A New Face for GCP:
A Proposed Redesign of the Global Classroom Project Web Interface

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Executive Summary

This analytical report describes a proposed redesign of the Global Classroom Project's Web-based conferencing system. The current system and similar systems are analyzed. Characteristics of the users, including survey results, are also presented. Using this information, a new design is presented focusing on (1) improving the display of the conversation structure, (2) providing additional features to support knowledge-building, (3) fostering engagement, as well as a sense of community, among students by creating an improved atmosphere and (4) enhanced aesthetic appeal of the interface. It concludes with a description of the future work required to actually implement this design.

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The Global Classroom Project (GCP) is designed to provide a forum for cross-cultural, digital communication and collaborative project development. This forum for experiential learning demands a high level of person-to-person communication and interaction that centers on the challenges of real-life contextual communication. Much of this class is virtual in nature, conducted on the World Wide Web through WebBoard conferencing software. Currently the students are from Georgia Institute of Technology, USA and the European University at St. Petersburg, Russia.

The new GCP Web interface design focuses on (1) improving the display of the conversation structure, (2) providing additional features to support knowledge-building, and (3) fostering engagement, as well as a sense of community, among students by creating an improved atmosphere and (4) enhanced aesthetic appeal of the interface. In addition, this design provides the foundation for the future development of a system that conforms to standard and international usability criteria, is accessible with minimal technology, and is built upon a framework that can be easily reused each semester.

Problems with the Current System

The current class (Spring 2003) consists of America- and Russia-based students. Students login to their respective American or Russian GCP sites to access information, such as course schedule, description of assignments, and course resources.

Then, all students login to one WebBoard (O'Reilly & Associates, 1998), a tool for online conferencing. WebBoard, however, was neither designed specifically for the GCP class structure nor cross-cultural use. Discussion in WebBoard is organized through top-level *conferences*, which an administrator (course professor) must create. Students' posts are organized as *topics* and *replies* under the conferences.

In Figure 1, there are thirteen conferences, beginning with "Cowboys," and ending with "Other Discussions." In the "Other Discussions" conference, there are three posts, as well as two replies (under user A. Jennings' "war discussion" post).

With few posts and replies, such as in the figure, conversation is rather easy to read, follow, and respond. However, imagine hundreds of posts and replies under the same conference. Three months into the semester, ten of these thirteen conferences have 20 or more posts and replies. Five have 80 or more posts and replies, and two have over 100! Quickly the quantity of information becomes overwhelming.

The best way to manage the number of posts and replies is to filter new messages. However, it is difficult to start and hold "natural" conversation, because when the user reads only the new messages, the previous threads are hidden, and the new messages are read without appropriate context. In addition, a user survey we conducted [Appendix A] indicates that users want the freedom to start new discussions or branch apart from the current conference or post. This "break down" in communication disrupts the coherence
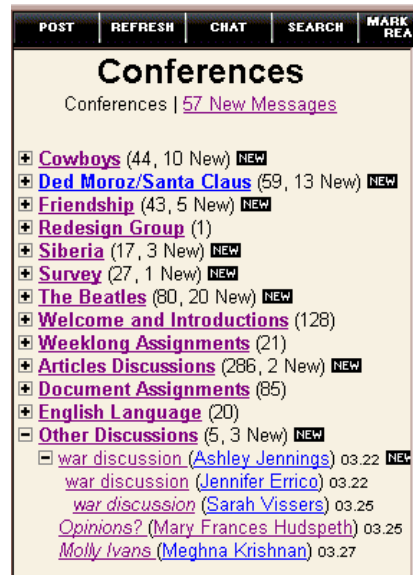
Figure 1: WebBoard Conversation Thread

of conversation. Conversation is the essential vehicle of communication in the GCP! A redesign must improve the display of conversation structure.

WebBoard users are unable to communicate nonverbal cues, such as facial expressions, gestures, and intonation. In addition, users are unable to collaborate directly on digital artifacts. This poses important problems, because the primary purpose of the GCP is to facilitate cross-cultural communication and group work. Nonverbal cues not only enhance communication, but sometimes give additional meaning to words (Dix, et al., 1998). The ability to collaborate on and edit a shared digital product is crucial to the mission of the course. Therefore, a new design must incorporate additional features and cross-cultural cues to support both knowledge-sharing and knowledge-building. In a course such as GCP, as well as in other types of computer-supported collaborative work (CSCW), the creation of new group knowledge is as important, if not more, than knowledge transfer (Dix, et al., 1998).

Finally, user comments lead us to believe that the aesthetic appeal of WebBoard is poor and could be improved. The current text-based system is built upon frames, in which the left frame contains the conversation thread (Figure 1), and the right frame is the target window for discussion thread links, as well as the form interface for posting new messages (Figure 2).
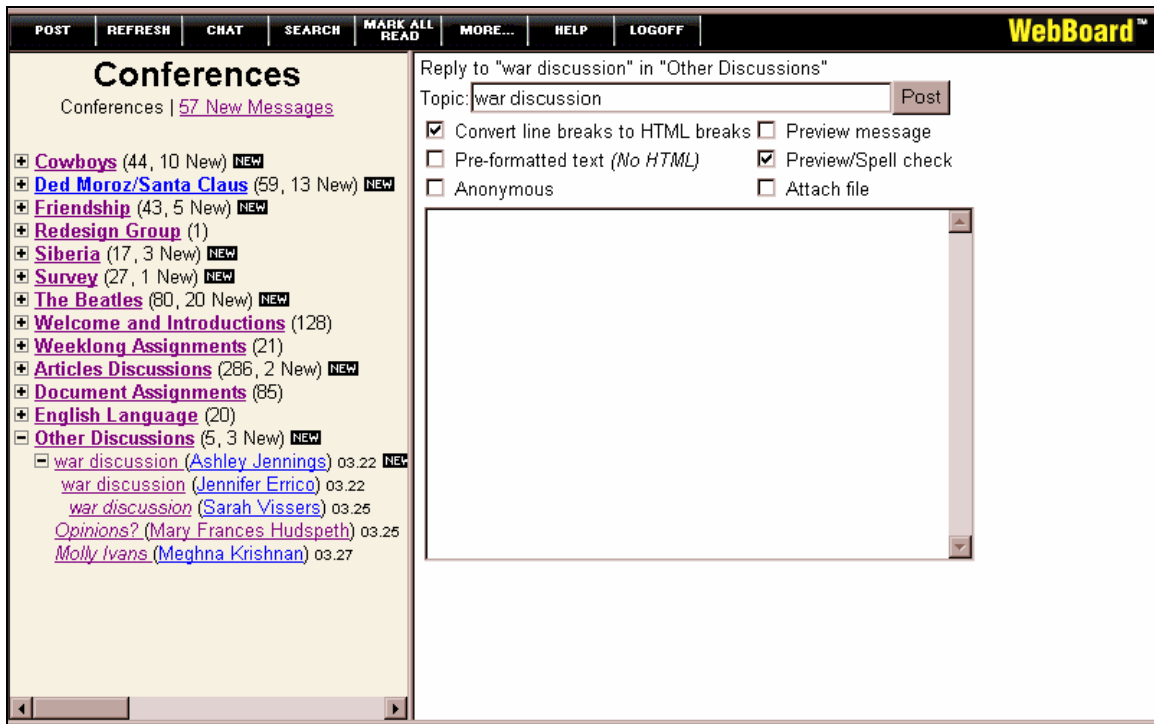
Figure 2: WebBoard Interface: Reply form in right-hand frame.

An improved redesign should foster a community atmosphere in which users enjoy interacting and participating, rather than viewing the structure of the course as essentially task-based.

Descriptions of similar systems

We reviewed some of the existing Web asynchronous discussion forums. Apart from the ones elaborated upon in this section, we reviewed many other sites. Most of them share similar features and hence we do not discuss them individually here.

