular thread (Figure 3-8). The rows in the table represent the senders, and the columns represent the recipients.

Topic 3. Let's figure out our studying style						
From -> ReplyTo	Edwin	Faraz	Ian Hien	Kai Hong	Patrick Tim	Quy
Edwin Kin-Long	.	.	.	.	.	1
Faraz Ahmed	.	.	1	.	1	.
Ian Hien Gia	.	.	.	.	2	.
Kai Hong Chan	.	.	.	1	1	.
Patrick Tim Woo	1	.	.	.	5	1
Quy Nguyen	.	1	.	.	1	.

Figure 3-8 Thread Interaction Table View

An interaction table can help the instructors understand the interactions between students in a number of ways. Firstly, by following the rows of the table, an instructor can determine which student has sent the highest number of replies, and how these replies are distributed among participants, which can serve as an indication of the involvement of each student in a thread. By following the columns of the table, instructors can recognize students receiving more attention, and in particular, from whom. This gives an instructor a detailed depiction of the interaction between students down to individual levels.

The interaction table also partially helps determine the quality of the messages posted by a given student as perceived by his/her peers. For example, if a student sent a lot of messages to others, but has only received a few replies, his/her messages might either have been short and trivial so as not to draw much interest from other students, or, the messages could have been unrelated to the current topics so as not to warrant further response. A student who has posted only a small number of messages but receives a large amount of feedback, on the other hand, may have posted comments of much common interest to other students. These numbers give the instructors additional information about the role of each student in a thread before reading their postings in details.

3.7.4 Thread Statistics View

The Thread Statistics view is another new CZTalk feature designed specifically

for instructors. This view displays quantitative thread summaries (Figure 3-9), showing

the total number of messages a thread contains, and listing all the active participants of a

thread. The number of postings contributed by each student is shown in this view as both

numbers and as histograms imposed on the names of each student. The average length of

the postings generated by each student is displayed immediately next to the number of

contributions.
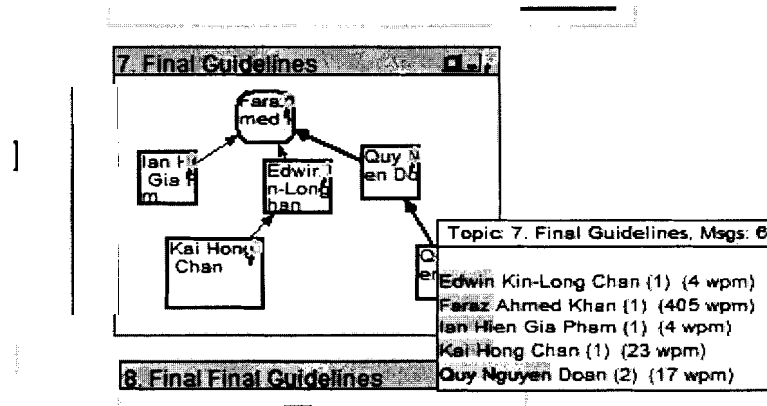
Figure 3-9 Thread Statistics View

Thread statistical summaries help instructors identify frequent contributors of

each thread. The histograms imposed on the names of each student provide instructors

with a graphical means to compare student participation in each thread. The average

length of messages posted by each student can help instructors partially determine the

quality of messages generated. For example, if most of the postings generated by a

student were very short, this could indicate that the messages produced were simple,

trivial, or "yes or no" type responses that do not reflect a high level of understanding of

the subject matter.

3.7.5 Modeless Message Window View

Users can view the content of messages using the Message Window view;

likewise, users can also view message content in separate modeless message windows, by

double clicking on the messages of interest (Figure 3-10). Since the messages windows

are modeless, users can open and read multiple messages at the same time.
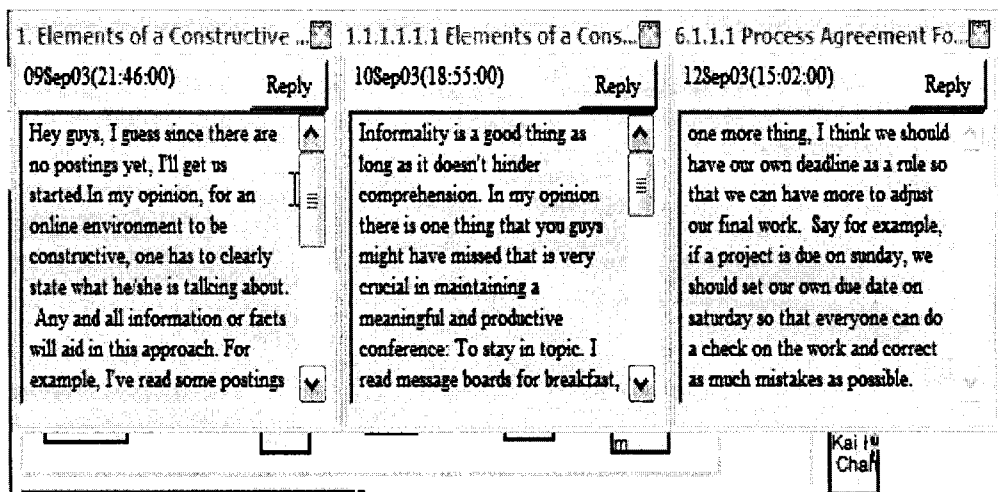
Figure 3-10 Modeless Message Window View

From time to time, an instructor may need to compare and contrast multiple

postings so as to understand their learning progress. The modeless message windows

provide instructors with the ability to view multiple messages simultaneously, without

losing the context of the discussion that would result in switching between messages.

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3.7.6 Participant Window View

All the participants of the discussion, along with the statistical summaries of their contributions to the discussion, are displayed in the Participant Window view (Figure 3-11). This view allows the instructors to quickly identify the participants of a discussion. Similar to that in the Thread Statistics view, the statistics of the entire discussion allows the instructors to obtain a quantitative overview of the discussion at a glance.

Participants (Msgs: 65)
```
Edwin Kin-Long Chan    (6) (28 wpm)
Faraz Ahmed Khan       (9) (111 wpm)
Ian Hien Gia Pham      (16) (86 wpm)
Kai Hong Chan          (8) (71 wpm)
Monica Sturgess        (2) (100 wpm)
Patrick Tim Woo        (14) (95 wpm)
Quy Nguyen Doan        (10) (92 wpm)
```

Figure 3-11 Participant Window View

3.7.7 Message Window View

The content of a message is displayed in the Message Window view when a message in the Discussion Map view is selected by a user (Figure 3-12). An enhancement to this view is that the attributes of a message (author, subject, time posted) have been implemented as buttons which can be used as shortcuts to perform attribute highlighting. For example, a mouse click on the author button allows users to highlight all the messages posted by the specified participant.
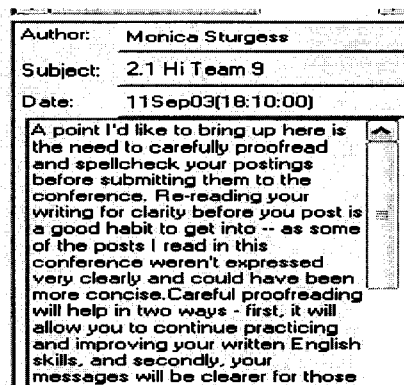
Figure 3-12 Message Window View

This view provides instructors with a fixed location to view message content, helping to avoid switching between web pages typical of other web-based online discussion interfaces. Avoiding switching between web pages helps instructors preserve the context of a discussion.

When reading a message, an instructor may be interested in other aspects which relate to the current message, such as the posting history of the student. The buttons on top of the message attributes give instructors a quick way to highlight those attributes.

3.8   Attribute Highlighting in CZTalk

To help instructors visually locate messages of interest, CZTalk provides five highlighting options based on message attributes. The five options are: highlight by participant, by subject, by time, by priority and by message content (keyword).

3.8.1 Highlight by Participant

The way a group works is very much dependent on the personal characteristics of its members (Santoro et al., 2004). Therefore it is necessary to analyze individual performance in a discussion in order to understand the dynamics of the group as a whole. Participant highlighting in CZTalk allows the instructors to colour-encode the messages written by a specified student (Figure 3-13). This helps the instructors to keep track of individual posting history and performance. CZTalk also provides instructors a means to understand the posting behaviour of individual students. By identifying the number of threads which have been initiated by a student, an instructor can understand whether a student prefers to start discussions on new topics, or to participate in existing discussions. By observing which threads a student has participated in the most, instructors can identify the topics which are of interest to students. With the context of the discussion always available in the Discussion Map view, instructors can also get an idea of how messages posted by each student are responded to by other students.
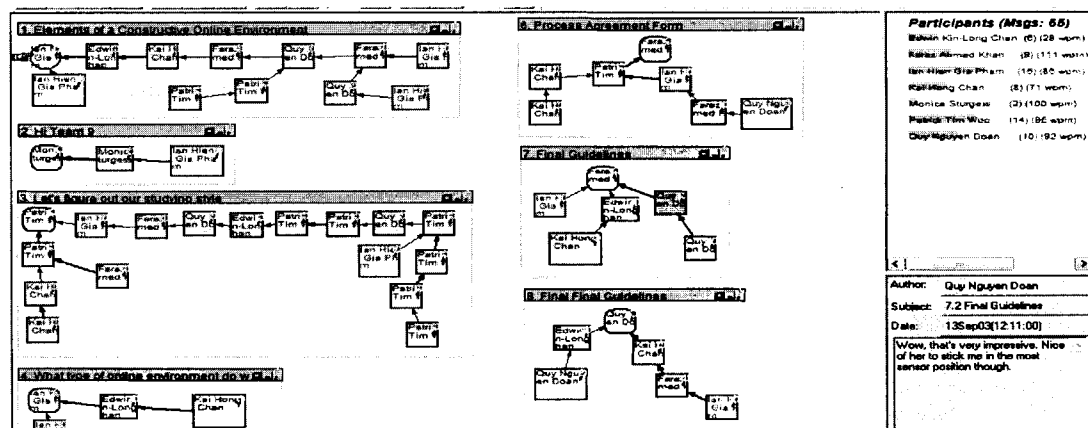
Figure 3-13 Highlight by Participant (in red)

3.8.2 Highlight by Subject

CZTalk allows the instructors to highlight an entire thread (Figure 3-14). Subject highlighting can help to flag the threads of interest to instructors. Moreover, since students who have participated in any given thread will also be highlighted with the same colour in the Participant Window view, subject highlighting gives the instructors an easy way to identify the students who have contributed to the highlighted thread.
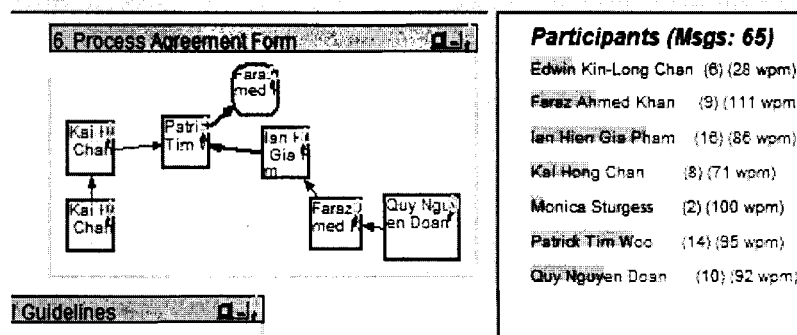
Figure 3-14 Highlight by Subject (in red)

3.8.3 Highlight by Time

The Dynamic Time Slider allows users to gain insight into the temporal characteristics of a discussion through direct manipulation of the time slider control (Figure 3-15). It has been implemented as slider with thumbs on both ends. The duration of the entire discussion is shown at the top left and right corners of the control. To select a specific time range, users can either drag the centre bar, moving the highlighted interval, or adjust its width by manipulating the thumbs. The range of dates selected by the users will be displayed in the text boxes right below the slider. Because of the tight

coupling between the Dynamic Time Slider and the Discussion Map view, all messages which fall within the time range specified by users will be highlighted. The highlighting is performed in a dynamic manner, i.e. messages are rapidly highlighted or un-highlighted as the users interact with the control.
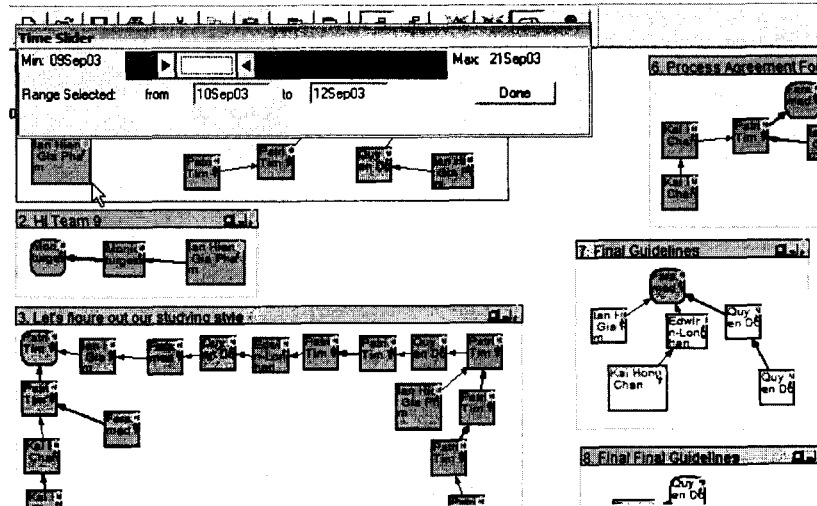
Figure 3-15 Highlight by Time (Dynamic Time Slider)

The Dynamic Time Slider control should help instructors in a number of ways. First, the control provides instructors with the lifespan of the entire discussion. Next, by manipulating the time slider, an instructor can quickly understand the development of each thread in a specific time scale, such as on a daily or a weekly basis. The control can also help instructors identify the temporal characteristics of the discussion such as peak submission dates. Further, instructors can utilize the control to distinguish messages that have made or missed various submission deadlines.

