

## A Visualization Tool for Managing and Studying Online Communications

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### ABSTRACT

Most colleges and universities have adopted course management systems (e.g., Blackboard, WebCT). Worldwide faculty and students use them for class communications and discussions. The discussion tools provided by course management systems, while powerful, often do not offer adequate capabilities to appraise communication patterns, online behaviors, group processes, or critical thinking. This paper discusses a Web-based program that represents temporal data as maps to illustrate behaviors of online discussants. Depicting discussions in this manner may help instructors and researchers study, moderate, and/or facilitate group discussions. The paper presents the rationale for program's development and provides a review of its technical specifications.

### Keywords

Computer-mediated-communications, Online discussions, Visualizing online discussions, Interaction patterns

### Introduction

The paper begins by providing readers background information about Computer-Mediated Communications (CMC) and a discussion of projects aimed at visualizing CMC. From these works, it introduces a software tool, Mapping Temporal Relations of Discussions Software, that the authors developed to assist instructors and researchers manage and study asynchronous online communications. The discussion serves to overview the software's purpose and functionality. The authors highlight software features and present observations made by users who tested it. Finally, the paper discusses the software and its implications from a pedagogical perspective.

### Background

CMC is communication that takes place between human beings by way of computers (Herring, 1996). The growth of CMC has been exponential. At any particular time, thousands of online conversations take place worldwide (Donath, 2002). Its pervasiveness has captured the interests of educators and research scholars from diverse fields of study. As Junge (1999) points out, an expanding literature base investigates CMC's formal linguistic properties; sociolinguists and ethnographers of communication study issues related to various CMC types; and discourse analyses of CMC modalities have explored, among other things, philosophical dimensions. Werry (1996) suggests that "interactive written discourse provides a fertile ground for analysis since it makes possible interesting forms of social and linguistic interaction and brings into play a unique set of temporal, spatial, and social dimensions" (p. 47).

In educational settings, there has been a growing reliance on CMC to support learning and communications in traditional face-to-face and online classes. Most colleges and universities provide course management systems (e.g., Blackboard, WebCT). These systems supply tools that enable students (and instructors) who are not in immediate and face-to-face contact with each other to use the computer to engage in synchronous and asynchronous discussion of course topics and analyze related ideas. This form of interaction is used to create a sense of online community among discussants, to engage them, and to have them think deeply and critically

about the concepts and ideas presented by the instructor and other students. It draws on aspects of traditional face-to-face classroom education but also has its own unique characteristics. For example, asynchronous computer conferencing is available 24 hours per day, 7 days per week, which allows contributions to online discussions to take place at different times. The temporal norms that evolve online are often quite different from those of a face-to-face class. CMC gives students time to reflect and to consider the content and wording of a contribution or response, which can be highly beneficial for learning (Palloff & Pratt, 2001). Students may also interact with other students, instructors, scholars, and experts from anywhere, given Internet access. To a great extent, these characteristics engender widespread utilization of and reliance on CMC within K-12, university, and corporate educational and training settings.

Although popular, there is still much to be known about CMC and the interactions that occur among discussants in online groups (Jeong, 2004) and about how they influence critical thinking, engagement, and the online community. There has been insufficient research to explicate the effects of CMC on communications and learning in online discussions (Jeong, 2003), which "... can be attributed to the lack of methods and tools capable of measuring group interactions and processes" (p. 26). In addition, while popular course management systems are technically advanced, many do not address key pedagogical goals (Duffy, Dueber, & Hawley, 1998) and thus could be improved. Hara, Bonk and Angeli (2000), for example, recommend that computer conferencing tools provide discussants with "...graphical displays to indicate the potential links between messages, the depth of those links, and the directionality of communication patterns" (p. 65).