WebCT
WebCT, Inc. which is a leading provider of e-Learning solutions for higher education, provides a Web space for colleges and universities to post course schedules and syllabi online. This includes a discussion forum. One needs a user name and password to login. Once the user has logged in, the interface as seen below appears.
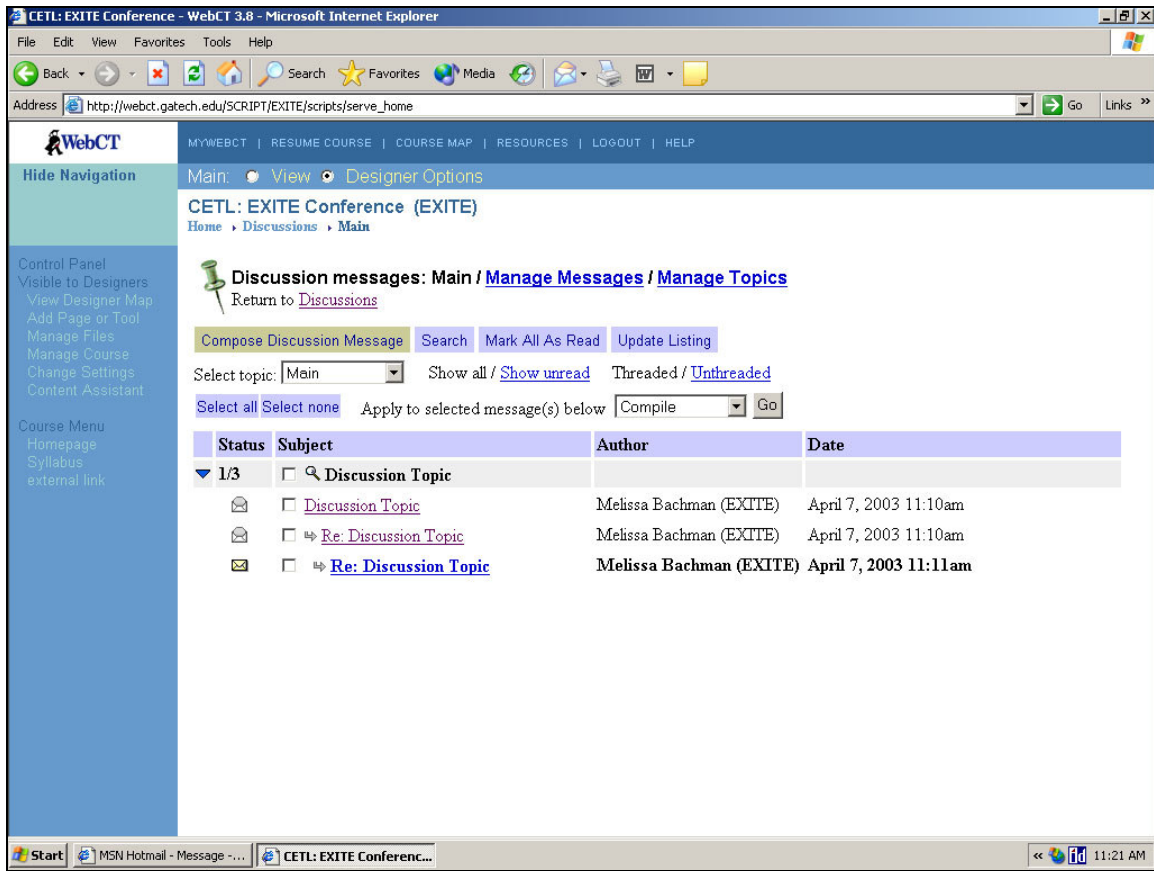
Figure 3: WebCT Discussion Board

The interface appears 'clean' and aesthetically simple. There are links on the left vertical frame of the screen. The remaining part of the screen is utilized for the discussion messages. Since one of our members has an administrator login permit, Figure 3 shows links to manage messages and topics. Except for these links, the rest of the interface is same for the others members.

The interface provides options to select topic, show unread/all and view the messages in thread format or otherwise. Also the viewer can select a few or all messages and can perform a task, like compile a message, delete, edit etc. The icon of a pushpin gives a metaphor of a bulletin board.

The cell padding between the cells in the table provides a well-organized tabular look. The cell under the 'Status' displays the number of threads that have been read out of the total number of threads. Similarly, the icons of 'opened envelopes' in contrast to the 'unopened' on the third thread is to indicate whether the message has been read or not. The colors are also used to delineate the read messages, denoted in red, from unread messages, denoted in blue. The messages are arranged in a hierarchical fashion with the starting message on top and then the next one below with an indent to the right. Additionally, there is an arrow indicating that this is a follow-on message or a reply to the above one.

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Status, Subject, Author and Date are the four headings for each thread.
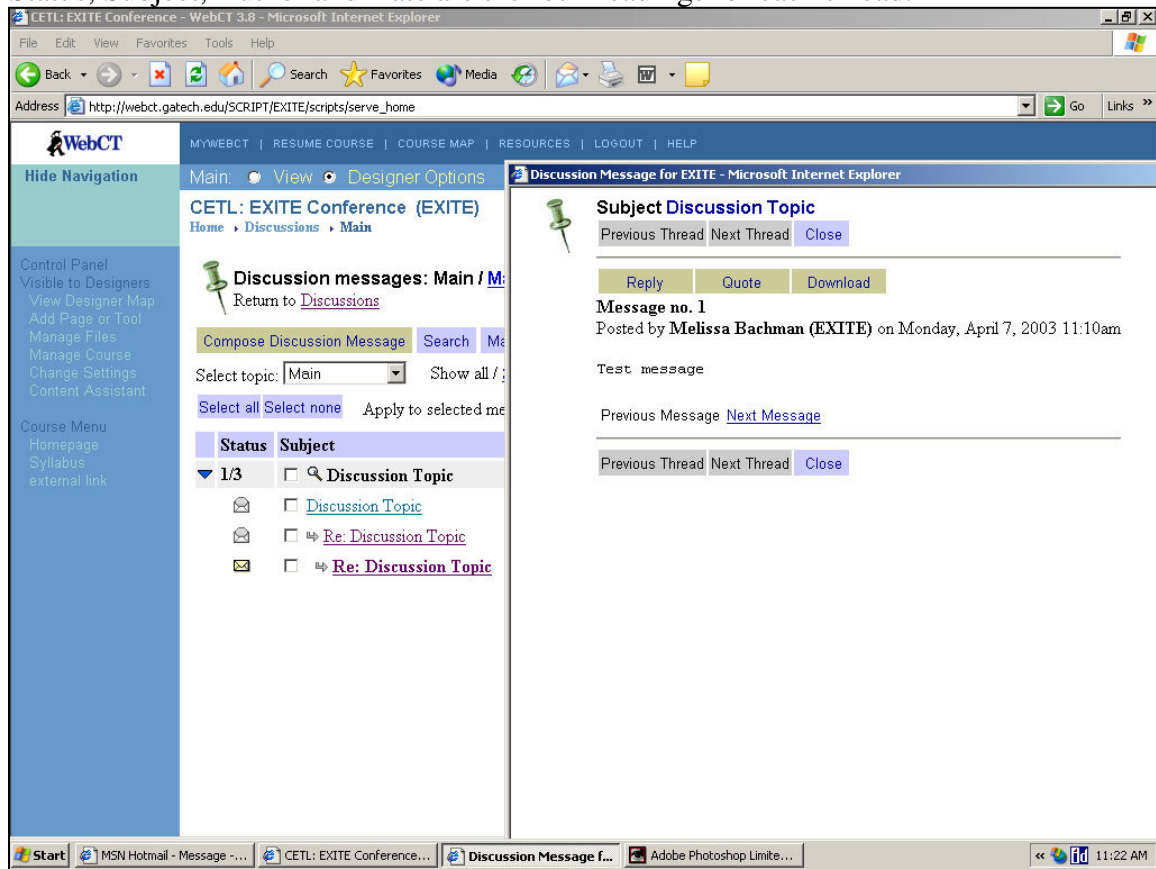
Figure 4: WebCT Message

Clicking a topic reveals the contents in that mail, and the Reply feature allows the user to type in the reply and, on submittal, the interface as seen in the right half appears. The reply can be made using the 'quote' feature where the text of the message to which the new message is being replied to also appears (which is similar to the one available in the existing WebBoard).

Though the indentation of the threads gives a good notion of the way the messages are arranged (as replies to the previous ones), it does consume a lot of horizontal screen space.

Google Discussion forums
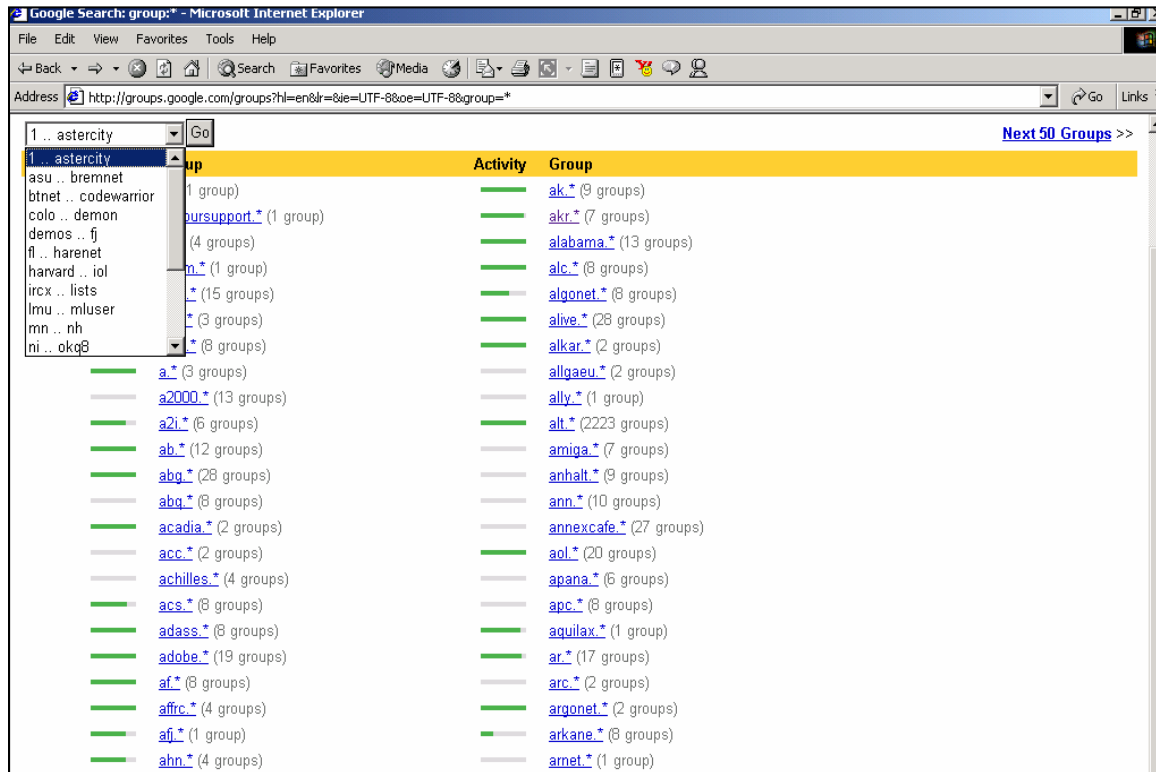
Figure 5: Google Discussion Forum

Google supports a huge Web space of discussion forums. As seen from the above snapshot, they have a large number of groups. The pull down list as seen on the upper left part of the screen allows one to go a topic, and the contents in the pull down list box are grouped alphabetically. In addition, the first 50 groups are listed on the first page. What is interesting from this interface is the usage of horizontal bars giving a visual representation of the level of activity in each group. Some of them are fully green and while some are still grey.