The time slider can be combined with other highlighting mechanisms to allow users to perform more complex analyses. For example, by combining the time slider and

participant highlighting, an instructor can see the rate of submission of a given student

over time. This composite search also assists instructors in recognizing a student's

posting habits, such as whether she prefers to post messages early in a discussion or to

post a large number of last minute messages in the hope of meeting submission deadlines.

3.8.4 Highlight by Priority

From time to time, an instructor may need to assign different levels of importance

to messages according to some specified criteria. An example of this may be to

differentiate the messages which have demonstrated different levels of critical thinking

skills. Using two levels of the colour green to represent two importance levels, CZTalk

allows instructors to assign different importance levels to different messages (Figure 3-

16). This tool can be used as a visual reminder for instructors.
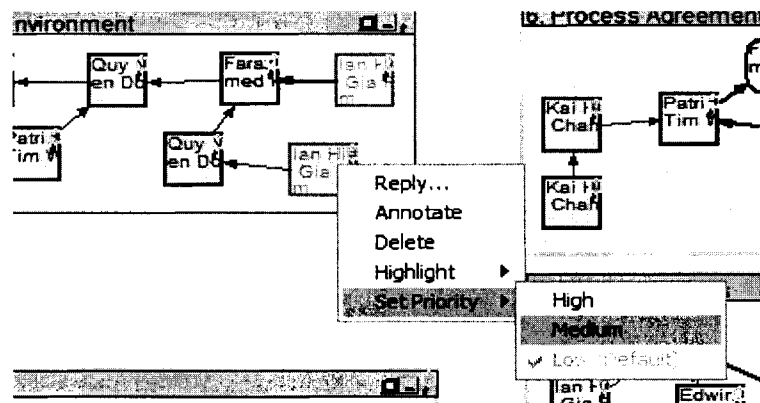
Figure 3-16 Highlight by Priority

3.8.5 Highlight by Message Content (Keyword)

Sometimes an instructor would like to track how a certain concept is discussed

and applied by students to make sure they have acquired the necessary skills and

knowledge. By performing a search on the message content, instructors can quickly

identify all the messages which contain specified word(s) (Figure 3-17). In addition,

because the structural information of the discussion is always available in the Discussion

Map view, an instructor can also see how these messages are distributed among threads

and how the other students have responded to them.
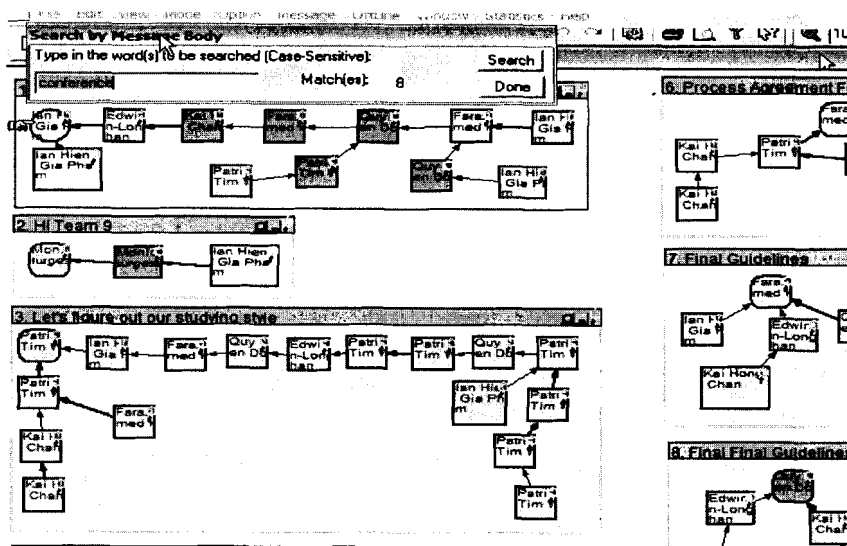
Figure 3-17 Highlight by Message Content

3.9 Comparison with Other Visualization Systems

One of the major differences between CZTalk and other discussion visualization

systems is the discussion environments on which they focus. The online discussion

visualization systems we have reviewed, including PeopleGarden (Xiong and Donath, 1999), Newsgroup Crowds and AuthorLines (Viegas and Smith, 2004), Anthropomorphic Visualization (Perry and Donath, 2004), Usenet Collaboration Visualization (Xiong et al., 1998), Conversation Map (Sack, 2000a), Netscan Dashboard (Smith and Fiore, 2001), and Grand Central Usenet (Neustaedter et al., 2003), were designed to help users to visualize open, unstructured discussion spaces such as the Usenet discussions. The primary focus of CZTalk, however, is to help users understand team-based, collaborative discussions found in structured environments such as course-based online discussions. The goal of the other systems is to convey relational and structural information about discussions to help users browse through discussion spaces. In addition to this general goal, CZTalk provides tools and features which will help course instructors analyze and evaluate student performance in such spaces using various quantitative and qualitative measures.

There are also a number of differences in the visualization approaches used in CZTalk and the other systems. While most of the systems, including the systems mentioned above, as well as Threaded Chats (Smith et al., 2000), ReMail (Rohall et al., 2001), Thread Arcs (Kerr, 2003), use variants of tree structures to visualize threads, CZTalk employs a network diagram to depict the overview of a discussion. The only system we found which also uses network diagram in its display is Conversation Space (Popolov et al., 2000). However, the network nodes in that system contain the actual message.

With the exception of synchronous discussion visualization systems, others can only display a single discussion thread at any given time. In contrast, CZTalk provides

users with a graphical, detail-in-context overview of the entire discussion. To reduce the problem of screen cluttering, a Continuous Zoom algorithm has been applied, allowing users to expand or collapse discussion threads while retaining the overall context of the discussion. This capability helps users focus only on the threads which are of current interest.

The listing of author names and their contributions in separate views is a feature found in most systems, but none of these systems show the average length of each author's contributed messages, as CZTalk does. The Netscan Dashboard (Smith and Fiore, 2001) system displays the interpersonal connections (i.e. the messages exchanged) between authors in graphs. CZTalk displays similar information in a tabular format, which is helpful for localized comparisons (Tufte, 1983) of the number of replies exchanged between students. The capability of displaying multiple messages in separate windows will prove helpful for instructors in comparing the messages posted by the same, or different students.

The network display of the overview of the discussion has influenced our design of the attribute highlighting mechanisms in CZTalk. The ability to highlight individual authors is found in all discussion visualization systems. Because CZTalk displays all the threads of a discussion, we have added a new highlighting option which allows users to highlight a single thread and identify the authors who have participated in this particular thread. In most of the systems which use tree structures to visualize threads, one of the screen's axes is always used to represent the chronological order of the messages. The network display in CZTalk, however, has utilized both axes in its visualization. New features have been designed to allow users to understand temporal characteristics of

messages. The "time" arrows, which can be displayed in conjunction with the "reply-to" arrows in the Discussion Map view, will allow users to visualize both the temporal order and the reply sequence of the messages simultaneously. This capability is particularly useful if the reply sequence of a thread is not linear i.e. there is at least one message in the thread which has received more than one reply. In such cases, the "reply-to" arrows are inadequate to depict the temporal order between messages. The availability of the "time" arrows thus allows users to identify such ordering quickly. The Dynamic Time Slider control not only allows users to highlight messages which have been posted within a certain time period dynamically - the possibility of combining the control with the other highlighting options gives users the means to perform more complex analysis on the messages.

Two unique highlighting options in CZTalk focus on the actual content of the messages. In addition to the instructors at SFU, the keyword search function is also reported by subjects as a desired function during the evaluation of a discussion visualization research prototype (Neustaedter et al., 2003). Allowing instructors to highlight messages based on their level of perceived importance should help them prioritize and categorize messages according to their different teaching purposes.

In summary, the features and tools we have included in CZTalk are mostly driven by the needs of a specifically targeted group of users trying to perform a specific set of tasks, i.e. course instructors who are trying to analyze and evaluate student performance in structured, course-based online discussions. CZTalk's focus on the analytical aspects of structured discussions is perhaps the most unique feature of CZTalk which

distinguishes it from other existing research prototypes in the area of CMC discussion visualization.

To evaluate the use of CZTalk by course instructors, a user study was designed to help understand how the instructors would make use of the tools and features of CZTalk in evaluating classroom discussions. The design details of the user study will be presented in the next chapter.

CHAPTER 4: CZTALK USER STUDY

This chapter describes the motivation, research goal, methodology and experimental design of a user study to evaluate CZTalk in helping course instructors evaluate student performances in a course-based online discussion environment.

4.1 Motivation and Research Goal

We were interested in how instructors would use the capabilities provided by CZTalk in evaluating student performances in course-based online discussions, as measured by their contributions to a discussion, interactions with other students, and the overall quality perceived by both their peers and the instructors. We were also interested in comparing the relative merits of CZTalk and CMS, the current discussion tool used by a number of course instructors at Simon Fraser University.

Student participation is of course the crucial ingredient in online course discussions and the ability to evaluate such participation is vital. A first step in evaluating student performance was to measure each student's contribution to a discussion, within each thread and overall. CZTalk provided several ways to assist a course instructor in studying the contribution a student made to the discussion.

After examining the contribution made by a student, an instructor would like to better understand both the interaction between students, and the quality of messages posted by a given student. This information might help the instructor understand not only

the role of the student in a discussion, but also provided information on the interaction pattern of that student for a given topic so the instructor could better understand the types of topic which drew most attention and possibly concerns and difficulties encountered by students. The mechanisms provided by CZTalk should help instructors more easily obtain this information.

In this user study, we would like to see how CZTalk would be used by instructors to perform typical analysis tasks and to obtain their subjective evaluations on why and how CZTalk might be useful in performing these tasks. We would also like to compare the qualitative differences between CMS and CZTalk when used by course instructors in their efforts not only to read individual messages, but in understanding the relationships between and overall patterns of all the messages posted in online discussions. Finally, the feedback and suggestions provided by the instructors would help us to determine what kinds of capabilities were lacking in CZTalk and this would give us guidance on future improvements.

4.2 Design and Methodology

4.2.1 Experimental Design

The approach we used to collect subjective evaluations on the use of CZTalk and to compare the qualitative differences between CMS and CZTalk was a qualitative user study. By watching how course instructors used CZTalk during the user study sessions and by collecting their comments during the interview sessions, we would evaluate the

use of CZTalk by course instructors who were evaluating student performance in online discussions. Their questions, feedback and comments would guide us in improvements to future versions of CZTalk.

The study was divided into three different sections: a pre-test questionnaire to obtain information on subjects' experience with CMS, the study proper in which subjects performed tasks using CZTalk, and a post session questionnaire to obtain qualitative reactions from subjects after the experiment sessions.

We first explained the steps and procedures of the study to the subjects at the beginning of the study. Then we asked them a few questions regarding their experience and their habits of using CMS. Our goal here was to understand their user behaviours and the CMS discussion environments they were usually faced with.

Through a number of meetings with a few instructors who were experienced with online discussions, we identified six different activities which might be required by course instructors in order to understand the messages posted in an online discussion forum. The activities were participation analysis, interaction analysis, time analysis, message's content search, annotating messages and prioritizing messages. These activities formed the basis of the second section of our user study.

In the second part of our study, our goal was to understand how subjects would use CZTalk in carrying out three analysis tasks which were derived from the activities aforementioned, and to determine what they found easy, and what they found difficult - and why. The analysis tasks were: Participation Analysis, Interaction Analysis and Time Analysis. The last three activities were not itemized as individual analysis tasks because they were actually tools for instructors rather than analysis tasks. Instead, we asked their

opinions on how these tools could help them during discussion evaluations. This part of the study was subdivided into six subsections: the first three subsections corresponded to the three tasks and the last three subsections corresponded to the three features developed specifically for course instructors. Before the start of the second part of this study, a demonstration was given to the subjects illustrating the capabilities of CZTalk. Subjects also received a one-page user manual which they could refer to if needed.

During each subsection, we explained the procedures of the subsection and then asked them to answer a few questions with the help of CZTalk. Their interactions with CZTalk and the time required to complete each task were observed and recorded by the experimenter. Hints would be provided if they seemed to have difficulty using CZTalk. At the end of each subsection, we asked the subjects for comments on the use of CZTalk to perform that particular task. In addition, we also asked their subjective preferences between CMS and CZTalk in performing that task.