## **Purpose**

Given the proliferation of online educational communications and the development of course management systems designed to support them, there is a need for tools that assist educators, researchers, and students engage in, make sense of, and study the relatively new and evolving area of CMC. This paper discusses a tool, Mapping Temporal Relations of Discussions Software (MTRDS), designed to visually and temporally represent asynchronous online discussions. It provides the rationale for MTRDS' development and reviews literature related to the temporality and visualization of online discussions, which are foundational to the project. In addition, the paper presents MTRDS and its technical specifications.

## **Online Discussions and Time**

CMC, specifically asynchronous communications, allows discussants to engage in discussion at a time convenient to them but they are often unaware of or overlook temporal norms that can affect online relations. Time cues within messages are important but are a frequently disregarded element in CMC. Walther and Tidwell (1995) purport that CMC lacks "...relationally rich nonverbal cues" (p.356). However, time cues, such as the time stamping of messages, delays in responding, a discussant's frequent or infrequent communications over time, still remain.

Chronemics refers to human perception of and reaction to time and how time is used and structured. It relates to time as a nonverbal communicative channel influencing human communications (Canfield). The presence of chronemic cues in CMC, such as the time a message arrives and the duration until a discussant responds, may impact the judgments one ascribes to the message and the message sender. How discussants use time and the variations of time during interaction episodes convey meaning at several levels. In an interaction episode, the individual who controls wait time is typically in a superior role. The person waiting for a reply to a message is subject to the preferences of the message sender as to when the message gets sent. The time when a message is sent and the delay between messages may evoke favorable or unfavorable reactions from message recipients.

According to Hewitt and Teplovs (1999), "... the growth potential of a message thread may depend, to some degree, on the age of its notes" (p. 235). If a message does not draw a response in the first few days of it being posted, it is improbable that the message will receive any response (Hewitt & Teplovs, 1999). The delay of responses characteristic of asynchronous communications can adversely impact discussion threads (Jeong, 2004). However, "longer response times produced critiques that elicited higher proportions of replies with elaboration and supporting evidence" (Jeong, 2004, p. 1). Thus, the temporal norms that evolve during CMC may have significant influence on communications and ignorance of them will likely result in user aggravation and misattribution (Walther & Tidwell, 1995). Tools that enable the observation of temporal patterns may prove useful in helping discussants moderate and effect worthwhile communications.

## Visualization of Online Discussions

Many communication technologies focus on textual representations of information ignoring modalities that emphasize such aspects as pattern recognition (Selvin et al., 2001). A number of researchers have developed systems and interfaces for visualizing online communications. For instance, Donath (2002) discussed a project, PeopleGarden, which employs flowers and a garden metaphor to visually represent message board participation. Babble (Erickson, Halverso, Kellogg, Laff, & Wolf) is an online conversation area that enables visualization of online discussants and their activities. People are shown as dots within a circle. The position of the dots changes according to the activity level of the person engaged in the conversation. Loom is another project that uses visualization techniques to reveal social patterns for Usenet groups (Donath, Karahalios, & Viégas, 1999; Donath, 2002; Boyd, Lee, Ramage & Donath, 2002). Among other things, it depicts conversational patterns such as individual postings, vocal members of the group, regular and irregular participants, and mood. Boyd, et al. state that provided, "...the innumerable styles of interaction in Usenet, immense possibilities exist for exploring alternative techniques and approaches to visually convey social interaction" (p. 2). Based on the work of Whittaker (1998) and Smith and Fiore (2001), they developed questions representative of social characteristics of individuals, conversations, and news groups and categorized them accordingly. Several questions appear relevant to learners' involvement in online conversations and the dynamics of those conversations:

### *Individual*

- How frequently does an individual post? How verbose is s/he?
- What types of tone, language and conversation techniques are often used?

### *Conversation/thread*

- How many participants are active in a conversation?
- What structure or pattern of communication occurs (i.e. back and forth vs. large participation vs. one person dominating)?
- Does the thread fracture into mini-threads?