In Figure 6, a particular group which discusses issues on Embedded Visual Basic is selected.

Figure 6: Google Discussion: "Embedded Visual Basic"

As seen from the interface, the position of this group in the whole set of Google groups can be obtained through the horizontal set of links on the top of the page – *Group:Microsoft:public:windowsce:embedded:vb*. Clicking each of these links takes the user to the listings under that subgroup. This kind of a visual layout of the hierarchy allows one to retain context in a deluge of subgroups and messages. There are no distinct thread patterns visible in this layout. The messages are arranged based on the date. The thread subject and the name of the most recent poster are indicated. The number of replies to a single message topic is displayed next to the thread topic.

The thread subject takes the user to that message as shown in Figure 7. The left pane shows a hierarchy of the messages under this main topic and the right pane shows the message. This arrangement is very similar to the arrangement in the existing WebBoard.
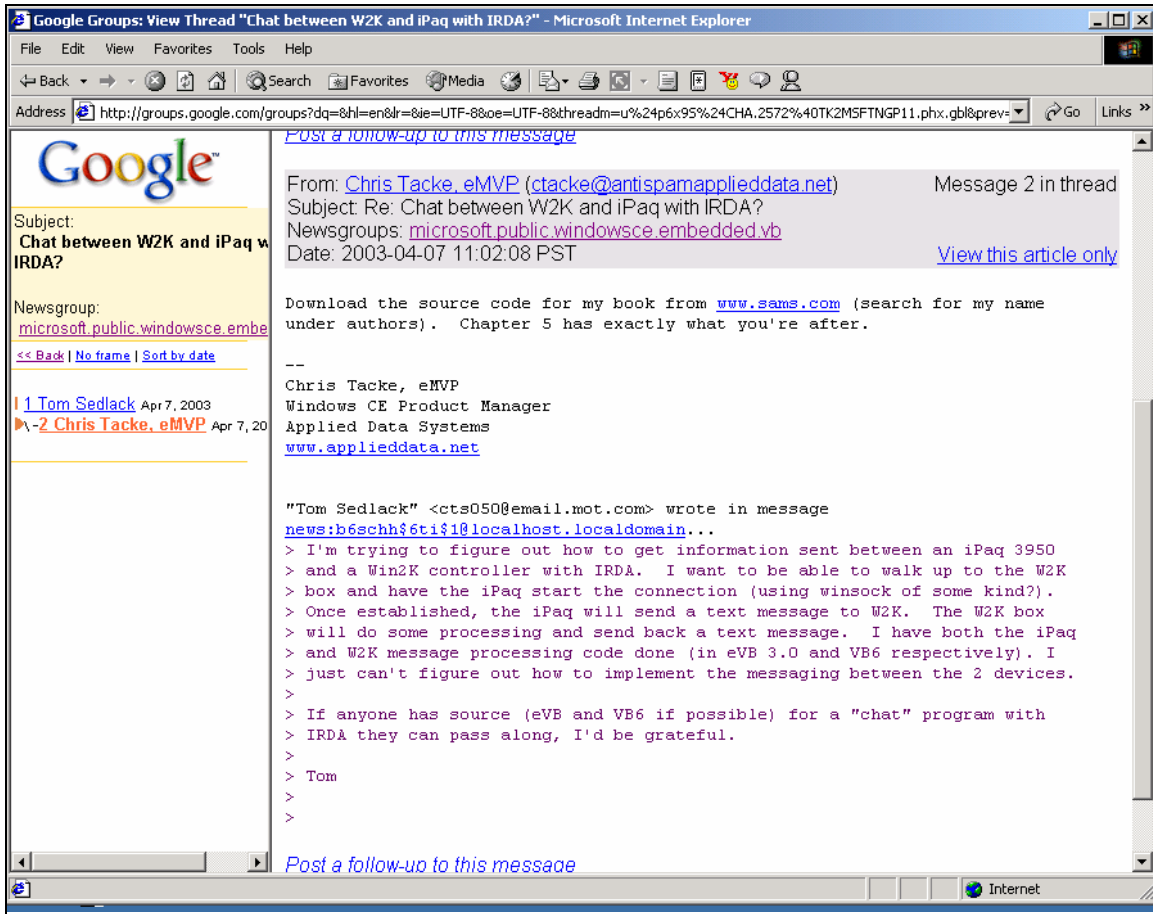
Figure 7: Google Discussion Message

Most of the discussions forums seem to have a few common features on their interface. Most of the interfaces follow a hierarchical approach based on the topics. It gives a notion of folders, subfolders, contents etc. Clicking on any topic takes the user to that message or subfolder.

They also have a visual representation of the hierarchical layout on one part of the screen showing the arrangement of the messages. This layout idea is either commonly on the left pane of the screen arranged vertically or on the top of the discussion lists arranged either horizontally or vertically. Some of them indent the replies to show the hierarchy while some do not. As the message is displayed, the user can click to reply (with or without quote) and then post it. By and large, we found that except for slight changes in layout and usage of color, the common, existing, popular message boards on the Web are very much similar to the exiting WebBoard interface with regard to the thread arrangement.

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User Analysis

The current users of the Global Classroom Project's WebBoard are primarily American students from Georgia Tech in Atlanta and Russian students from the European University at St. Petersburg. Other users include the GCP professors from these universities, as well as other potential future users from other countries who want to browse the discussions on the Board and learn how the GCP works.

Interaction between users is typically through written English. Two-thirds of current users are native-English speakers; most of the others rate themselves as good or fluent communicators in English. Other methods of communication may include uploading images to the board or providing links to other Websites.

Because users are from different countries, there are cultural differences besides language that should be acknowledged when designing a new interface. These include metaphors, mental models, navigation, appearance and interaction (Marcus, 1999).

The GCP is a multi-disciplinary program. In fact, the two participating universities differ in the types of students they attract. Georgia Tech is an educational institution that focuses on science and technology. The European University at St. Petersburg focuses on social sciences and humanities. Considering that different students participate every semester, the users may be studying a wide range of subjects. In the class of Spring 2003, most of the Americans are undergraduate students majoring in Science, Technology and Culture. Just over 10% of the Americans are graduate students studying Human-Computer Interaction. All of the Russian students are in a graduate program with a variety of disciplines including social and political science, history, and economics.

From an analysis of the students' resumes, we determined all users have prior experience using Microsoft Office products, such as MS Word, Excel and Power Point, as well as experience with Web Browsers such as Internet Explorer and Netscape Navigator. According to resumes of current users, most of the Georgia Tech students list additional computer experience including HTML and multimedia applications. The Americans have greater, almost unlimited, access to computers and the Internet; where as the Russian students may only have access during their scheduled class times. The technology in Russia is also older, resulting in slower Internet connections and computers and only basic browser capabilities.

GCP participants live in multiple time zones and are accessing the WebBoard system at different times throughout the day. Students at the two universities also have different weekly class schedules, as well as semester schedules. It is impossible to predict when people will choose to use the WebBoard. Asynchronous communication is typical and necessary to meet the requirements of the class. Users may interact with the entire class when discussing a topic or may work in smaller project groups.

The face of the GCP is ever-changing. New users at Georgia Tech and the European University at St. Petersburg are introduced to the WebBoard every semester. Universities

in Sweden and other countries have expressed interest in joining the discussions. In the future, systems associated with the GCP may need to support college-level users from a variety of different cultures with many different backgrounds. The only assumptions that can be made are the users can communicate in English and they have basic computer skills including experience with Web browsers. The technology required to participate must be easily available and accessible by all users.

The current Russian and American students were asked to complete a survey about the WebBoard system [Appendix A]. Nine American students, six Russian students and one student who chose to keep his or her origin anonymous responded. All but one of the American students who completed the survey had used similar systems to the WebBoard prior to this class while only two of the Russian students had used similar systems. Many stated they like the system because it is easily accessible at any time. One commented, "You can post at any time of the day; this is convenient because you don't have to wait till class time to talk with your group members." Another said, "Web board creates an classroom that is open 24/7 within which we can ask questions and communicate with anybody who happens to be on. I enjoy that type of access." Another strength mentioned was the ability to communicate with multiple people at a time. One respondent said, "It's really easy to communicate with a group of people rather than sending out a mass email." Three people said they liked that messages from classmates did not fill up their E-mail inboxes. A student explained, "it is fine because it does not clutter my inbox for my email." Some of the characteristics they did not like about the WebBoard system were the lack of message thread organization and the limited spell checker. When asked what they thought could be improved, comments made included, "Better organization of threads to manage the messages and discussion" and "Extend the vocabulary of spell checker."