After the completion of all tasks, a post-session questionnaire was used to determine whether subjects felt CZTalk was a useful tool for course instructors overall, and asked for suggestions for additional needed functions. The entire user study took 40 to 60 minutes for each subject. In addition to paper notes made by the experimenter, the sessions were audio-recorded.

Because the user study was conducted by the developer of the software (i.e. not by an independent experimenter), certain measures were taken to ensure that the study would not be contaminated by the presence and biases of the experimenter, as well as any biases induced in subjects by the experimenter. At the beginning of the study, subjects were reminded of the importance of unbiased data and they were asked to give their

comments only based on the tools available to them. The questions and statements used during the interviews were chosen carefully to make sure they were as neutral as possible. Also, the experimenter would leave the room before the subjects started completing the post-session questionnaire so they would have a chance to write their comments without the presence of any investigator.

4.2.2 Subjects and Data Source

The target audience of CZTalk was course instructors who needed to understand and evaluate student performances in course-based online discussions. In particular, we wished to compare qualitative differences between CZTalk and the text-based discussion interface used by the instructors at SFU (the CMS environment). As a result, the subjects we wanted to recruit were course instructors currently using CMS. By sending email to course instructors currently using CMS to conduct classroom discussion, we obtained 5 subjects for the user study.

To ensure the user study would closely resemble the discussion environment faced by the subjects, an archived discussion of the Tech 100 course conducted during the 2003 Fall semester was chosen as the experiment discussion. It had a total of 7 participants, 65 messages, 9 threads and lasted for 13 days. It was used as the discussion environment for all the subjects. Since not all participants in this study had taught this course before, using this discussion across all participants should also allow us to observe what differences, if any, existed between participants familiar with the discussion format and those unfamiliar with it.

4.2.3 User Study Tasks

As mentioned in the previous sections, we wished to collect subjects' subjective evaluations on the use of CZTalk on 3 analysis tasks and 3 features which were identified and designed based on the activities performed by course instructors during discussion evaluations. During the user study sessions, subjects would make use of the views (Discussion Map, Participant Window, Message View, Annotation View, Interaction Table and Thread Statistics View) and the highlighting options (by participant, by subject, by priority, by time and by message content) provided by CZTalk.

The first analysis task asked the subjects to answer a number of questions regarding student participation in the discussion. They were first asked about the quantitative aspects of student participation (the frequency of contributions made and the average length of messages posted by students) of one thread and of the entire discussion. The statistical summaries displayed in the Participant Window and the Thread Statistics View should allow the subjects to obtain this information quickly. The next question asked the subjects to identify the students who had not contributed to a particular thread. There were at least 2 approaches to this question. Subjects could bring up the list of active students of the thread of interest through one of the views (Interaction Table, Thread Statistics View) and compare it with the list of all students in the Participant Window. Subjects could also use the Subject Highlighting option to highlight the students who had contributed to this thread. The last question asked the subjects about the posting history of a given student. By highlighting the student of interest and looking at the discussion overview in the Discussion Map, subjects should be able to pinpoint the thread to which this student had contributed the most.

Our second analysis task required the subjects to answer questions about the temporal characteristics of the discussion. First, subjects needed to distinguish messages which missed two different submission deadlines, with one applied to the entire discussion and the other one applied to a single thread only. Although the subjects could answer the question by comparing the messages with the deadlines directly, an easier approach would be making use of the Time Slider control and highlighting the desired messages by sliding the control. The next question asked the subjects to find out the peak submission date of a particular thread. By narrowing the Time Slider control down to a one-day interval, subjects should be able to recognize the number of messages posted within this thread on each day. The last question was different in that it required subjects to perform a composite search. It asked subjects to describe the submission patterns exhibited by a particular student in a 5 days period. Subjects would first need to highlight the student of interest before they could make use of the Time Slider control to answer the question.

The third analysis task required the subjects to answer a few questions about interactions between students during the discussion. The first question asked them to describe the reply pattern of a thread. The reply structure of the discussion displayed in the Discussion Map should assist the subjects to answer the question quickly. Subjects then were asked to identify the thread which generated the most replies. Again the visual support of the structural information of the discussion in the Discussion Map should help the subjects identify the thread by visual inspection. Subjects were next asked to find the student who received the most replies within a particular thread. Besides counting messages directly, subjects could open the Interaction Table and answer the question by

comparing corresponding entries in the table. The final question of this task was to compare and contrast the interaction patterns exhibited by two students, as measured by the number of initial thread messages each had posted, and by the number of students who had replied to their messages. With the help of the Participant Highlighting and the Interaction Table subjects should be able to identify differences between these two students.

After completing the tasks, subject were asked to provide their opinions on why and how the three features (Message's Content Search, Message Annotation, and Message Prioritization) might be helpful to them during discussion evaluations. The goal was to collect subjects' feedback on the usefulness of these tools and to better understand how subjects would make use of the features when they were evaluating student performances in course-based online discussions.

CHAPTER 5: DISCUSSION OF THE USER STUDY RESULTS

This chapter describes the major observations and findings during the CZTalk

user study sessions. A discussion of the significances and implications of the user study

is presented at the end of the chapter.

5.1 Major Findings and Observations

This section describes the major findings and observations obtained during the

user study sessions. It is divided into five different subsections. The first subsection

reports the results obtained from the pre-test questionnaire. The following three

subsections describe the results of the three analysis tasks performed by each subject.

The last subsection records the subjects' subjective evaluations on three tools which were

developed specifically for instructors to help them in discussion evaluations.

5.1.1   Characteristics of the Online Discussions Encountered by Subjects

All of our subjects were very experienced CMS users. Most of them had used the

system for 5 years and their average CMS experience was almost 4 years. Most of them

had taught, or were teaching, one or two courses during the last 4 semesters, including the

current one. Online discussion was a mandatory component for all the courses they

taught. Except for one subject who taught a combination of undergraduate and graduate courses occasionally, the rest of them were responsible for undergraduate courses only. Student enrolment in each course was huge. The average number of students enrolled in each graduate course was 11 and for undergraduate courses, the average was134 students. Except for the graduate courses, instructors were responsible for managing and evaluating more than 100 students each semester. As an example, in the past, the Tech100 course has enrolled almost 300 students. Currently, 445 students are enrolled in the course. To accommodate the large class size, this course has always been taught by 3 instructors.   One subject was responsible for 230 of the students enrolled in Tech100 this semester.

The subjects rely heavily on online discussions in their courses. Most of the courses required students to contribute to scheduled online discussions every 2 weeks, but there are some courses that require weekly participation. Discussions usually consist of 4 to 8 students organized into teams. Most of these team-based discussions last about 4 to 5 days, except for one course which required students to participate in semester long team discussions. Each team generated about 25 to 40 messages at each discussion; multiplying by the number of teams administered by each instructor, it is clear that evaluation of individual students is a very challenging task for the instructors.

Our last question asked the subjects to describe the typical message distribution of an online discussion over time. All subjects agreed that the distribution pattern varied depending on the goal of the discussion being conducted. For example, student contributions were concentrated at the end of a discussion when the course asked students to provide reflections on essays written by their peers. For project-based discussions,

there was a more evenly-distributed outcome because daily contributions from students were essential for the completion of the tasks.

5.1.2   Participation Analysis Task

The subjects in each user study sessions were required to complete 3 different sets of analysis tasks. The first analysis task set was Participation Analysis. The purpose of this task was to help us understand how subjects would use CZTalk to analyze student participation of a discussion.

Our first question asked the subjects to identify the student who was the most frequent contributor. The subjects were all able to find the correct answer from the discussion statistics displayed in the Participation Window. One subject reported she could answer the question by "just looking at the histogram."

It was observed that the subjects took different approaches and strategies to navigate the discussion to complete tasks. When subjects were asked to provide the name of the student who did not contribute to a particular thread, they answered the question by comparing the active students in a thread with the list of all students in the Participation Window. Four different approaches were used to obtain the list of active students in a thread: direct observation in the Discussion Map, highlighting individual students, and looking at the Thread Statistics or the Thread Interaction Table view. Multiple search strategies were also observed when subjects were required to answer a question about the posting history of a given student. All subjects used Participant Highlighting to complete the task. However, different views and visual elements were

employed to initiate the query. Four subjects highlighted the student from the Participant Window, whereas one subject highlighted that student by using the highlighting option available in the Discussion Map.

The Participant Window provides statistics on the entire discussion and a number of discussion level operations. This design helped the subjects locate relevant information more quickly: whenever they believed the task should be performed at a discussion level, they would always begin the task by looking at the information and operations available in the Participant Window.

We asked subjects about their subjective evaluations of using CZTalk to perform the analysis task. Subjects liked the discussion overview displayed in the Discussion Map because it allowed them to see the activity of each thread quickly. They also liked the Participant Highlighting feature because it allowed them to follow the messages posted by any given student easily. The statistical information provided in the Participant Window was useful because it provided a quick overview of the discussion. The ability to open multiple messages in separate windows allowed subjects to compare content between messages more easily. They also liked the intuitiveness of CZTalk in attribute highlighting - they simply needed to click on the corresponding visual elements. The major weakness reported by subjects in performing this task was the small sizes of the message nodes in the Discussion Map and the message windows.

The subjects also mentioned a number of usability problems in the current CMS system. Firstly, the lack of statistical information forced subjects "to manually count things." They reported that it was difficult to understand the thread structure using the text-based organization of threads in CMS. A lot of web page switches and mouse

clicking was required in order to check student participation in threads and to compare message content between students. Overall, subjects preferred CZTalk over CMS in performing this task.

5.1.3   Time Analysis Task

The next analysis task set was Time Analysis. The purpose of this task was to help us understand how subjects would use CZTalk to answer questions regarding the temporal characteristics of a discussion.

The first 2 questions asked subjects to find messages which missed submission deadline dates. All but one subject tried to answer the questions by opening the Time Slider control immediately. The subjects exhibited interesting behaviours when they first opened the Time Slider. Instead of using the slider to select dates, many of them tried to type into the text fields of the control their desired dates.

Multiple strategies were also observed in the tasks mentioned above. Four subjects used the slider to highlight messages posted before the deadlines and answered the questions by counting all the messages without highlights. One subject answered the questions by highlighting and counting all the messages that were posted after the deadline dates.

One of the Tech100 course instructors demonstrated the value of having the overview of the discussion. After completing the specified task, she selected and read the messages which were late, and then explained to the investigator that she would penalize

only a few of them because many of them were simply additional comments and should not be counted as late submissions.

The next 2 questions asked subjects to look for posting patterns exhibited by an individual student and a group of students who had contributed to one particular thread over a few days. These 2 tasks took subjects the largest amount of time to complete among all tasks of the user study - while the average time to complete these 2 tasks was 93.6 seconds, the average time to complete each of the other tasks was 25.5 seconds. At the beginning of these 2 tasks, subjects immediately opened the Time Slider and narrowed it to a range of one day; however, problems with associating the Time Slider to the Discussion Map view soon surfaced. In order to select the desired dates, subjects had to manipulate the Time Slider to ensure that it covered only the dates of interest - the text boxes immediately below the slider shows the range of dates selected. However, subjects often forgot to read the text boxes before looking at the Discussion Map view. Instead, they would simply manipulate the Time Slider and immediately look at the results displayed in the Discussion Map view, without ensuring that the Time Slider covered only the dates desired. This meant that subjects conducted frequent switching between the Time Slider and the Discussion Map view because they had to return to the Time Slider and re-adjust it whenever they realized that it did not cover their desired dates. The situation became worse when they performed composite searches combining participant highlighting and the Time Slider control because they had to associate 2 types of highlighting at the same time.

Again, we asked for subjective evaluations at the end of the task. Subjects agreed that CZTalk's ability of checking submission deadlines was a very important and useful

feature. Some also liked the Time Slider's capability of checking daily participation of individual students. The visual feedback was welcomed by the subjects because they did not have to count and it allowed them to detect patterns easily.

The subjects complained about the difficulties in manipulating the Time Slider control, commenting that it was "a little awkward," "tricky to use," or that they had to spend a lot of time to "make it right between dates." Further, one of the subjects did not like the frequent colour changes in the Discussion Map when the Time Slider was moved because those colour changes were too distracting. One subject was concerned about the scalability of the control when it had to handle semester long courses.

All but one subject preferred CZTalk over CMS in performing this task because CZTalk eliminated the need to check each thread and conduct a manual count. In the worst cases, an overview of the CMS discussion had to be printed out so that the dates could be highlighted so as to look for posts. The subject that did not prefer CZTalk had no preference between the two tools. She said CMS was sufficient for her in checking deadlines.

5.1.4 Interaction Analysis Task

The last analysis task set was Interaction Analysis. The purpose of this task was to help us understand how subjects would use CZTalk to complete tasks related to interactions between students in a discussion.

The first 2 questions of this task related to reply patterns. By looking at the Discussion Map and following reply arrows, subjects were all able to describe the reply

pattern of a given thread. The next question asked the subjects to point out the thread which had generated the most replies. Subjects answered the question by comparing and picking the thread "with the highest number of replying arrows."