### *Group*

- How many threads are usually active?
- How many people participate in the group, and how frequently do they post?
- How many people start conversations?
- Are people who initiate threads also tend to reply to others' messages?

(Boyd, et al., 2002, p. 3)

Conceivably, by representing these data visually and dynamically during online conversations, one can provide discussants greater awareness of the communication dynamics and perhaps shape it in productive ways. Moreover, such visualization can improve the conferencing environment, which is often disconcerting to users.

Each of the aforementioned projects emphasizes the social dimensions of online conversations and the design of visualizations to represent online conversational spaces intuitively and meaningfully to users. However, they are more interfaces than educational tools for analyzing online conversations. Educational researchers employ a variety of techniques and tools to represent and study CMC interactions. For example, Howell-Richardson and Mellar (1996) created message maps to temporally identify periods of variable discussion activity as well as the patterns of interactivity. Among other things, maps helped identify message clustering, concentration of referential links, and the degree of participant activity. Blake and Rapanotti (2001) made conference interaction maps with nodes representing messages posted to a conference area and arrows defining relationships among nodes. Each node includes indices of time, sender, message contribution, and message agreement with prior messages. Hara et al. (2000) used conference activity graphs to visually illustrate transformations of student interactions over time. In the authors' view, these works, while serving different aims, lend credence to the significance of the temporality in CMC and the relevance of visualizing online conversations.

## Mapping Temporal Relations of Discussions Software

In the summer of 2004, the authors developed Mapping Temporal Relations of Discussions Software (MTRDS) to assist them analyze the temporal aspects of online educational course discussions. Prior to MTRDS, they created print illustrations similar to figure 1 to visualize conversations, which proved time consuming and caused extended delays between the discussions and the creation of maps. Their effort to depict conversations visually was due, in large part, to the design of computer conferencing systems, which organize conference messages

hierarchically by thread/topic and time. As new messages get added, they become indented under the post that provoked the reply. Such organization makes it difficult to examine discussions as well as evolving temporal norms, especially when the number of messages increases. Mapping temporal relations provides a more compelling view. For example, the authors created hand-made maps similar to what is depicted in figure 1, which illustrates a discussion that occurred over 15 days. The Y-axis represents time (hour) and the X-axis represents day or date. Each square denotes a discussion post and contains the participant's initials and a unique numeric identifier (not shown in figure 1). The lines connecting posts indicate replies. From such an illustration, one can observe spatial and temporal dimensions of discussions, including message clustering; the general time and date of discussion activity; individual patterns of interactivity, such as individuals who contributed consistently over time and those who contributed sporadically; and those who appear on the periphery of discussions. In the authors' view, maps provide useful information about communication patterns. It is conceivable that these kinds of data may help educators manage discussions as well as engender collaboration and critical thinking during conversations. For instance, an instructor or moderator who has this information at his/her disposal could prompt a discussant on the periphery of a discussion to engage him/her in more timely interactions.