The students were asked to indicate how helpful the WebBoard is to discuss topics in class. They used a scale from 1 to 7 where 1 was very helpful and 7 was very unhelpful. The average rating was 3.5. They were also asked to rank characteristics of a message on order of importance. The message characteristics included the poster, or author, of a message, the subject, the previous posts on a subject, the replies to a post, and the date. Figure 8 shows that the Subject of a message was most important to the respondents and the date was least important.
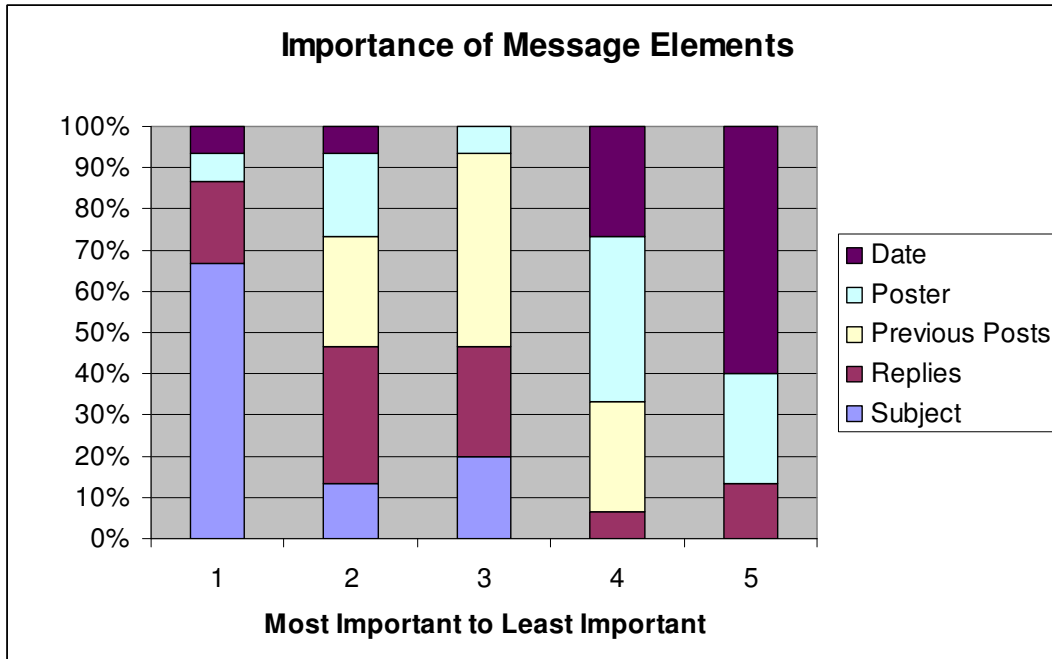
Figure 8: Importance of Message Elements

Task Analysis

We performed a hierarchical task analysis to understand the users' functional expectations of the GCP Web interface.

Student View:

1. Launch the Web site
    Type the URL (Uniform Resource Locator) of the Website on a Web browser with an Internet connection

2. Login
    Every user, whether student or administrator, types a username and password to access relevant information and participate in the discussions.

3. Interact with contents
    3.1. Class Information
        This pertains to the general information of the class which the students pursue; for example, currently the American and Russian batch of students need to have information on the Spring 2003 - LCC 4406 and 6320, and the contents depend on the school and location.

    3.1.1. View Schedule
    3.1.2. Overview Grading and Assignment information

3.1.3. View contact information

3.1.4. Course resources – Read online or download

3.2. Web Conference

> This pertains to the asynchronous discussion forum.

3.2.1. Update Profile

> The users create, modify, and delete information regarding their profile, like username, email id etc…

3.2.2. Read the discussion threads

3.2.2.1. Filter Unread Messages

3.2.2.1.1. New

> New messages only

3.2.2.1.2. Conferences

> All messages in the forum

3.2.2.2. Thread Topics

3.2.2.2.1. Welcome and Introductions

3.2.2.2.2. Weeklong Assignments

3.2.2.2.3. Articles Discussions

3.2.2.2.4. Document Assignments

3.2.2.2.5. English Language

3.2.2.2.6. Other Discussions

3.2.3. Respond

> Users could choose to respond to the threads they read

3.2.3.1. Reply

3.2.3.2. Post new thread

4. Logout

Once the users finish all that they want to do during the login period, they log out of the system and, if necessary, login at a later time.

Usability Criteria

Consideration of standard usability criteria is important in the design of any interface, so that users can easily and purposefully navigate or interact with the virtual space. However, conformance with standard usability criteria is absolutely critical in the redesign of the GCP interface, because the platform is not simply a tool for information transfer; it is the sole means of cross-cultural communication and digital product collaboration – the goals of this course. In addition, because students of many cultures will use the platform, the interface must also conform to international usability criteria. "Cultural preferences and biases impact what is deemed 'user friendly;' thus, usability issues must take on a cultural context" (Badre & Barber, 1998).

According to Dix, et al. (1998), standard usability criteria fall within the following three categories: learnability, flexibility, and robustness. Learnability refers to the slope of the learning curve, that is, how quickly new users can effectively interact with the system. Flexibility refers to the number of ways users can interact with the system to achieve their goals. Finally, robustness refers to how well users can assess goals and performance given the quantity and effectiveness of the feedback the system provides.

A sub-criterion of learnability especially relevant to the GCP redesign, is familiarity, the extent to which users' knowledge of everyday life and real-world experience affect interactions with the interface. However, when considering an international user group, familiarity is a challenging criterion to meet. For example, metaphors are useful for teaching new concepts and are often applied to graphical computer interfaces, such as the file system of Windows. However, interpretations of a metaphor, or icons which represent it, are highly dependent on one's cultural background (Evers, et al., 1999). Metaphors, it seems, are not universal.

Two important sub-criteria of flexibility to the GCP redesign are dialogue initiative and multi-threading. Dialogue initiative gives the user "freedom from artificial constraints" on inputs (Dix, et al., 1998). In order to facilitate conversation and "natural" dialogue, users must have ample freedom in inputting and organizing their conversation threads. Multi-threading allows the user to easily pertain to more than one task at a time, such as the use of windows in Windows and Mac systems. This is important, because, for example, a GCP student may need to reference an article and reply to a post at or around the same time.

Finally, two sub-criteria of robustness particularly essential to the GCP interface are recoverability, the ability of users to correct their mistakes, and task conformance, the degree to which a system supports all of the users' tasks in an understandable way (Dix, et. al, 1998). The GCP interface must allow users to complete their tasks effectively, as well as provide ample feedback. According to Donald Norman, interaction should reflect the *execution-evaluation cycle*, which consists of an input loop (user establishes goal, forms an intention, and specifies an action sequence), execution of the specified action, and a feedback loop (user perceives system state, interprets system state, and evaluates the system state with respect to goals). Problems can occur either during the input or feedback loops (*gulfs of execution* or *gulfs of evaluation*, respectively). Both types should be avoided.

Table 1: Three standard usability criteria and sub-criteria relevant to GCP

Learnability	Flexibility	Robustness
familiarity	dialogue initiative	recoverability
	multi-threading	task conformance

In addition to standard usability criteria, special consideration should be taken to make the interface suitable across different cultures, a process referred to as *localization* (Badre & Barber, 1998; Dix, et al., 1998). "Cultural usability emphasizes the importance of the relationship between culture and usability in World Wide Web (WWW) design…A

global interface design must capture the nuances of cultures, rendering an interface that allows the targeted audience to 'feel at home,' without sacrificing the creative and artistic aspects of design that make the WWW an interesting place to explore" (Badre & Barber, 1998).

In light of these cultural considerations, Badre and Barber (1998) suggest that learnability, efficiency, and satisfaction are among the three most critical usability criteria. As described above, learnability refers to the ease of learning a new system. Efficiency refers to the productivity (minus wasted effort or time) of a system, and satisfaction relates to the amount of pleasure elicited from using a system.

Other cultural usability criteria include simplicity, accessibility, and ease of navigation (Chou, 1998). In addition, Chou cites a high correlation between effective communication and effective performance; therefore the design of an interface must be transparent in order to facilitate concentration on conversation.

Another interesting consideration concerns the social orientation of different societies. For instance, achievement motives differ between individualistic and collectivist cultures. Individualistic cultures are those which reward independence, such as America, and collectivist cultures are those which emphasize the collective needs of family or community, such as China. Individualist cultures stress achievement of personal goals; whereas collectivist cultures stress meeting the needs of the group.

According to Sternberg (1998), the social phenomenon of social loafing is affected by cultural orientation toward individualism or collectivism. Social loafing, a factor cited in Western social psychology literature, occurs when individuals work less hard as members of a group than they would if they worked alone. Interestingly, social loafing is more common in highly individualistic societies. In China, for instance, individuals work harder in a group than when alone. In terms of GCP, it may be important to know the social orientation of participating cultures, as it could affect group productivity.

To this point, overriding cultural usability issues have been considered, such as international usability criteria and social orientation. Jakob Nielson (1996) provides highly specific international usability specifications, including translating times into the local times of major locations, providing special versions of pages that are easily printable, and conducting interface evaluations with users of all targeted cultures via telephone or remote testing. Many of Nielson's additional suggestions concern language; however, because GCP is conducted in English, this is less of a concern. Nonetheless, it may be important to augment the system with additional language support features, since many users' native languages are not English.