Our next task asked subjects to determine the most prolific student in a thread. Two approaches were used. Two subjects answered the question by opening the Thread Interaction Table and comparing corresponding entries. The other subjects scanned the thread of interest in the Discussion Map and counted the messages posted by each student directly. Interestingly, subjects who took the second approach (10 seconds in average) completed the task faster than the subjects who used the Thread Interaction Table (25.5 seconds in average).

The last task was to compare interaction behaviours between 2 students. The first subtask required subjects to compare the number of initial thread postings contributed by each student. All subjects answered the question by performing Participant Highlighting on each student and "looking at the circles" (the visual representation of an initial thread posting in CZTalk) each student had contributed. The second part of the question asked subjects to compare the replies received by each student. All subjects used the Discussion Interaction Table feature to approach the question. One subject mixed the meanings between the rows and columns of the table, and consistently gave incorrect answers. The time required to complete the tasks for the second student was much less than that for the first student. The average time to complete the set of analysis tasks for the first student was 76 seconds. However, it only took subjects 37 seconds on average to complete the same set of tasks for the second student.

Like the previous tasks, we invited subjects to provide their subjective evaluations. All subjects believed that the visual overview of the discussion was an important and useful feature. Its usage was explained by one subject "[I can] get a sense of which students are generating discussions and which students are replying to others". They also liked the interaction tables for comparisons. Having the ability to highlight students was helpful in understanding the interactions between individual students. However, one subject commented that the interaction tables might become difficult to follow for a large discussion because of the large amount of table entries.

All subjects preferred CZTalk over CMS in performing this task, for a number of reasons. First of all, subjects complained that the text-based environment in CMS did not allow them to "see what the interaction patterns are, if at all... I can only see the text and it's very confusing". Lack of distinction between initial messages and their replies in CMS created difficulties for the subjects to distinguish between them. Threads in CMS were represented as "text-based outlines with user ID, and that's not helpful".

5.1.5 Subject opinions on three other features

After the completion of the analysis tasks, we asked subjects for their opinions on the usefulness of three features in the context of online discussion evaluations: Messages' Content Search, Message Annotation, and Prioritizing Messages.

The subjects believed the Message's Content Search feature could be useful in 2 ways. They could use the feature to "get a sense of how widely a topic is discussed". One subject also mentioned she would use the feature to understand how major concepts

would be discussed and used by students in their postings. They would also use the feature to do searches on students and get a sense of how they were referenced by their peers.

All but one subject felt the Message Annotation function was a useful feature. One subject noted she would utilize the feature to "make notes to [her]self about good or bad examples" and "comment on critical content." The only subject who did not find the feature useful believed writing replies to students through the CMS environment satisfied her teaching purposes.

An example was given by one subject describing how the Prioritizing Messages feature would be useful. "I need a way to mark messages which are really good or bad... this can help me remember the message so I can bring it to the class and discuss with students". Many subjects complained the colours used to distinguish between the levels of importance (light and dark greens to represent the importance levels of high and medium respectively) were difficult to differentiate. One subject even commented that the extensive use of colour highlighting caused confusion because with 2 different types of highlighting, she must remember that certain colours can highlight students, but certain other colours could not. Overall, subjects agreed that having a means of prioritizing messages was useful; however, they also said that the visual representation of message prioritization in CZTalk was not appealing.

5.2 Discussion

The subjects in this study were course instructors who were experienced and extensive online discussion users. Problems in CMS made it difficult for them to understand the discussions when it was time for evaluation. Based on our observations and the subjective evaluations made by the subjects throughout the user study sessions, four main strengths of CZTalk over a text-based discussion interface such as CMS have been identified. They are:

- CZTalk's multiple-view approach with different levels of detail helps users to locate and access desired information quickly and easily.

- Continuous display of a visual overview of the discussion aids information browsing and navigation.

- Direct manipulation of visual elements allows easy query formulations and data exploration.

- Displaying message content and thread statistics only when required reduces cluttering and promotes inter-thread and inter-message analyses.

These strengths are discussed below.

Three views are always present: the Discussion Map view displaying a visual overview of the entire discussion, the Participant Window view displaying all the participants involved in the discussion and their participation statistics, and the Message Window view, which displays the content of a selected message.

The multiple-view design approach helped subjects explore the discussion spaces more easily in a number of ways. First, multiple views with different levels of detail helped subjects focus on the appropriate level of detail. Whenever subjects were asked to complete discussion level tasks (to provide overall participation of a student in a discussion for example), subjects would immediately look for the information and the operations available in the Participant Window. Obviously, the multiple-view approach helped the subjects locate and seek information faster.

Having different views in CZTalk also provided information which was only relevant to a particular level of detail. Subjects stated that displaying the discussion level statistics of each student in the Participant Window provided them with a quick understanding of students' participations in both quantitative (histograms and total number of postings) and partially, the qualitative (average length of postings) aspects.

The design of CZTalk also helped subjects locate and perform discussion level operations in an easier manner. When the subjects needed to highlight a particular student, they could simply move to the Participant Window view and choose the highlighting option available there.

The major component of CZTalk is the Discussion Map view, showing an overview of the entire discussion. The overview was very useful for the subjects because it allowed them to compare the participation of each thread and identify the "hot topics" easily. One subject commented, "I can see what my students are doing in terms of conference activity... [it is] much easier to notice possible problems and correct them early." The visual presentation of the reply patterns between students in the Discussion

Map view was also welcomed by the subjects because it let them understand the interaction between students at a glance.

The results of all visual queries are immediately available to users through the Discussion Map and Participant Window views. This encouraged subjects to explore the discussion further, since they can browse and navigate the discussion space within the search process. In one instance, when the subject had completed a task using the Time Slider control, she immediately clicked on the highlighted messages in the Discussion Map because she wanted to investigate the reasons why that pattern existed. The additional insight gained during information exploration and navigation will help promote the quality of teaching. It was explained by one subject: "I can take it to my colleagues and use this type of information to actually look at the bigger picture of the course."

Most of the queries in CZTalk are carried out by pointing and clicking on the corresponding visual elements (e.g. message node, thread cluster node, or a student's name in the Participant Window view). Allowing direct manipulation on query formulations helps avoid unanticipated search results, a null set for example, due to typing errors (Baeza-Yates and Ribeiro-Neto, 1999). The subjects also agreed that constructing queries by pointing and clicking, which itself is a key element in the principles of direct manipulation (Ahlberg and Shneiderman, 1994), was easier and more intuitive than typing in the search criteria in text-based searches. The results of the queries are displayed in the form of highlights on the visual elements in CZTalk. This provided 2 additional benefits to the subjects. Firstly, the visual responses allowed them to detect trends and patterns of the discussion easily. "I like to watch the colour

changes… so I do not need to count, very useful, and [makes it] a lot easier." Another subject liked CZTalk's graphical approach to information presentation, which made it easier to detect patterns than a text-based presentation. The results of each query are immediately visible, therefore the subjects can use that information in formulating subsequent queries. Furthermore, since the contextual information of the discussion was always available in the Discussion Map, it provided the subjects with instant access to the discussion for further navigation and exploration. These features encouraged the subjects to explore the data and gain additional and unanticipated information during the iterative search process.

An additional advantage of the tight coupling between views was that it allowed subjects to personalize their search strategies. The ability to highlight postings contributed by each student was considered to be the most useful highlighting feature. This ability allowed the subjects to detect the how and when of student participation, as well as identify how responses were made. Most subjects executed the highlighting operation from the Participant Window. However, one subject always began a task by checking the options available from the elements in the Discussion Map. She used the Participant Highlighting option available from the Discussion Map. Direct manipulation of the visual elements and the tight coupling between views allowed subjects to form individual information browsing and search strategies easily.

After browsing and querying, an instructor will likely have discovered several messages they would like to examine in more detail. In CZTalk, message content is displayed only when desired by users. The detail-on-demand approach provides several advantages for users. More screen space becomes available by hiding the information not

relevant to the subject's present search goal. This helps reduce screen cluttering since unnecessary data can be hidden. Hiding unimportant details also helps subjects focus on their current information seeking tasks.

Subjects can choose to display multiple messages or thread summaries at the same time in separate windows. Subjects identified this feature as important because it allows them to compare message content between students or to follow messages posted by a particular student. Displaying thread statistics allows subjects to quickly retrieve quantitative comparisons of different threads. In addition to saving time, the statistical summaries help avoid errors due to manual counting. As explained by one subject, "the table is quite helpful, [because] it showed the counting... it's easy to make errors if I count by myself."

In contrast, a typical text-based discussion environment like CMS lacks features important for instructors evaluating online discussions. Without an overview of the discussion available at any given time, the subjects have to switch back and forth between different web pages to seek the level of detail they need. Lack of visual support for interaction between students within and across threads forces subjects to reconstruct the ebb and flow of the discussion mentally, based on the text elements scattered all over the screen.

Current discussion interfaces do not support direct manipulation of discussion elements and visual querying by pointing and clicking. Subjects have to make many text-based queries to look for desired information. Frequent context switching and the inability to refine the search progressively discourage subjects from performing further exploration and investigation. The inadequate support of inter-message analyses and

cross-thread comparisons forces subjects to perform such analyses manually, using a printout of the discussion.

While subjects felt CZTalk had many advantages over a typical online discussion environment, they expressed some concerns as well. First, many subjects found the Time Slider control difficult to use. They felt that the control was useful because it allowed them to understand student contributions within any time intervals dynamically and visually. Unfortunately, frequent adjustments and sliding of the control were necessary for the subjects to ensure that it was covering only the desired dates. One subject was confused by the rapid colour changes in the Discussion Map caused by sliding the control. She commented that, "it's too time-consuming because too many things were highlighted and popping in and out... I [could not] keep track of what I was looking for."

Other than the problems associated with the Time Slider control, one instructor complained that the small size of the message nodes and message windows reduced the legibility of the information contained within them. Some of the subjects also mentioned CZTalk's inadequate support for assessing the qualitative aspects of discussions. One subject was of the view that, "[CZTalk] seems to focus on gathering... quantitative data as opposed to qualitative, [which would] focus on the ease of reading, grammatical structure, tracking key phrases and ideas."

A number of design changes were also suggested by the subjects. They will be presented in the next chapter.

CHAPTER 6: CONCLUSION

6.1 Summary

The goal of this study was to develop tools to help users, particularly instructors who conduct course-based online discussions, better understand discussion spaces. A better understanding of the discussion space will assist them in evaluating the discussions. This research has led to the design and development of CZTalk, which applies a number of information visualization techniques to assist users in gaining insight into online discussions, and supplies them with tools to measure different quantitative and qualitative aspects of messages contributed by students. Subjects in a qualitative user study confirmed that CZTalk was a more useful tool in evaluating structured, course-based discussions than traditional text-based environments.

We started with a review of existing research studies to investigate CMC's usage, any reported problems, and proposed solutions. We found that although most people have the means to access useful information on almost every topic through online discussion spaces, this does not necessarily mean they access this information with ease. The text-based online discussion interfaces available today do not provide adequate support to allow users to understand the role of each author and their contributions, the context in which they occur, and the flow and development of discussions over time. To alleviate these usability problems, research to date has mainly focused on providing users

with better visual support with respect to the author's participation history, and the ebb and flow of discussion threads.

One of the major applications of CMC is in course-based online discussions. The use of online discussions eliminate the time and location constraints of learning, and its persistence characteristic provides students with opportunities to reflect on discussion materials carefully and logically. However, the usability problems existing in text-based interfaces have made it difficult for instructors who need to understand the discussions in order to evaluate and provide appropriate guidance to individual students.

After a number of formal and informal discussions with course instructors at SFU, we identified 3 major analysis tasks and 3 features which would be useful during online discussion evaluations. The 3 analysis tasks include participation analysis, time analysis and interaction analysis. These features (content search on messages, message annotation and message prioritization) provide instructors additional means to identify and categorize messages according to their content.

Based on earlier research and the instructors' suggestions, we developed CZTalk, a multi-view visualization tool that provides instructors with the contextual information of discussions, and allows them to access quantitative and qualitative measures of student performances in course-based online discussions.

CZTalk contains a number of features to assist course instructors understand the participation patterns of individual students. Individual contributions are displayed as both numeric values and in histograms, and are available at both thread and entire discussion levels. With these displays, an instructor can quickly identify the most frequent contributor(s) to a thread and to the entire discussion. Colour-coding individual

students allows an instructor to keep track of the submission history of each student. CZTalk's multi-view display further enables instructors to quickly identify contributors to a particular topic by highlighting individual threads.

In addition, a dynamic time-window slider allows highlighting messages within a specified time period. With the slider, an instructor can determine whose messages have made the various submission deadlines. CZTalk also allows instructors to combine the time-window slider with other highlighting criteria to perform more complex analysis. For example, combining the slider and participant highlighting features will allow an instructor to determine the submission behaviour of any particular student. This feature could help an instructor figure out whether a student tends to submit postings at the beginning, end, or evenly throughout, a particular time period.

After measuring students' rate of participation, a course instructor needs to determine the interaction between students and the quality of posted messages. CZTalk supports a number of visual functions to assist instructors in deciding the quality of a message. First, the network display of discussion messages gives the instructor an overview of the entire discussion, including both depth and reply pattern of individual threads. The visualization allows an instructor to easily identify which thread is most heavily discussed by students, and how the discussion is constructed. A display of the average length of messages posted by individual students will give instructors an idea of the type of discussions in which a student tends to be involved. If the responses generated by a student tend to very short in length, he/she is more likely to produce simple, trivial postings rather than contributions to lengthy and deep discussions. Another measure of the quality of a message is its relevance to a discussion. The

capability to search and highlight messages content will help instructor to find out which messages contain specified keyword(s) and phrases.

The perceived importance (by other students) of a message posted by a student can also be determined partly by the number of replies it receives. A posting will not receive many replies if the message is either not relevant to the discussion or if the content does not merit further discussion. CZTalk provides two ways to analyze the reply pattern to a message. First, the network display of the discussion should allow instructors to quickly identify which message(s) are the foci of threads graphically. Moreover, CZTalk displays the number of messages sent and received by each student in tabular format. This tool provides an instructor with statistics on the interactions between students. Finally, CZTalk lets instructors annotate and highlight messages based on priorities - this feature provides instructors with an additional means to comment on the quality of messages posted and categorize them according to their teaching purposes.

To evaluate the use of CZTalk, a qualitative user study was designed and conducted with course instructors. The results of the user study confirm that CZTalk's visual aspects, ease of use, and the ability to discover patterns of participation, make it a more useful tool for evaluating course-based online discussions than a traditional text-based discussion environment.

6.2 Research Contribution

We developed CZTalk as a multi-view online discussion visualization tool. In particular, it is designed to help instructors better understand the development of course-

based online discussions, and in assisting them in their analysis and evaluation of such discussions. CZTalk's ability to download and display discussions allows instructors to visualize student participation and interaction occurring within individual discussions, as well as compare messages across multiple conferences. The colour-encoding of attributes allows instructors to detect message patterns while retaining structural information about the discussions. The addition of a dynamic time-window slider allows instructors to query the temporal relationships among messages of a discussion. Rearranging and presenting the various statistical summaries of a discussion in different formats provide instructors with an overview of the discussion before going deeper into the discussion messages of interest. A qualitative user study conducted with course instructors confirmed that the features and functions provided by CZTalk are more useful for them in understanding and evaluating course-based online discussions than traditional text-based interfaces. In summary, the contribution of this thesis is the design, development, and evaluation of new features and functions in an online discussion visualization tool to assist users analyzing and evaluating structured, course-based discussions.

6.3 Future Work

A number of design changes were suggested by the subjects during the user study. The first suggestion made by the subjects was that it would be preferable for the message nodes in the Discussion Map to have variable sizes to accommodate the text contained

within them. A further suggestion was that bigger fonts would help make the text more legible.

With respect to the time slider, there were a number of recommendations. The subjects commented that the text fields of the time slider should be made editable to include an option of typing in the desired dates during time analysis. In addition, it was suggested that the time of day should be added to the time slider control so that more precise comparison could be performed. One subject also suggested having buttons beside the slider so as to give the option of manipulating the dates by clicking on the corresponding buttons.

In addition to comments about sizes of various features and the time slider, other suggestions for additions to CZTalk were noted. One of these involved adding the rate of contribution of students presented in graph form, so that submission trends of students could be more easily identified. A second suggestion was to add shading to the diagonals of the Interaction Tables, so that self-replies could be distinguished immediately.

Subjects also suggested some design changes focusing on the qualitative aspects of discussions. One subject would like to have an option to display the messages within the same thread all at once so they can be read, and the development of the thread can be depicted, in their natural order. Displaying excerpts of the matched messages during keyword search would help instructors determine the relevancy of messages in a quicker and simpler manner.

There were also suggestions about how to track messages posted by individual students. One subject suggested tagging the quotes used by students so as to determine if a student had cited the references correctly. As well, the option to display all the

annotations made to a particular student was said to be more useful if displayed in a single window, because annotations would help instructors in assigning final grades. An interesting suggestion was to allow subjects to assign the annotation marks with different colours to represent the quality of messages. This design change has 2 advantages. First of all, the different colours of annotation marks would help instructors to quickly locate important messages in the Discussion Map. By combining these annotation marks with other forms of highlighting, an instructor would be able to easily determine the quality of messages posted by each student.

After the design changes and recommendations are made, a field study should be conducted to investigate how instructors would make use of CZTalk for an extended time period such as one semester. This information will help us to better understand how CZTalk will be adopted and used by instructors in a real-life setting.

The capabilities to send, receive and display email messages is built into CZTalk. A further research direction would be to investigate the opportunities for using CZTalk as a communication tool to mediate online discussions through listserv email discussions. Given its analysis capabilities, CZTalk would become a tool providing visual support during both message generation and discussion analysis processes.

This study has shown that principles in Information Visualization are useful for course instructors trying to analyze and evaluate structured, course-based discussions. The usefulness of Information Visualization principles is demonstrated by the feedback of our user study subjects, who commented that the ability to display an overview of the discussion, and the tools which allowed them to construct queries on the visual elements directly, were of the most valuable features of CZTalk to them. The subjects suggested a

number of design changes, including combining the priority highlighting and annotation features so that one could assign annotation marks with different colours to represent the quality of messages. Overall, this study has illustrated that for the instructors to evaluate classroom-based discussions efficiently, it is invaluable for them to be able to organize and manipulate the discussion spaces visually and directly. These results validated our research goal of developing a visualization tool that helps instructors evaluate structured, course-based discussions.

APPENDIX A: CZTALK USER STUDY

Pre-Test Questionnaire

CZTalk User Study Pre-test Questionnaire

How long have you been using the CMS conferencing tool? _____ (years)

	2004-3	2004-2	2004-1	2003-3
Courses in which you have used CMS to conduct online discussions:				
Number of students enrolled in each course:				
Number of discussions conducted during the semester:				
Number of students in each discussion:				
Number of days or weeks each discussion would last:				
Approximate number of messages generated in each discussion (average/minimum/maximum):				

Message Distribution over time in a typical discussion (please check the appropriate shape):
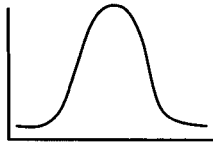
a) Peaked during the middle of the discussion

b) Peaked during the beginning of the discussion
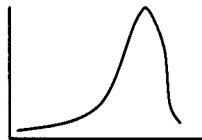
c) Peaked during the end of the discussion

d) Some other shape (Please draw or describe):

User Study Tasks

1. Participation Analysis

a) Which student has contributed most to the whole discussion?
b) Which student(s) have not contributed to the thread "6. Process Agreement Form"?
c) Which student has contributed the most to the thread "3. Let's figure out our studying style"?
d) Which student has posted the shortest messages on average to the whole discussion?
e) Posting history of a student: to which thread has the student "Ian Hien Gia Pham" contributed the most?
f) What other types of "participation analyses" do you do? Please describe them, and try to perform them with CZTalk.

2. Time Analysis

a) Suppose the final submission deadline of the discussion is September 20 2003. How many messages missed the final submission deadline?
b) Suppose the last date to submit contributions to the thread "8. Final Final Guidelines" is September 16 2003. How many messages within this thread missed the assignment submission deadline?
c) Which date is the peak submission date of the thread "3. Let's figure out our studying style?
d) Identify submission patterns exhibited by the student "Patrick Tim Woo" from September 09 2003 to September 13 2003. (for example, does that student make all his contributions evenly everyday, does he have any peaks of submission dates, etc.)
e) What other types of "time analyses" do you do? Please describe them, and try to perform them with CZTalk.

3. Interaction Analysis

a) Are the replies in the thread "9. Final Final Final Guidelines?" turn-based or do they focus on only a few messages?
b) Which threads generated the most replies in the entire discussion?
c) Which student received the most number of replies to thread "3. Let's figure out our studying style"
d) Look at the interaction behaviour of the student "Faraz Ahmed Khan" by determining:
     i) Number of initial thread messages he posted
     ii) Number of messages he received
     iii) Number of students replying to him
Do the same for the student "Kai Hong Chan". Which student has received more attention (i.e. more messages exchanged) from the other students?
e) What other types of "interaction analyses" do you do? Please describe them, and try to perform these with CZTalk.

Questions after each analysis task

- Does CZTalk help you to perform this task? If so, please try to describe how it does so. If not, please describe what it should do that it does not do
- Do you like the way CZTalk helps with this task? If so, please say what you like. If not, please say what you dislike about the way it works
- Which tool (CZTalk/CMS) do you prefer for this task? Why?

(Note: We will ask subjects how the tools in questions 4 & 5 & 6 may be useful to them, but we will also watch to see how these tools are used throughout the study)

4. Messages' Content Search

Would you make use of this capability in evaluating student contributions? If so, please describe how you would do so.

5. Message Annotation

Would you make use of this capability in evaluating student contributions? If so, please describe how you would do so.

6. Prioritizing Messages

Would you make use of this capability in evaluating student contributions? If so, please describe how you would do so.

Post-Test Questionnaire

1. Does CZTalk help you understand and evaluate students' performance in an online discussion environment? What are the ways in which it does so?

2. What are CZTalk's major strengths?

3. What are CZTalk's major weaknesses?

4. What specific capabilities are missing in the current version of CZTalk?

5. What specific capabilities are available in CMS but not in CZTalk?

6. Is CZTalk a useful tool in evaluating course-based online discussions?

APPENDIX B: CZTALK USER STUDY RESULTS

Pre-Test Questionnaire

How long have you been using the CMS conferencing tool? (years)

Subject 1	3
Subject 2	5
Subject 3	5
Subject 4	5
Subject 5	1.3

2004-3	Q1	Q2	Q3	Q4	Q5	Q6	Q7a)	Q7b)	Q7c)	Q7d)
Subject 1	IAT 200, IAT 812, INTD 401/2/3	35, 12, 131	11, 13, 13	5 to 12, 12, 6	mostly 1 week, some in INTD = all term	avg: 30, 20, 4		IAT 200, INTD 401/2/3	IAT 812	
Subject 2	Tech 100	115	5	3 to 6	4 days	acg: 40 to 100	70% of time		30% of time	
Subject 3	IAT 100	104	10	4	5 days	avg: 4-6		X		
Subject 4	Tech 100	100	6	5 to 6	4 days	24+ (minimum)			X	
Subject 5	Tech 100	230	6	6	4 days	30 - 40				X

2004-2	Q1	Q2	Q3	Q4	Q5	Q6	Q7a)	Q7b)	Q7c)	Q7d)
Subject 1	n/a									
Subject 2	n/a									
Subject 3	n/a									
Subject 4	INTD 50	22	1	5 to 6	5 days	45+ (minimum)			X	
Subject 5	n/a									

2004-1	Q1	Q2	Q3	Q4	Q5	Q6	Q7a)	Q7b)	Q7c)	Q7d)
Subject 1	Tech 101	50	13	6	4 days	avg: 25	Tech 101			
Subject 2	Tech 101	100	6	4 to 6	4 days	avg: 40 to 100	70% of time		30% of time	
Subject 3	Tech 124	104	10	4	5 days	avg: 4-6		X		
Subject 4						24+ (minimum)			X	
Subject 5	Tech 101	114	6	6 to 8	4 days	30 to 40				X

2003-3	Q1	Q2	Q3	Q4	Q5	Q6	Q7a)	Q7b)	Q7c)	Q7d)

Subject	Course					Duration	Avg				
Subject 1	INTD 210/211/212, ETEC 695	50, 10	12, 9	6, 10		4 days - 1 week	avg: 20, 15		ETEC 695		INTD 210
Subject 2	Tech 100	100		5	4 to 6	4 days	avg: 40 to 100	70% of time		30% of time	
Subject 3	Tech 117	104	10	4		5 days	avg: 4-6		X		
Subject 4	Tech 100, Tech213/214/215	50, 80	6, 12		5 to 6 (both)	4 days, 4 to 5 days	24+ (minimum)			X	
Subject 5	Tech 100	125		6	6 to 8	4 days	30 to 40				X

Transcripts of the User Study Sessions

Task 1a)

(Subject 1)
- Observation:
Subject looked at the Participant Window and answered the question by looking at the numbers displayed inside the window.
- Time: 10s

(Subject 2)
- Observation:
Subject immediately looked at the Participant Window and answered the question correctly.
- Time: 4s

(Subject 3)
- Observation:
Subject immediately looked at the Participant Window and answered the question correctly.
- Time: 3s

(Subject 4)
- Observation:
Subject first clicked on thread #1 and opened the Interaction Table in the Discussion Map, and thought that the table would provide her the contributions of the entire discussion. Then subject tried to perform Participant Highlighting on a student, and because this option also did not give her an answer, she seemed confused. Then subject was reminded about the features in the Participant Window and she was able to answer the question correctly by "even just looking at the histogram."
- User Comments (if any)
When subject was reminded about the Participant Window her first response was "right... that's the easiest way to look at it."
- Time: 1m 44s

(Subject 5)
- Observation:
Subject looked into the Participant Window immediately, but thought that the average length of messages was students' message counts at the beginning. Subject was able to answer the question correctly when she was told the difference between the numbers at the Participant Window.
- Time: 28s

Task 1b)