Design Space: Developing an appropriate metaphor

According to Sternberg (1998), culturally-based knowledge has a profound effect on performance and memory. Therefore, if the new GCP interface is to maximize

performance of a cross-cultural group of students, it needs to tap into the collective knowledge bases of the students of each participating country. Currently students of Russia and America participate in the GCP. However, the improved platform must be flexible enough to allow for future users of additional countries.

With this in mind, we sought to meet our first usability requirement, learnability, as well as our intent to design an improved atmosphere, by searching for an appropriate metaphor. The purpose of a metaphor is to draw on existing knowledge structures to make a new system easier to learn; however, the interpretation of metaphors and icons is dependent on one's cultural background (Evers, et al., 1999).

For instance, Evers, Kukulska-Hulme, & Jones (1999) investigated cultural aspects of understanding the Website of a virtual campus (DirectED, 1997). The homepage of the Website is a metaphor for a campus, with icons such as a suitcase ("Residence"), file cabinet ("Business Office"), books ("Bookstore), and a coffee cup ("Café"). The participants in the study were from England, Netherlands, Sri-Lanka, and Japan and were interviewed to assess their understanding of the icons. Results indicated that the participants had very different expectations of what each icon represented. For example, the English users thought the "Café" would be a place to chat online, whereas the Dutch associated it with drinking alcohol in a pub and the Sri-Lankans associated it with drinking coffee or tea. The investigators concluded that these differences in expectations arose from the participants' everyday knowledge and experience.

In a similar vein, Nielson (1996) evaluates a children's computer game called "Give the Dog a Bone;" he emphasizes the need for icons and metaphors to match the users' culture. One task in the game is for the child to select a ball icon from several different icons. However, most European children choose a round cookie icon, because they do not recognize the ball. The ball is actually an elliptical American football, with which most European children are totally unfamiliar! The European children think a ball must be round, so choose the next best thing, the cookie.

Even in our current GCP class, the cultural differences in icon interpretation are apparent. For instance, the Ded Moroz/Santa Claus group compares Santa Claus, la Befana, and Father Frost. In the Beatle group, the Americans discover that many Russians associate the rock 'n' roll icon with the fall of communism.

The differences in icon interpretation among cultures make selection of a metaphor challenging, especially considering more countries may join the GCP. We considered metaphors, such as a virtual café, a globe, and even the universe. However, as we began to associate icons with each metaphor, we recalled from our research that icons, if used, must be localized to each specific culture, and metaphors are not universal (Evers et al., 1999). In other words, creation of an immersive, "universal" metaphor with appropriate icons would require *localized* icons for each culture. However, development of localized icons would be an additional divide, a barrier to new understandings and communication. The design of an interface should be transparent, in order to focus on conversation (Chou,

1999). Our goal is to make the interface "acultural" and as conducive to effective communication as possible.

Therefore, we shifted our attention to a universal metaphor for idea generation, the mind map. Mind maps allow for annotation of concepts, visualization of relationships between ideas, invitation of critique, and bootstrapping of ideas (Grey, 1996). "A mind map is a powerful graphic technique which provides a *universal* key to unlock the potential of the brain. It harnesses the full range of cortical skills - word, image, number, logic, rhythm, color and spatial awareness - in a single, uniquely powerful manner" (Newswire, 2002). The next section contains a detailed description of the mind map metaphor.

Detailed Description of Digital Product

The GCP redesign combines some of the best features of the current system, such as an asynchronous discussion platform and online central location, with several positive changes, such as an improved visual discussion structure, an online document collaboration feature, and an administrators' database of assignments. The following screenshots describe several key features or changes and include the new login page, homepage, and several discussion pages. Additional detailed descriptions include the Group pages and the Administrators' Database.

Login Page
Users from all countries would first arrive at the login page (Figure 9). The course semester and title appear in the left graphic. The menu bar across the top highlights features available to course members. However, all but "Schedule" and "Language Aids" are inactive from this initial screen. Course features include the following:

- **Home** – Homepage of the course (Figure 10). It primarily contains course announcements, alerts, and reminders. From the homepage, all links in the upper navigation are active.
- **Course-wide Discussion** – "Meat" of the asynchronous communication (Figures 5.3 – 5.6). A drop-down menu contains links to each conference. It contains hyperbolic mind maps of course-wide discussion, including introductions, article discussions, and other (non-small group) discussion.
- **Schedule** – Contains the syllabus, including schedule and description of assignments and grading.
- **Resources** – Contains hyperlinks of course-related articles and readings.
- **Groups** – A drop-down menu contains links to each small group (in Spring 2003, this would include Cowboys, Beatles, Friendship, etc.). Each small group page contains small group discussion and a place to collaboratively edit documents.
- **Contact List** – Links to hyperlinks of all students' and professors' email addresses and resumes or bios, if available.

Figure 9: GCP Redesign Login Page

- **Language Aids** – Links to online language resources and English language discussion forum.

Homepage

From the login page, users login, as with the current WebBoard system. Guests may login and view the course-wide discussion, but may not post or reply to messages. Once registered users login, they are directed to the GCP Homepage. See Figure 10.

From the homepage, registered users have access to all course features. The heading reads "Welcome, *(student's registered name)*." Course announcements are dynamically updated from the administrators' database. In other words, the administrator would fill out fields such as "date" and "body" in a Course Announcement database. The database content updates the Webpage in real-time. Students may scroll through past announcements.

Figure 10: GCP Redesign Homepage

Course-wide Discussion
Users can begin viewing the discussions by choosing a discussion topic from the Course-wide Discussion dropdown menu or choosing a group name from the Groups dropdown menu. There are many screen layout options available when viewing the discussions. Every user is different and may prefer different techniques to browse through the discussion information, allowing a better understanding of the content. The redesigned GCP Web Board is flexible and allows each user to save his or her preferred viewing options.

When a discussion is chosen, there are two different ways to navigate through the threads: a traditional hierarchical list and a hyperbolic, "mind-map" tree. A hierarchical list is used in the current WebBoard system and is common in similar systems. It may be more familiar to the users and provides an overview of the data. A hyperbolic tree is better at keeping focus on the current message while providing context as to how it relates to the entire discussion. It is also better at showing relationships between messages. Users may benefit from viewing both hierarchies at the same time or may choose to view only their preferred hierarchy. Figure 11 shows what would be displayed if a user selected the "Other Discussions" topic from the Course-wide Discussion dropdown menu while viewing both at the same time.
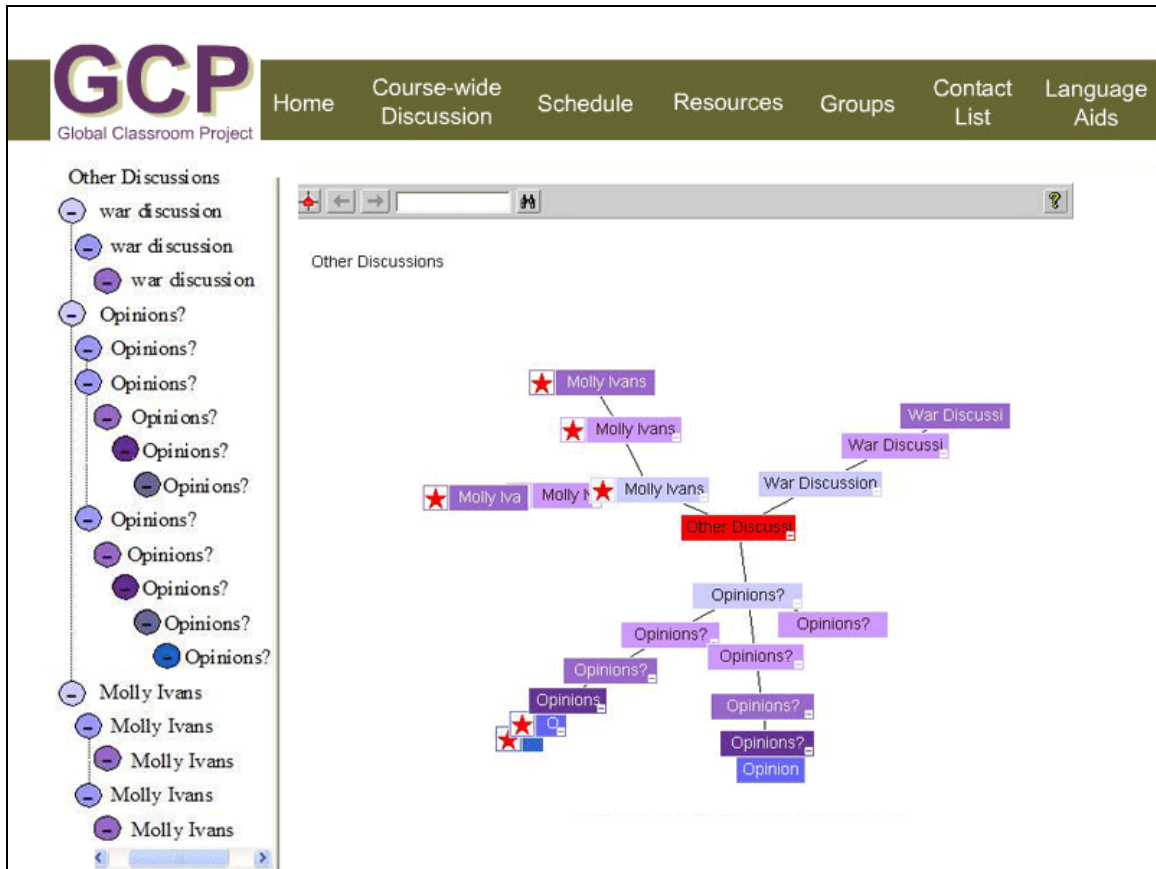
Figure 11: Display of both Hierarchy Trees

On the left is the traditional hierarchical list, showing the titles of posted messages. All replies to a message are indented and listed beneath the original message. A small circle is located left of each message title and displays a '+' if replies to the message are currently collapsed and not viewable or a '-' if all replies are currently viewable. If there are more messages than can be displayed at one time on the screen, vertical scrollbars will be displayed. Likewise, if the message titles are indented such that some titles are hidden, horizontal scrollbars are displayed. The color of the circles change depending upon how many messages removed they are from the original message. An icon, such as a red star (not shown), appears to the left of the circle to indicate the message is new or has never been read. Users can read a message by clicking on its title.