(Subject 1)
- Observation:
Subject first right clicked on a message and looked for the options available to her. Realizing that there's no option which could help her to answer the question, subject right clicked on the thread and looked for the options available to her. Subject then chose the Show Thread Stats option from the context menu and answered the question by comparing the names between the Show Thread Stats window and the names displayed in the Participant Window.
- Time: 48s

(Subject 2)
- Observation:
Subject looked at the thread of interest in the Discussion Map and performed Participant Highlighting on all the messages within the thread. Subject answered the question by picking up the names in the Participant Window who were not highlighted.
- Time: 59s

(Subject 3)
- Observation:
Subject looked at the Participant Window and believed that the list would have included all the participants of the thread of interest. Then subject looked at the messages of the thread in the Discussion Map and seemed confused because the names of the students participated in the thread did not match to the list at the Participant Window. Then subject was told another approach to look at the statistics and active participants of a thread would be to use the Show Thread Stats option on the thread of interest.
- User Comments (if any)
Subject commented about using the Show Thread Stats option to look at and compare student participations. "It's really hard to compare (with the Participant Window) for a very long list of student... not easy to do such comparisons." Subject was then introduced another approach to look at student participation of a thread was to use Subject Highlighting option, and subject commented that "it's easier this way".
- Time: 48s

(Subject 4)
- Observation:
Subject opened the Interaction Table of the thread of interest in the Discussion Map. Then subject compared the names on the Interaction Table with the names on the Participant Window and provided the answer correctly.
- Time: 1m 28s

(Subject 5)
- Observation

Subject first thought of using Subject Highlighting, but did not use it at the end and instead, subject looked at all messages within the thread in the Discussion Map and answered the question correctly.
- User Comments (if any)
After the task, subject was told another approach to this task could be to use the Thread Stats option, and subject responded "It's much easier to see it that way."
- Time: 1m 4s

Task 1c)

(Subject 1)
- Observation:
Subject immediately right clicked on the thread and chose the Show Thread Stats option.
Subject gave the correct answer by looking at the numbers displayed by the Show Thread
Stats window.
- Time: 15s

(Subject 2)
- Observation:
Subject first right clicked on the thread of interest in the Discussion Map and looked at
the options available to her. Subject then chose the Show Thread Stats option from the
context menu and answered the question by looking at the numbers displayed.
- Time: 34s

(Subject 3)
- Observation:
Subject looked at the messages in the thread of interest in the Discussion Map, then she
right clicked on the initial message and looked for the options available for her. Subject
chose the Show Thread Stats option and answered the question correctly by looking at the
numbers.
- Time: 35s

(Subject 4)
- Observation:
Subject first right clicked on the thread of interest in the Discussion Map, then she looked
into the context menu and chose the Show Thread Stats option. Subject was able to give
the correct answer by looking at the numbers displayed by the Show Thread Stats option.
- Time: 12s

(Subject 5)
- Observation
Subject immediately used the Thread Stats option to the thread of interest. Subject was
able to answer the question right way by looking at the Thread Stats window.
- Time: 9s

Task 1d)

(Subject 1)
- Observation:
Subject looked at the Participant Window and provided the correct answer by looking at the numbers displayed in the Participant Window.
- Time: 7s

(Subject 2)
- Observation:
Subject quickly looked at the Participant Window and provided the correct answer by looking at the numbers displayed within the Participant Window.
- Time: 9s

(Subject 3)
- Observation:
Subject realized the Participant Window displayed the statistics of the entire discussion. Subject therefore looked at the Participant Window and answered the question correctly.
- Time: 11s

(Subject 4)
- Observation:
Subject realized she was asked about the statistics of the whole discussion so she immediately looked at the Participant Window and provided the correct answer by looking at the numbers at the Participant Window.
- Time: 8s

(Subject 5)
- Observation
Subject immediately looked at the Participant Window and answered the question correctly.
- Time: 31s

Task 1e)

(Subject 1)
- Observation:
Subject first right clicked on thread #1 and chose the Show Thread Stats option. However this option only gave her the statistics about a single thread so subject turned to look at the Participant Window and right clicked on the name of the student of interest and looked for the options available to her. Subject first opened the Discussion Interaction Table but this also did not give her the correct answer. Finally, subject performed Participant Highlighting on the student and was able to answer the question correctly by looking at the highlighted messages in the Discussion Map.
- Time: 52s

(Subject 2)
- Observation:
Subject first opened the Discussion Interaction Table from the Participant Window, but subject realized this option would not give her the answer because it only displayed statistics at the discussion level. Subject then performed Participant Highlighting on the student of interest from the Participant Window. After highlighting subject was able to give the correct answer by looking at the messages in the Discussion Map.
- Time: 34s

(Subject 3)
- Observation:
Subject first looked at the Participant Window, then right clicked on the student of interest and chose the Participant Highlighting option. Subject was able to answer the question by looking the messages posted by the student in the Discussion Map.
- Time: 25s

(Subject 4)
- Observation:
Subject first performed Participant Highlighting on the student of interest from the Participant Window. Then subject looked at all the student's messages highlighted in the Discussion Map and gave the correct answer quickly.
- Time: 10s

(Subject 5)
- Observation
Subject first found one of messages posted by the student of interest in the Discussion Map, then chose the option Highlight all messages by this author. Subject was able to answer the question immediately by looking at the student's postings in the Discussion Map.
- Time: 31s

Task 1f)

(Subject 1)
"I am not trying to look at the length of messages, but I do look at how active a student is... how many postings to all or to individual thread."
"Your tool allows me to figure out which thread generates most discussion that's important"
"other than that, just trying to see if they met the minimum posting requirements... which I think I can do it by highlighting individual student because that's gonna show me if they have started their own thread and they are supposed to reply to 2 other threads for example... so I can see it here."

(Subject 2)
"One thing I can think of is who has participated at when... I can highlight a student and use that time liner tool to see when he participated."
"Sometimes students go in and posted all the messages at the last minute, so I can use this to check whether he has participated everyday... if a conference goes from Tuesday to Friday and they just go in on Friday and made all his posts that's not what we want."

(Subject 3)
"I am mostly interested of the qualitative not quantitative... I would mostly mark (highlight) a student and check which thread a student has participated, and how many, and who are they talking to using the visual map."

(Subject 4)
Subject liked the feature of opening multiple postings in multiple windows. "I like the way I can compare the two (students)... for example, how they cite between each other and whether they have cited correctly, having both side by side it is much easier to look at"
"In CMS, I cannot compare side-by-side, and I need to lots of clicking and see the postings one by one."

(Subject 5)
Subject commented:
"I do not do any types of such tasks (in CMS) because I have to read everything... there's no tool to help"
"This tool (CZTalk) actually helps me to perform these tasks"

Subjective Question #1

(Subject 1)
"I find it more useful than CMS because I need to manually count things (in CMS) which's no good."
"Once I learnt how to pay attention to the bars of the histogram they are also useful to give me some information."
"Words per message (message length)... would be useful somewhat looking at the quality but not 100%."
"I like the highlighting so I can see how individual student is doing in a discussion, what they are paying attention to and what they are not."
"Being able to see many threads all at once is good for structural analysis."
Subject also suggested she would like to see the content of an entire thread "because I can see the relevant content at once... if I just look at a single post I cannot get that context... I want to be able to pull out messages in a thread all at once."
Subject also suggested the sizes of the modeless message windows are too small "they are kind of difficult to read."

(Subject 2)
"Yes, it gives both visual report as well as numerical report so I can get to see it in both ways... it helps me quickly to see what's going on in the conference."

(Subject 3)
"I need more time to work with it and see if it makes marking faster."
"With the map, I can see who started the conference and see what they did."
Subject also suggested another way of how she would use Participant Highlighting. "I can highlight participant by different colours and check their progress.... the highlight can also help me to see whether I have marked everyone because eventually they should all have different colours."
"I can also get a sense of their dialogue quickly."
"The quantitative numbers can be useful for an at-a-glance overview."

(Subject 4)
"Yes... the global overview is very useful"

(Subject 5)
"Yes... (CZTalk) makes it easier to see it... to see the pattern"

Subjective Question #2

(Subject 1) – Included in #1

(Subject 2)
"Yes, because its visual feel and very intuitive... I like the feature where I can highlight and see who has participated."

(Subject 3)
"It has more organizational tool to package and structure the threads to myself."
Subject also would like to see the capability for CZTalk to send emails to students. "it would be useful if I can send emails to students and make soft comments on their postings... but (the comments) need to send back to the whole conference."
Subject also suggested about how to display student participations in the Participant Window "the Participant Window should somehow show the participations of each thread, who has and who has not participated"

(Subject 4)
"Yes. I like the highlighting because I can check the performance of student at each thread easily by looking at (the message window)... so I can cross compare (between threads) of a student and between students over time"

(Subject 5)
"Yes... (CZTalk) is pretty intuitive, and it makes it visual"

Subjective Question #3

(Subject 1)
"CZTalk because it can do whole lot more easily than CMS… (CZTalk) provides lots of statistical information which is far more easier to do with CMS."

(Subject 2)
"CZTalk, because I can see the overall picture of the conference. In CMS all you have are all these threads, and there's no organizational tool other than people answering to the threads… there's no intuitive organization of threads"
"(In CMS) I have to click on every single thread to find out what each person says and it's very difficult to see the participation rate of different student"
"With this (CZTalk) you can do very quick analysis and can quickly identify students… so I can check the conference everyday, get a quick visual representation about what happened, then move on to the next team… it's time saving."

(Subject 3)
"CZTalk I guess… another design issue is that I don't like the messages boxes floating on the map because they would cover the context of the discussion… I would like to see them dockable at the lower right hand window."

(Subject 4)
"CZTalk by far. CMS does not do any of this."

(Subject 5)
"CZTalk… but I would use both… because I am so used to CMS, but I think I will get used to CZTalk"

Task 2a)

(Subject 1)
- Observation:
Subject first opened the Time Slider. Subject then moved the thumbs of the Time Slider and highlighted the messages which were posted before the submission deadline date. Subject answered the question by counting the number of messages which were not highlighted.
- User Comments (if any)
Subject suggested she would like the text fields of the Time Slider to be editable "so I can enter the dates into the boxes."
Subject also expressed concerns about precision when Time Slider was used to handle semester long course because "it would be very hard to change it by everyday if the discussion lasts for a longer time… you need more precision when making adjustments"
- Time: 29s

(Subject 2)
- Observation:
Subject opened the Time Slider immediately. Subject tried to type the deadline date into the text fields of the Time Slider at first, but she was told that the only way she could manipulate the dates in the current version of CZTalk was to move the thumbs of the slider and the slider itself. Subject then moved the thumbs of the Time Slider and answered the question by highlighting the messages which were submitted beyond the deadline date. After the task, subject looked at the messages in the Discussion Map and explained how she would not consider some messages to be late because of the content of the messages.
- Time: 31s

(Subject 3)
- Observation:
Subject first looked at all the messages in the Discussion Map and soon she seemed confused about how to proceed. Subject was then told the location of the Time Slider. Once subject opened the Time Slider, she first tried to type in the deadline date into the text fields of the Time Slider but she was told she could only choose the range by sliding the slider. Eventually subject moved the thumbs of the Time Slider and answered the question correctly.
- Time: 1m 47s

(Subject 4)
- Observation:
Subject chose the Time Slider tool right the way. Then subject moved the thumb of the Time Slider to highlight all the messages that were posted within the submission deadline and answered the question correctly by looking at the number of messages without highlights.
- Time: 58s

(Subject 5)
- Observation
User was able to choose the Time Slider option right the way. Subject then moved the slider to the deadline date, and counted all the messages that were not highlighted.
- Time: 48s

Task 2b)

(Subject 1)
- Observation:
Subject opened the Time Slider immediately and highlighted the messages which were posted before the submission deadline date. Subject then looked at the thread of interest in the Discussion Map and answered the question by counting the messages which were not highlighted.
- User Comments (if any)
"It's very easy to get distracted because all these (highlighting to the messages other than the current thread of interest) is irrelevant information... but it is pretty easy to ignore and find useful patterns."
- Time: 25s

(Subject 2)
- Observation:
Subject opened the Time Slider and gave the correct answer by moving the thumbs and highlighting the messages which were posted after the submission deadline. Subject also compared the names of the authors who posted in the thread of interest to that in Participant Window and gave the names of students who have not submitted to the thread at all.
- Time: 24s

(Subject 3)
- Observation:
Subject quickly opened the Time Slider and answered the question correctly by moving the thumbs of the Time Slider to the desired deadline date and counted the number of messages without any highlighting.
- Time: 10s

(Subject 4)
- Observation:
Subject realized she was asked about the submission deadline of one thread and she performed steps similar to Task 2a) to get the correct answer.
- Time: 9s

(Subject 5)
- Observation
Similar to 2a). Subject moved the Time Slider to the appropriate deadline date, and counted all the messages that were not highlighted.
- Time: 25s

Task 2c)

(Subject 1)
- Observation:
Subject opened the Time Slider and narrowed the slider down to one day interval. Subject then slide the slider back and forth and answered the question by counting the number of highlighted messages in the thread of interest of each day.
- User Comments (if any)
Subject expressed interest when using the slider to look at daily contribution "that's interesting to look at."
- Time: 1m 3s