The hyperbolic tree view displays a hierarchy in a finite area, mimicking a mind-map. Each message is represented as a rectangular node labeled with the message title. The root node, in red, is the title of the discussion. As the nodes radiate outward, they become exponentially smaller. This allows a larger representation near the focused area while still displaying the overall structure of the tree.

When a new message is posted in this discussion, a new node is created and connected to the root node. Any replies to this message are represented as nodes connected from the message node. For example, Figure 11 shows that a new message with the title

"Opinions?" was created. Three users replied directly to this message, as shown by three nodes connected to the original "Opinions?" node. Two of those replies had additional replies, creating a branch of message nodes. A user can see how one message on a topic created three different conversations on a similar topic. The hyperbolic tree shows the evolution of the discussion.

The color of the nodes indicates the number of levels from the root node a message is. The node color will be the same color as the message's corresponding circle in the hierarchical tree list. A red star icon on the left edge of the node indicates that a message is new or has not been read. When a user hovers over a node with a mouse, a tool tip showing the name of the poster is displayed. A user also has the option of viewing an associated thumbnail with each node. In Figure 12, the node's thumbnail is a picture of the poster. Viewing the thumbnails, a user can get more information about the conversation. For example, the middle branch of the "Opinions?" conversation was a discussion between the original poster of the message and another user.
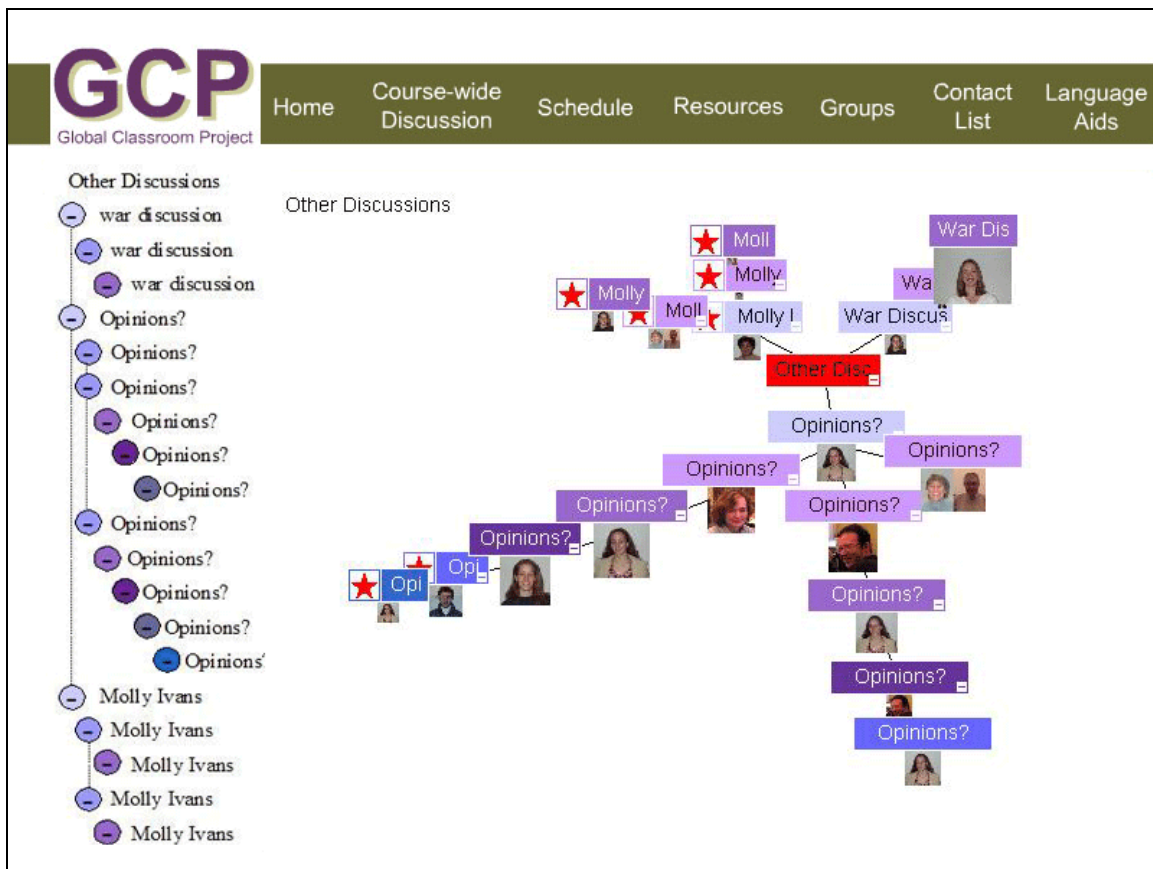

Figure 12: Hyperbolic Tree with Thumbnails of the Posters

A user can change the focus of the tree in two ways. If a user clicks on a node, it becomes the larger center node and the rest of the tree moves and changes size to reflect this. A user can also click and drag a node to a desired position. The tree will move and

change focus as it is dragged, making the nodes in the center of the screen the larger nodes. A user can double-click on a node to view the message.

When a message is selected, it can be displayed in two ways. The message can be shown in a frame right of the message trees (Figure 13). If the poster's image was not displayed in the message tree, a thumbnail will appear next to the message information. The message title is highlighted in the hierarchical tree and its node is highlighted in the hyperbolic tree. After reading the message, users may post a reply by pressing the "Reply to Message" button located beneath it. A user may post a new message that will be connected to the root node by pressing the "Post New Message" button. If the user selects a word or phrase from the message and then presses the "Post New Message" button, the selected words will automatically be the title of the new message. Another technique is to drag the selected word or phrase to an area on the hyperbolic tree to create a new tree. A screen will be displayed where a user can write his or her message. When finished, the tree shows a new message node, connected to the root node, with the selected words as the title. When the user hovers over this node with the mouse, a dotted line appears connecting it to the original message node from which the words were selected.
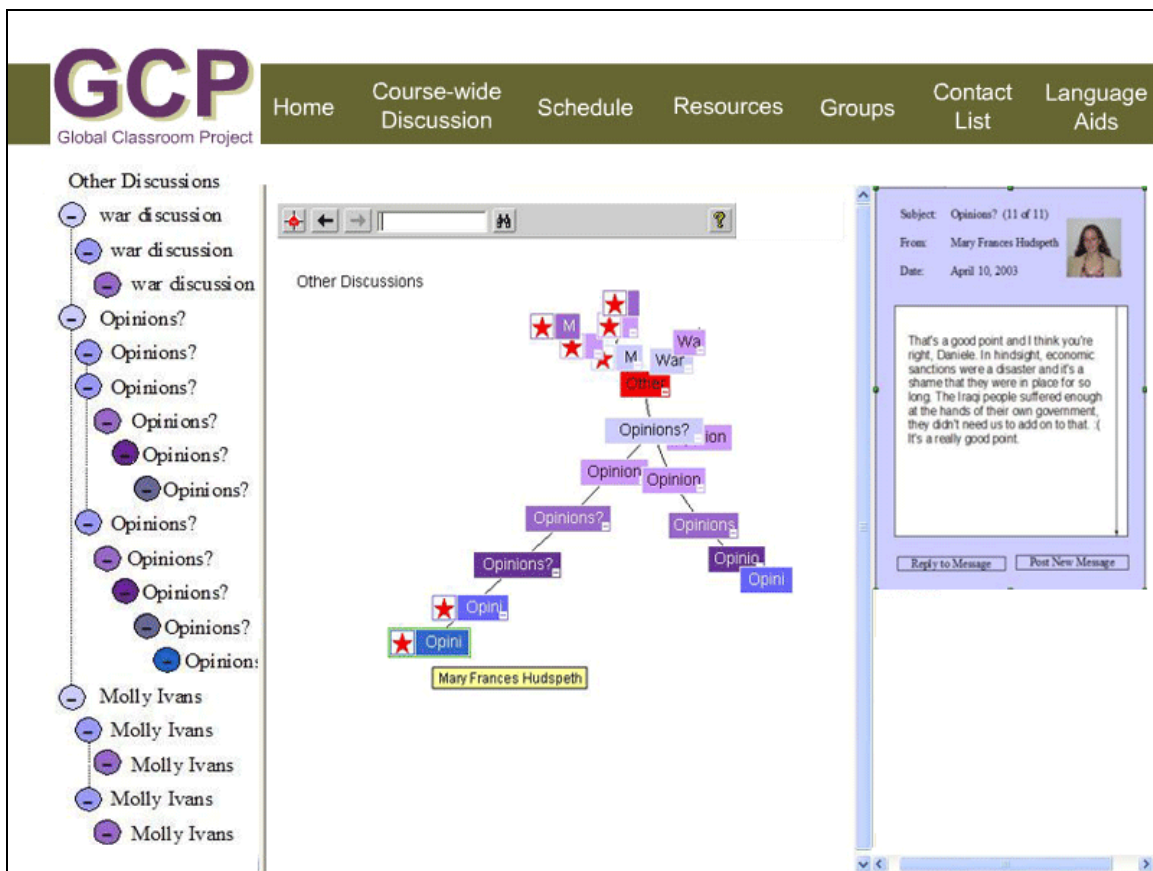

Figure 13: Message displayed to the right of the trees

The second way to display messages does not use a new frame, but instead displays the message within the hyperbolic tree, as shown in Figure 14. When a message is selected,

it moves toward the center to allow enough space to display a "message bubble". The bubble contains the message information, such as title, poster and date, and the message in a text box. If the message is so large it cannot be viewed at one time in the text box, a vertical scrollbar will be displayed. The title of the message in the hierarchical tree is highlighted. The "Reply to Message" and "Post New Message" buttons appear below the message text box. The user still has the option of selecting text out of the message and dragging a copy of the text onto the tree to create a new message. This new message, by default, will be connected to the root node. When others view this new message, the related message in which the text came from will be highlighted allowing the reader to see its origin.

The hyperbolic tree is a Java applet and can be run in a Java-enabled Web browser like Internet Explorer or Netscape Navigator. The size of the applet would be about the same as that of a small image. The technological demands needed to run the hyperbolic tree is minimal, however if users do not want this additional overhead, they can choose to not view the hyperbolic tree. Users can edit their profile to select if they will use both trees or just one of the tree options and to choose the method they prefer to use when viewing a message. This flexibility of the design allows users to set up the environment in a way that allows them to maximize their understanding and enjoyment of the knowledge being shared.
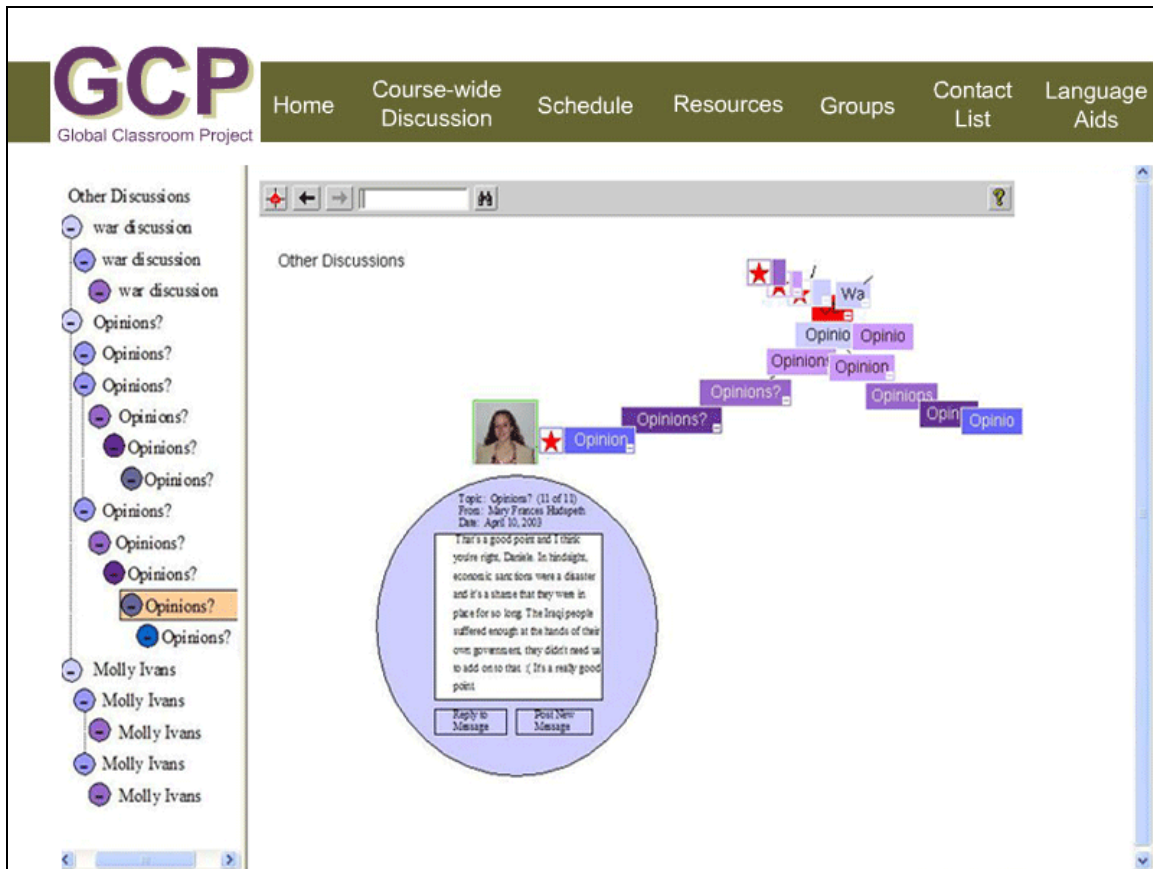
Figure 14: Message displayed as a bubble within the hyperbolic tree

The new system can help users bypass older messages by altering the brightness of the nodes' color. The newer message nodes and their parents will be brighter than older message nodes, which will slowly lose brightness and fade. Older nodes will always be visible, with the least bright nodes being 50% dimmer than the newest nodes; however users can easily look past them in search for the most current nodes. Users may also search for words within a message. Nodes containing the word will be highlighted, and the first result message will be displayed. The corresponding node will be centered in the tree. If the user presses the next button (indicated by a black, right arrow) the next message node will be moved to the center and its message will be displayed.

Group Pages
The "Groups" drop-down menu contains a list of all the project groups. Each project group links to their own "group space" on the site. This space consists of their group's discussion forum (separate from "Course-wide Discussion," but in the same mind map format) and digital document collaboration.

Figure 15: Digital file collaboration: File directory in WebCT

The digital document collaboration is the unique feature in the Groups pages. The system allows group members only to upload and download files from any Web browser

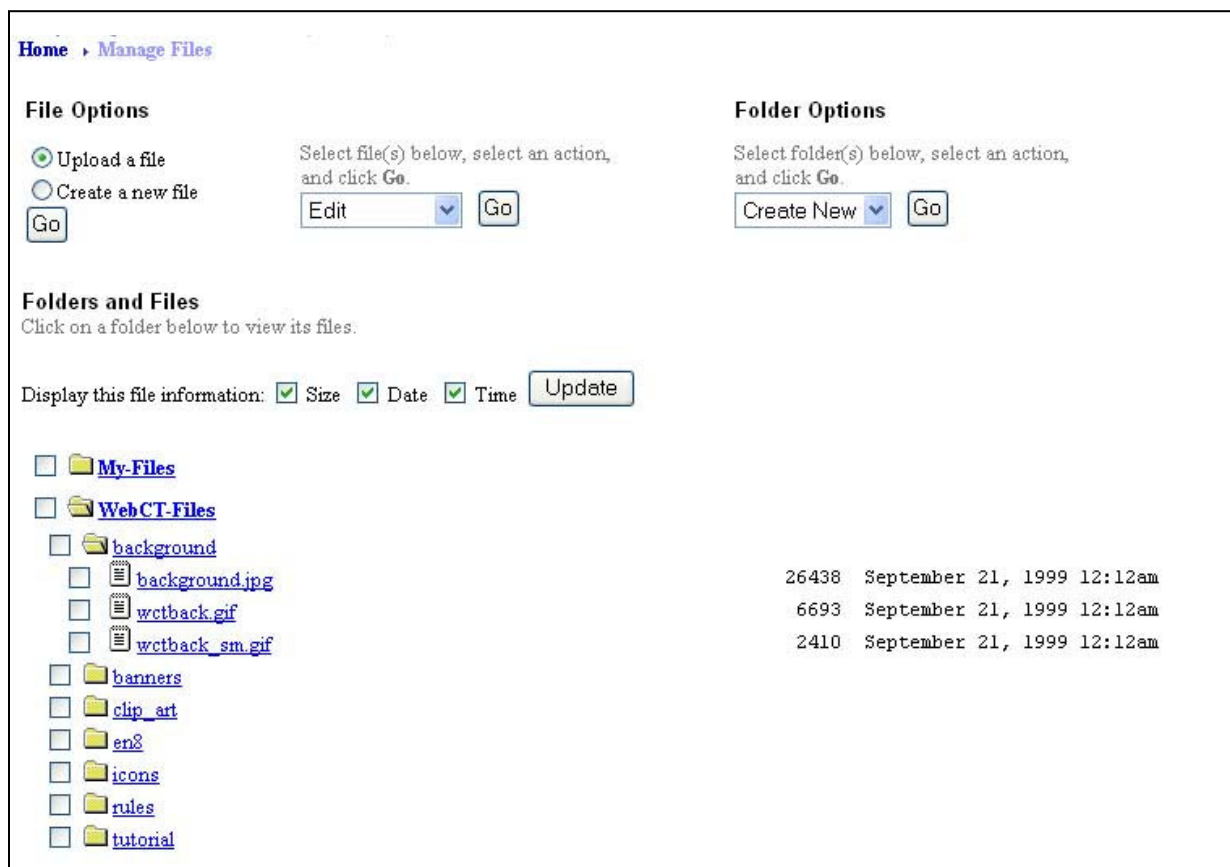(such as in WebCT in Figure 15). This way, documents can be passed from one member to another. Newer versions of a document can either replace the current document (if the user keeps the original file name intact) or supplement the current document (if the user changes the file's name). The files can also be organized into appropriate directories. Figure 15 is a screenshot of a file directory in WebCT.