(Subject 2)
- Observation:
Subject was able to narrow the slider of the Time Slider to one day interval and gave the correct answer by sliding the slider back and forth. However, subject needed to adjust the thumbs of the slider frequently in both directions to make sure she was looking at just one day because the slider was always overlapping between two days.
- Time: 43s

(Subject 3)
- Observation:
Subject first opened the Time Slider and narrowed the range down to one day. Subject then slide the Time Slider back and forth and was able to answer the question correctly.
- Time: 59s

(Subject 4)
- Observation:
Subject opened the Time Slider and moved the thumb to a one day interval. Then subject slide the entire bar back and forth. Although subject could give the right answer, she seemed to have troubles to move the bar between dates because she had to pay a great attention to check whether the Time Slider was within the time range she was trying to select, especially when she was trying to slide the bar between the boundaries of different dates.
- User Comments (if any)
"It (the sliding) is a little awkward..."
"Because it is a very specific question asking me about a specific date... too much attention needed and it actually hurts."
Subject also suggested one feature she would like to see. "If I can type in the dates and the results pop up that may be better."
- Time: 1m 31s

(Subject 5)
- Observation
Subject quickly realized that she has to look at the submission pattern on a daily basis. Subject slide the Time Slider within one day interval, then moved the bar back and forth

and answered the question correctly. Subject had to pay great attention when using the Time Slider, especially at the boundaries between dates because sometimes subject could not tell whether the slider had already passed the day boundaries.
- Time: 1m 15s

Task 2d)

(Subject 1)
- Observation:
Subject performed Participant Highlighting on the student of interest. Subject then opened the Time Slider and narrowed it down to one day interval. Subject was slow at the beginning because she needed to associate two types of highlighting: one from the Participant Highlighting and the other one from the Time Slider. However, after practicing for a few days subject was able to do it a little quicker and was able to provide the correct answer.
- User Comments (if any)
Subject suggested she would like graphs depicting the rate of submission of each student over time. "It would be more useful to have graphs... so you have something like on your questionnaire so I can click on a student and graph the participation... in that way I don't have to count and I immediately get a visual representation."
- Time: 1m 8s

(Subject 2)
- Observation:
Subject first performed Participant Highlighting on the student of interest from the Participant Window. Subject then opened the Time Slider and followed the steps similar to Task 2c) to answer the question. Again subject needed to pay great attention at the slider and frequent adjustment to the thumbs of the slider was observed.
- Time: 1m 35s

(Subject 3)
- Observation:
Subject quickly performed Participant Highlighting on the student of interest. Then she looked at the messages in the Discussion Map and was confused about how to obtain the time information. Subject then was told about it was possible to do a search combined with Time Slider and highlighting. Subject then opened the Time Slider but she still seemed to have difficulties because whenever she slide the slider she had to pay great attention to the Discussion Map and tried to look for the messages with highlights from both Time Slider and Participant Highlighting options. However subject was still able to provide the correct answer.
- User Comments (if any)
"it's too time consuming because too many things were highlighted and popping in and out... I cannot keep track of what I was looking for."
- Time: 2m 27s

(Subject 4)
- Observation:
Subject remembered she could do a search combined with Participant Highlighting and the Time Slider, thus she first performed a Participant Highlighting to the student of interest from the Participant Window. Then she opened the Time Slider and tried to do the steps similar to Task 2c). Again subject seemed to have troubles to slide the Time

Slider between dates and she had to move the slider within the time period of interest about 3 times before she could give the correct answer.
- User Comments (if any)
Subject reported she answered the question by looking the colour change of the messages only. "I am not counting the numbers... I am just using the colours to look at the trend."
- Time: 2m 59s

(Subject 5)
- Observation
Subject first highlighted the postings posted by the student of interest using the Highlight by this author option from one of the student's messages. Subject then chose the Time Slider tool and tried to slide it on a daily basis. Again subject needed time to adjust the thumbs and slide the bar at the beginning, but subject was able to move the bar around and answer the question quickly when she got used to the Time Slider.
- Time: 1m 56s

Task 2e)

(Subject 1)
"I rather need a general trend only on each student... better show at different levels"
(thread and discussion levels)

(Subject 2)
"What I could probably do is to take a look and see what the participation was per day, to make sure they contributed everyday and answered to their peers" (that is part of the course requirement).

(Subject 3)
"The only thing I will look at is whether students made deadlines and who lose marks... other than that I don't really care... how they posted the messages throughout the discussion is up to them"

(Subject 4)
"What just did is important... when the assignment required students to participant by the end (of the discussion) I can use the slider to check if they have posted the messages as required."

(Subject 5)
"... basically I am only interested in students who posted late."
"need to work with CZTalk longer to see if there are more things can be done... It's too hard to do anything like this in the current (CMS) system"

Subjective Question #1

(Subject 1)
"I am more looking for just general trends, not necessarily have to count precisely... I only need the numbers because the tasks suggest so... from my teaching I may care about the trend but I wouldn't care about which date has the most postings."
Subject expressed concerns about the in-between times before crossing the boundaries between two days "what I am expecting here is to show me the 10th, 11th and 12th and not those in between times"
Subject also suggested she would like the Time Slider to include time of the day.
"Sometimes time of day is relevant, for example posting has to be in by 5pm of such and such day... for me if I am trying to see who have posted late this tool would not give me the precision that I need."

(Subject 2)
"Yes, it also helps me to determine the reasons... because sometimes teammates posted in 12 or 1 o'clock and you can't expect other teammates to give feedback until the next day, so I will check for time liners if that's a factor of the conference."

(Subject 3)
"Opening multiple windows... for me it's kind of hurt to track what's happening. The slider sliding back and forth and the frequent colour changes... too confusing"

(Subject 4)
"This tool is really good because I can check who did not participate, and what were the reasons... and I can take it to my colleagues and to use this type of information to actually look at the bigger picture of the course."

(Subject 5)
"Yes... (CZTalk) makes it graphic; it's visual so I can see patterns."
"(in CMS) I have to write down ticks on a piece of paper to do this."

Subjective Question #2

(Subject 1) – included in #1

(Subject 2)
"Yes but it's a little tricky because if I can't just type in (the dates) and do a quick check sometimes that's tricky to get to the right time frame."
"It's good at looking the overall because you can see how the pattern is going, but I need time to get used to it… to make sure it gets to the right dates."

(Subject 3)
Subject suggested she would like to type in the exact dates when doing a time window search. "(for example) I can type in a student's name from say Monday to Thursday and to do a search"

(Subject 4)
"The scrolling (of the Time Slider) is not working for me."
"I like to watch the colour change… so I do not need to count, very useful, and a lot easier."

(Subject 5)
"Yes, again because it makes it graphic"
Subject also suggested she would like to see the dates in the Time Slider "go in chunks", so she is able to move the dates up and down by clicks, "so it wouldn't take me as long to get that thing right at where I want it to be."
Subject also expressed her opinion about the Time Slider "I don't like the sliding… I have to spend a lot of time to make it right between dates"

Subjective Question #3

(Subject 1)
"CZTalk because it's giving me a sense of which student missed deadlines and that's important information. CMS has similar function where you can search for postings for a given student within a certain time frame but it's more difficult to use."

(Subject 2)
"CZTalk. In CMS I have to check into each thread and count these numbers by hand… it is very time consuming, especially for a long thread."

(Subject 3)
"I am not sure… what I did is just too simple, and I don't really need any patterns or trends. In CMS, it just takes me seconds to check for this."

(Subject 4)
"CZTalk… CMS does not do it"
"In the current system, I have to print the overview, highlight the dates on the paper and look for the posts."

(Subject 5)
"CZTalk, because I cannot even do the similar tasks in CMS."

Task 3a)

(Subject 1)
- Observation:
Subject looked at the thread of interest in the Discussion Map and was able to explain the reply pattern of the thread correctly by following the replying-to arrows.
- Time: 19s

(Subject 2)
- Observation:
Subject first opened the Thread Interaction Table of the thread of interest. However subject discovered that the table would not give her the answer because it only gave her the reply counts of the thread only. Subject then looked at the thread of interest in the Discussion Map and was able to describe the reply pattern of the thread correctly.
- User Comments (if any)
Subject commented "in the table you did not see much, but here (pointing at the Discussion Map) you can see the kind of interaction."
- Time: 1m 1s

(Subject 3)
- Observation:
Subject looked at the thread of interest in the Discussion Map and was able to quickly identify and explain the reply pattern of the thread.
- Time: 23s

(Subject 4)
- Observation:
By looking at the thread of interest in the Discussion Map subject was able to tell the reply pattern the thread exhibited and answered the question correctly.
- Time: 15s

(Subject 5)
- Observation
Subject looked at the thread of interest in the Discussion Map and could point out the replying pattern of this thread immediately.
- Time: 14s

Task 3b)

(Subject 1)
- Observation:
Subject looked at the thread of interest in the Discussion Map and she quickly identified the thread with the most number of replies.
- Time: 12s

(Subject 2)
- Observation:
Subject looked at the messages in the Discussion Map and was able to pinpoint the thread with the most number of replies right the way.
- Time: 10s

(Subject 3)
- Observation:
Subject understood that she was looking for "the thread with the most number of these replying arrows". Subject looked at the threads in the Discussion Map and gave the correct the answer.
- Time: 46s

(Subject 4)
- Observation:
Subject first asked the investigator about whether she was only required to look at the replies to the initial postings of each thread or she needed to look at all the replies of each thread. Once the question was clarified subject was able to answer the question quickly and correctly by looking at the Discussion Map.
- Time: 31s

(Subject 5)
- Observation
Subject looked at all the threads in the Discussion Map and was able to pinpoint the thread which had the most number of replying messages.
- Time: 46s

Task 3c)

(Subject 1)
- Observation:
Subject first tried to count the number of replies received by each student by hand. Soon subject right clicked on the thread of interest and looked for the options available to her. Subject chose Thread Interaction Table option and she provided the correct answer by looking at the entries of the Thread Interaction Table.
- Time: 33s

(Subject 2)
- Observation:
Subject right clicked on the thread of interest and opened the Thread Interaction Table. By looking at the numbers displayed subject was able to answer the question correctly.
- Time: 18s

(Subject 3)
- Observation:
Subject looked at the messages of the thread of interest in the Discussion Map and counted the replies to each student directly. Subject was able to answer the question correctly.
- Time: 17s

(Subject 4)
- Observation:
Subject did not use any other tool in CZTalk. Instead, subject scanned the messages of the thread of interest and provided the correct answer quickly.
- Time: 7s

(Subject 5)
- Observation
Subject looked into the thread of interest in the Discussion Map and actually counted the messages received by each student. Subject was able to provide correct answer by counting the messages directly.
- Time: 6s

Task 3d)

First student of interest
i)
(Subject 1)
Subject performed Participant Highlighting on the student of interest and answered the
question "by looking at the circles that I highlighted" in the Discussion Map.
- Time: 17s

(Subject 2)
Subject first performed Participant Highlighting on the student of interest. Subject then
looked at the highlighted messages in the Discussion Map and was able to provide the
correct answer.
- Time: 6s

(Subject 3)
Subject performed Participant Highlighting on the student of interest from the Participant
Window and provided with the correct answer by counting the number of initial
messages posted by the student in the Discussion Map.
- Time: 36s

(Subject 4)
Subject first performed Participant Highlighting to the student of interest from the
Participant Window, then she looked at the highlighted messages in the Discussion Map
and answer the question correctly.
- Time: 29s

(Subject 5)
Subject first highlighted all the messages posted by the first student of interest. Then she
looked the Discussion Map and counted the number of initial message posted by the
student. However, she provided the wrong answer.
- Time: 18s

ii)
(Subject 1)
Subject first asked "Can I do a global table?" so she was told about how she could
generate the Discussion Interaction Table from the Participant Window. With the
Discussion Interaction Table subject answered the question by counting the
corresponding entries in the Discussion Interaction Table.
- Time: 29s

(Subject 2)
Subject asked about "the table that shows the interaction for the discussion" so she was
told how to open it in the Participant Window. With the Discussion Interaction Table
subject answered the question correctly.
- Time: 37s

(Subject 3)
Subject tried to count the messages the student received from the Discussion Map at the
beginning. But soon subject right clicked the student's name in the Participant Window
and checked the options available to her. Subject finally chose the Interaction Table
option from the Participant Window. Subject seemed to have forgotten the meaning
betweens the rows and columns of the Interaction Table so clarifications were made.
Subject was able to provide the correct answers after the clarifications.
- Time: 50s

(Subject 4)
Subject right clicked on the Participant Window and looked at the options available. The
she chose the Interaction Table tool from the context menu and answered the question
correctly by counting the numbers in the table.
- Time: 35s

(Subject 5)
Subject also tried to count the number of messages the student received directly by
looking at the Discussion Map and seemed confused. So the subject was told about
another approach by using the Interaction Table and she seemed recalled the tool by
responding "oh right right... I remembered this". With the Interaction Table she was able
to answer the question immediately.
- Time: 1m 16s

iii)
(Subject 1)
Subject used the Discussion Interaction Table in the way similar to ii) and answered the
question correctly.
- Time: 6s