When the group is ready to submit a document to the professors, a member must right-click on the file. The "Assignment Drop Box" command appears. By clicking "Assignment Drop Box," the file is sent the administrators' GCP database (described in more detail in the next subsection). A success confirmation provides feedback to the group. The "Assignment Drop Box" database fields contain group name, date, and file name. Administrators can sort by each of these fields.

GCP Administrators' Database and Other Considerations
For successful and timely upkeep of the course, it is necessary that the administrators can easily access, edit, and update information. For this reason, we propose that the administration-side of the site consist of database-driven Webpages. In other words, the administrator inputs data into Web-based forms, in order to input and retrieve relevant information. However, the content of the forms is stored in a series of databases on the server. Necessary features of the administrators' database include the following:

- Easily able to retrieve user statistics (posts, access, etc.)
- Creation of groups and conferences
- Management of course and group member statuses
- Ability to input, edit, and update course announcements on the homepage
- Ability to input, edit, and update course resources
- Ability to input, edit, and update language resources
- Ability to retrieve, sort, and download assignments
- Ability to upload graded or edited assignments to Groups pages

In addition, development of the GCP site may include a "Gallery" feature, whereby the administrators can simply copy exceptional assignments or digital products to an online gallery. A "Gallery" Website may contain links to exemplar assignments, searchable or sortable by semester or by project type or name. As administrators grade assignments, they can upload the assignments to the appropriate Groups pages; if the assignment is "Gallery quality," the administrators would check an "Include in Gallery" checkbox, and the assignment would simultaneously upload to the Gallery.

User Scenarios

Start of the Semester: Russian student
Vadim studies American History at the European University at St. Petersburg and is enrolled in the Global Classroom Project this semester. He has studied English for several years, but has not had the opportunity to converse with Americans.

He creates a username and password and logs into the GCP site. The homepage welcomes him, "Welcome Vadim!" Dr. Herrington, the American professor, has posted the first course announcement on the homepage, which encourages students to introduce themselves on the "Introductions" Course-wide Discussions conference and to read the Dragga article.

Vadim rolls his mouse over the "Course-wide Discussions" link in the main menu and selects "Introductions." He is not the first to post in this forum. Several users have posted from the main "Introductions" node. He can follow the conversation from the linear thread on the left, or he can click each mind map bubble that surrounds the main node.

Vadim decides to click each bubble. He reads the posts, two from Americans and three from Russians. As he reads the posts, the "new message" icons disappear. An American, Paul, signs his post, "Catch ya later." Vadim is unfamiliar with this phrase, so selects the "Language Aids" link from the main menu. There he finds a collection of online English language resource collected and submitted by the professors and students over the course of several semesters. He checks several English-Russian online dictionaries, but cannot find this slang expression. He decides to start an English language discussion by posting the first node on this page, which asks for an explanation of this American phrase.

Vadim returns to the Introductions page and posts a greeting to the class. He then selects "Resources," which links to course-related readings. He finds and reads the Dragga article online and posts comments to the "Dragga" conference under the "Course-wide Discussions" menu. He then logs out for the day.

Mid-semester: American student
Linda, an American undergraduate majoring in Society, Technology, and Culture, is a member of the "Cowboys" group. After logging in and reading the course announcements and her new messages in "Course-wide Discussions," Linda selects "Cowboys" from the drop-down menu under "Groups."

She reads new messages in the Cowboys conference. One message mentions cowboys' attire, although this is not the focus of the message. Linda "copies" the phrase that mentions attire from the message and "pulls" it to an empty space on the screen in order to begin a new, independent node. From there, she writes a message to her group which says the group should consider analyzing what cultural views cowboys' attire may reflect.

In addition, Linda is the last person to edit the group's revised proposal. She downloads the latest version from the Groups screen to her C-drive. She makes edits and uploads it back to her group's page. She then right clicks the file name and selects "Assignment Drop Box." The file is sent to the Administrator Database, and the system sends Linda feedback, "Your assignment has been sent."

Linda also has been working on an introduction for the group's analytical report. From the Groups screen, she uploads the document from her C-drive to the GCP server. Now her group members can read or download her document. They can then make edits and upload the revised version.

Linda checks again for new messages in "Course-wide Discussions" and then logs out for the day.

Future Work

We have proposed a new *design* for a Web-based conferencing system to be used by the Global Classroom Project students. However, this is just a start. *Development* of the new system must be accomplished by a team (perhaps three to four students) of skilled programmers and graphic designers. Implementation could be spearheaded by co-project managers (GRAs or other graduate students) – one in America and one in Russia. The managers must have programming or multimedia development backgrounds and should be able to specify the most efficient ways to (1) link the GCP site to a dynamic database and (2) make the conversation mind map fully functional and robust.

Finally, any outstanding product must undergo an iterative design process. This requires usability and user testing. Before development begins, the co-managers should timeline the production, including usability testing at critical points, such as when prototypes are functional and when "pieces" of the product are in a testable form. Usability testing might include cognitive walkthroughs, think alouds, focus groups, and heuristic evaluations. Results from the usability tests should guide redesign…and redesign, and redesign. An HCI graduate student may guide the testing (perhaps as a project studio or Master's project).

Conclusion

As aspiring HCI experts, we have focused on the *design* of an improved GCP platform. Our design enhances the display of the conversation structure and provides additional features to support knowledge-building by invoking the use of mind maps, whereby users can "boot-strap" ideas, extracting key words and beginning new nodes or replying directly to others' responses. We anticipate that the online document collaboration feature and the improved aesthetic design of the interface will foster engagement, as well as a sense of community, among students. In addition, our design provides the foundation for the future development of a system that conforms to usability criteria, such as learnability, flexibility, and robustness, is accessible with only a computer, browser, and Internet connection, and is built upon a database that can be archived and then reused each semester.

Appendix A: User Survey Data

1. How does web board assist you in communicating with fellow classmates?

       4 - asynchronous communication, post anytime
       3 - demand is not on email inbox
       3 - communicate with many people, from different countries
       3 - reach more people at once
       2 - easy collaboration
       2 – everyone's opinion is heard
       2 - novel space for communication
       1 - easier to communicate through writing than verbally
       1 - think about answer before responding
       1 – obtain project progress

2. What do you like about using the web board?

       5 - easily accessible
       5 - available anytime
       2 - organized
       2 - contact multiple people
       2 - easy to use
       2 - mark all as read
       1 - create links without html
       1 - discussion more detailed than a class discussion
       1 - multiple conferences
       1 - opinions of others
       1 - fast
       1 - can be selective of messages
       1 – flexible

3. What do you think can be improved with the web board?

       2 – should have better thread organization
       2 - improve spell checker
       1 - edit old posts
       1 - UI does not show that you logged off
       1 – should have more flexibility in marking all read
       1 - slow influx of new messages
       1 - indicate which posts were new
       1 - improve cooperation
       1 - communication skills
       1 - change topic
       1 - attachments
       1 - function more like email or send alerts

4. What other similar systems to the web board have you used? Can you describe what you liked and disliked about them?

       3 - webx
       2 - webcrossing - can make changes to post
       2 - webct
       1 - vBulletin - easy, rarely uses frames
       1 - yabbforum - better organization
       1 - yandex.ru
       1 – sundry

5. What communication skills do you think are necessary to successfully complete a project in this class?

       3 - mutual understanding
       2 - strong English
       2 - openness to ideas
       1 - attention to detail
       1 - computer experience
       1 - ability to recognize different approaches people take to class and alter yours
          to facilitate communication
       1 - internet
       1 - check everyday
       1 - regularly posting
       1 - time management
       1 - being able to articulate
       1 - pliability
       1 - work as team

6. On a scale from 1 to 7, indicate how helpful the web board is to discuss topics in class.
(1 = Very Helpful, 7 = Very Unhelpful)

       Average – 3.5

7. On average, how many messages await you when you log in to the web board?
       A) less than 6:   4
       B) 6 – 15:   4
       C) 16 – 25:   3
       D) 26 – 45:   3
       E) More than 45:   1

8. Rate yourself as to how often you post a message.
       A) Once a day: 0
       B) 2 – 3 times a week: 12
       C) Once a week: 3

D) Less than once a week: 0

9. Rank the following characteristics of a message in order of importance. (Give a 1 to the most important, 2 to the next important, etc.)

	1 Most Important	2	3	4	5 Least Important
Poster	1	3	1	6	4
Subject	10	2	3	0	0
Previous posts on same subject	0	4	7	4	0
Replies to post	3	5	4	1	2
Date posted	1	1	0	4	9

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