(Subject 2)
Subject immediately opened the Discussion Interaction Table and answered the question
by counting the corresponding entries in the Discussion Interaction Table.
- Time: 19s

(Subject 3)
Subject first opened the Interaction Table from the Participant Window. However,
subject mixed the meaning between the rows and the columns of the Interaction Table
and provided the wrong answer by counting the number of entries of the row, as
supposed to count the number of entries of the column of that particular student.
- Time: 17s

(Subject 4)
Subject again looked at the Interaction Table and provided the answer almost instantly.
- Time: 2s

(Subject 5)
Subject was able to use the Interaction Table to answer the question immediately.
- Time: 3s

Second student of interest
i)
(Subject 1)
Similar to i) above.
- Time: 15s

(Subject 2)
Similar to i) above. Extra time was needed because subject mixed between two students with the same first names.
- Time: 29s

(Subject 3)
Similar to i) above.
- Time: 20s

(Subject 4)
Subject took the same steps in i) above and answered the question correctly.
- Time: 11s

(Subject 5)
Similar to i) above and the subject was able to answer the question correctly.
- Time: 5s

ii)
(Subject 1)
Similar to ii) above.
- Time: 9s

(Subject 2)
Similar to ii) above.
- Time: 15s

(Subject 3)
Similar to ii) above.
- Time: 16s

(Subject 4)
Similar to ii) and iii) above, subject opened the Interaction Table and answered the questions correctly.
- Time: 28s

(Subject 5)

Subject immediately chose the Interaction Table option and answered the question correctly.
- Time: 18s

iii)
(Subject 1)
Similar to iii) above.
- Time: 2s

(Subject 2)
Similar to iii) above.
- Time: 9s

(Subject 3)
Similar to iii) above. Again subject mixed the meaning of the Interaction Table and produced the same mistake.
- Time: 8s

(Subject 4)
Similar to ii) and iii) above, subject opened the Interaction Table and answered the questions correctly.
- Time: 0s

(Subject 5)
Similar to ii).
- Time: 0s

- User Comments (if any)
(Subject 1)
Subject suggested she would like to include the totals for each row and column in different interaction tables so "I don't have to count it myself."

Task 3e)

(Subject 1)
Subject commented on the interaction tables "it's fairly easy to do that kind of comparison."
Subject also suggested "one thing it may be useful here is to shade this diagonal" so self-replies could be noticed more easily.

(Subject 2)
"the entire discussion (map) is helpful... because if an assignment asked students to post messages and give feedback to teammates, then I can use that for that... then I will look for why. I will use it for the time liners factor and look and see if they are interacting with their teammates in the way we asked them to... in a task-based discussion this is very important to check."

(Subject 3)
"Can't think of any other than highlighting a student and look for how he did and when, also how others talked to him, like did they talk to him"

(Subject 4)
"I cannot think of any now."

(Subject 5)
"I cannot think of any other because it is too hard to do with CMS."

Subjective Question #1

(Subject 1)
"What table shows me is to get a sense of which students are generating discussions, which students are replying to others and if there are some students may be ignored altogether for some reasons... whether students are not making intelligent posts or just because some have been left-out. I like this table and I would like to have totals on that."
"I like the Participating Highlighting... I can get a sense of how much activity, or how active individual students are in a discussion."

(Subject 2)
"Yes because I can look at interactions at different ways... because now I can look at each thread interaction, and also the entire discussion interaction."

(Subject 3)
"Yes I think the highlighting by participant... I can scan over quite easily."
"The table is quite helpful, it did and showed the counting... because it's easy to make errors if count by myself."

(Subject 4)
"I like the visual representation, and the table is quite helpful."

(Subject 5)
"Yes... (CZTalk) creates possibilities I have never thought about... CMS is too complicated to check similar things."

Subjective Question #2

(Subject 1) – included in #1

(Subject 2)
"Yes. In CMS I cannot really see what the interaction patterns are, if at all... I can only see the text, and it's very confusing."

(Subject 3)
"Half and half. It's good because it's easy to use, but it's easy to miss the numbers as well."
Subject suggested including more information in the Interaction Table "it will be more helpful if it shows, for each student, how many threads have they started."

(Subject 4)
"Yes. The visual map and the arrows help me to look at interactions."

(Subject 5)
"Yes... I am still learning (CZTalk) but I think I will get used to it."

Subjective Question #3

(Subject 1)
"CZTalk. In CMS you are scrolling through the text-based outlines with user ID, that's not helpful."
Subject also commented on the size of the rectangles representing messages in the Discussion Map "you should make the size of the messages larger because student's names will be cut off... you should allow the boxes to be different sizes depending on the information you are trying to put in there."

(Subject 2)
"CZTalk."

(Subject 3)
"CZTalk. In CMS I can only open one thread at a time, but I did not really get a sense of who started it... also at the end, if I need to mark the overall participation I have to count manually, and it's very labor intensive. CZTalk is much better for that kind of thing."

(Subject 4)
"CZTalk."

(Subject 5)
"CZTalk"

Question 4 (Message's Content Search)

(Subject 1)
"Yes I can get a sense of how widely a topic is discussed and I can click on any one if I want to see it."
Subject also suggested she would like to have the option to see excerpts of the messages which matched the searching criteria "useful to have the option to show only the matches if I just want to see where they are, or thumbnails of messages all at once... a little excerpts of each like the first 2 lines or something, so I can get a sense of which message I am trying to look for, and it also helps to narrow the search."

(Subject 2)
"It's more helpful in finding a certain message because sometimes if a student posted a really good message and we only remembered a few words from it then we can type that in and bring that up so we can show to the class... but you still cannot look for critical content of messages by word search like that."

(Subject 3)
"Yes... generally names, so I can see how student is being referenced by each other."

(Subject 4)
"Yes it is helpful... when discussing a particular topic like "Gender in CMC" I will put in the keyword like "Gender" and see how students will use the language and the concept... I can also put in the keywords and major concepts from their readings and see how they will use the concepts."

(Subject 5)
"Definitely... One way I can think of is to look for students' names in messages (to look at how students cited each other in their postings)"
Subject also suggested she would like to look at more than one discussion at a time so she can "check students' postings across multiple conferences."

Question 5 (Message Annotations)

(Subject 1)
Subject was first confused about the differences between annotating a message and replying a message. After explaining to her that annotation would not be visible to student subject still questioned about the usefulness of this feature "I can reply to a message why would I want to annotate student (messages)."

(Subject 2)
"We can make notes to ourselves about good or bad examples… I can comment on critical content."
Subject also suggested to use the colour of the annotation dots to represent the importance of or rating on a message according to its critical content "(use the dots) to represent exceptionally good or bad postings and we can rate it with different colours."

(Subject 3)
"I am sure I would (use it)… I would make note to myself about why a student is given a low grade so to remind myself and if the student comes back and ask, then I can simply bring it up"
Subject also suggested she would like to "bring up all annotations made to one student, so I do not have to go back and find my comments and when I made them."

(Subject 4)
"I will definitely make notes to myself."

(Subject 5)
Subject also suggested this feature is more useful if "there's a way I can pull-out all annotations made to a student over the semester across multiple conferences… so by the end of the course I can look at all the annotations I made to each student and help me to assign a final grade to each of them"
"Now I track the number of messages they have done but I don't check how many of them were really good because it's just too hard to track it (in CMS)."

Question 6 (Prioritizing Messages)

(Subject 1)
Subject expressed concerns about the multiple meanings of colours "now I have 2 different types of highlighting... I have to remember green doesn't highlight a student but other colours highlight student that's confusing"
Subject suggested "I wonder there's some other way... like flags on messages or something like that."
Subject also suggested to place the symbols (e.g. annotation dots, magnifying glasses) outside the messages "better to attach the symbols onto the outside of the boxes... it may make it look more clutter but it may make it easier to read the information... because the box would not be being covered so that you are not overlapping with this text you are trying to convey inside the box... thinking outside the box here you go!"

(Subject 2)
"(the colours) it's hard to see."
"rather I would like the dot to have difference colours. I can combine with student highlighting and check who has more good postings posted, by just looking at their dots, so I can encourage students to post more critical content."
"(with the dots) I can quickly see the content of messages, because it's important to check the student's critical thinking process and to be able to give critical feedback."

(Subject 3)
"Maybe if I had to stop marking in the middle, I can use this so I can look back to start marking again."

(Subject 4)
"in terms of content... it maybe helpful."
Subject also suggested another feature she would like to include in CZTalk. "Tag quotation marks will probably be useful... so when somebody is using quotes, there's a quick and easy way to see if they cited the references correctly... (tags) also help me to see if students are going beyond, (as against to) writing very quick and simple responses."

(Subject 5)
"I don't like the colours... you need some better colours"
Subject commented that this feature is useful "as long as it is invisible to students... in CMS, I can do something similar, but it is also visible to students so I never use it."
"(CZTalk) has more potentials than CMS for tracking messages"
Subject also provided an example of how to use this feature. "I need a way to mark messages which are really good or bad. This can help me remember the message so I can bring it to the class and discuss with students... (in CMS) I have to rely on my memory because there's no way to mark them."

Post-Test Questionnaire

1. Does CZTalk help you understand and evaluate students' performance in an online discussion environment? What are the ways in which it does so?

(Subject 1) Yes – for statistical aspects. Easy visualizations of # posts, relationships, relative contributions = very helpful. However, it focuses very much on these quantitative aspects at the expense of content/quality of posts.

(Subject 2) Yes. It allows me to pinpoint certain aspects of students' performance (such as frequency, timeliners or interactivity) and give a quick visual picture of what is occurring.

(Subject 3) Yes, it helps evaluate student performance in that I can compare student performance over several conferences easily. However I do not think it would actually help with the 'evaluating' unless it was integrated into some kind of marking software.

(Subject 4) Yes. I can evaluate # of contributions, student interaction and time liners. As well, I can compare content between students quite easily.

(Subject 5) Yes – mainly by making it graphic and easy to use.

2. What do you think CZTalk's major strengths are?

(Subject 1) I can SEE what my students are doing in terms of conference activity -> much easier to notice possible problems and correct them early.

(Subject 2) Major strengths are the intuitiveness of how each analysis can be performed – clicking for highlight one student or using the timeline to quickly see when students participated. So overall, the visual aspects, ease of use and quickness on ability to discover patterns of participation.

(Subject 3) Its major strength is that you can universally highlight / track students' participation over several conferences.

(Subject 4) Quick visual representations of information. I don't have to do a lot of reading! Key terms: I like the directory!

(Subject 5)
- Graphics
- Showing the postings graphically
- Search for a team

3. What do you think CZTalk's major weaknesses are?

(Subject 1)
- Small text and cluttered boxes
- Small windows for viewing posts
- Inability to read on active thread in natural flow

(Subject 2) Can't think of any other than you have to download the conferences to the CZTalk platform. It would be great if this tool could be integrated into the CMS as a live tool, rather than to analyze a conference in a static state.

(Subject 3) Weakness is that it seems to focus on the gathering of quantitative data as oppose to qualitative. Most of the tools seemed to give you how many posts, how long, type of information. Qualitative analyze would focus on ease of reading, grammatical structure, tracking key phrases and ideas. Also sophisticated note taking systems that are student as oppose to conference dependant.

(Subject 4) The time slider is awkward, a bit too fussy. I have to hold the mouse tightly to control the dates.

(Subject 5) Need to be able to do some cross - conference analysis

4. What capabilities that you would like added to CZTalk?

(Subject 1)
- Finer graph on timeline – down to at least minutes
- sort participant list by first name, last name, # posts, wpm -> would wpp (words per post) be cleverer, less confusable by words per minute?

(Subject 2) See question #3. Also, would like to see a system for tagging critical posts. For example, a differently coloured ball in the corner of posts to tag depth of critical thinking displayed.

(Subject 3) Covered in above post.

(Subject 4) Can you tag quotation marks (" ") or citations brackets so we can track referencing?

(Subject 5) [Same as #3]

5. What capabilities are available in CMS but not in CZTalk?

(Subject 1)
- ability to view listing of all posts (author/subject) in discussion (WebX won't let you see this by thread, which is a problem...)
- ability to view all posts (content) in a discussion (again WebX won't let you see this by thread, which is a problem...)
- "thumbnails" of search results – author, subject, date and first few lines of each hit

(Subject 2) The CMS is live, whereas, CZTalk is not.

(Subject 3) The most important aspect of conferencing is a dialogue. In the CMS you can create comments as you mark.

(Subject 4) Not sure at this point. I'd have to think about it.

(Subject 5) Not sure if there are any.

6. All in all, do you think CZTalk is a useful tool in evaluating course-based online discussions?

(Subject 1) Yes

(Subject 2) Extremely useful and would like to use it as an evaluation tool for both participation and critical content of student's posts.

(Subject 3) Yes, it offers the visualization of some types of data which would be hard to gather through the CMS. The only way I could evaluate if it was 'useful' is through more in-depth use. The key factor for me would be if I was able to mark more efficiently in this environment.

(Subject 4) Yes! It helps me look at behaviour and interaction, which can save me time when looking for content.

(Subject 5) Yes

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