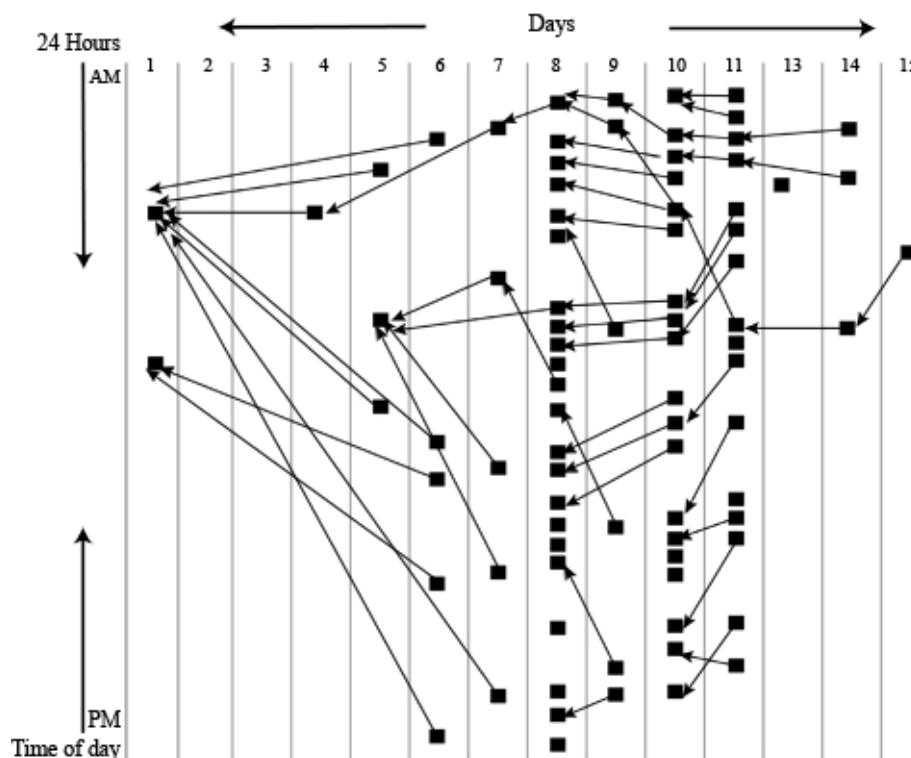


Figure 1. Hand-made student discussion activity map

## MTRDS and Other Approaches to Represent and Study CMC

As mentioned, educational researchers (e.g., Howell-Richardson and Mellar, 1996; Blake and Rapanotti, 2001; Hara et al., 2000) have used a number of approaches to represent and study CMC interactions. The authors believe that many components of MTRDS build upon these works as well as offer unique variations on them. Characteristics that the authors view as unique to MTRDS include the following:

- MTRDS is not a discussion board but a tool that manipulates data from existing discussion boards, and thus it can potentially be used with a wide array of existing discussion tools. It represents data visually and provides an interface for viewing discussions that highlights their temporal and spatial dimensions.
- MTRDS visualizations are dynamic and reflect changes when they are made to the discussion transcript.
- MTRDS is entirely Web based and accessible to users with an Internet connection and a Web browser.
- MTRDS enables users to read discussion messages while, at the same time, examine discussion characteristics such as message clustering, concentration of links, temporal norms, and the degree of participation.
- Because the authors spent a great deal of time creating maps by hand, they designed MTRDS to be easy-to-use and efficient. Once the user creates a discussion file, he only has to open the MTRDS' Web site and click a button to upload the file and the map is created.

## MTRDS Design

MTRDS is a Web-based prototype that dynamically maps the temporal aspects of discussions. At present anyone who uses WebCT (a popular Web-based course environment) can compile discussion board messages in a text file and then upload the file to the software using a Web browser. MTRDS generates a visual representation of discussions based on hour and date. Figure 2 represents a drawing of a map rendered by MTRDS. The X and Y axes denote day/date and time, respectively. Each discussion message/post is represented by a color-coded circle (message node) and a line (link) that connects a response node to the originating message. An originating message (i.e., the Parent), when replied to will have one or more child messages. A line with a single arrow pointing backward represents the linkage between a response node (child) and its originating message (the Parent). From the maps, one can readily determine the ancestry of a particular response node (child). MTRDS draws arrows indicating which message is being responded to or followed up by a specific message. Thus, the arrows point backward. It is important to point out that this kind of a map illustrates the pattern of responding. On the other hand, if one is interested in the flow of discussion of the topic, it may make more sense for the arrows to point forward. However, this depends on the instructor's/researcher's purpose for using the map.

MTRDS color-codes messages by topic because discussions often contain multiple topics/threads. Color coding also reveals isolated message threads and those that dominate. When the user passes the computer mouse over a message node, the node highlights and the post time appears in the far left (time) column. If the user clicks the mouse button on a message node, the view expands and presents a scroll box containing the message, author's name, and post time.

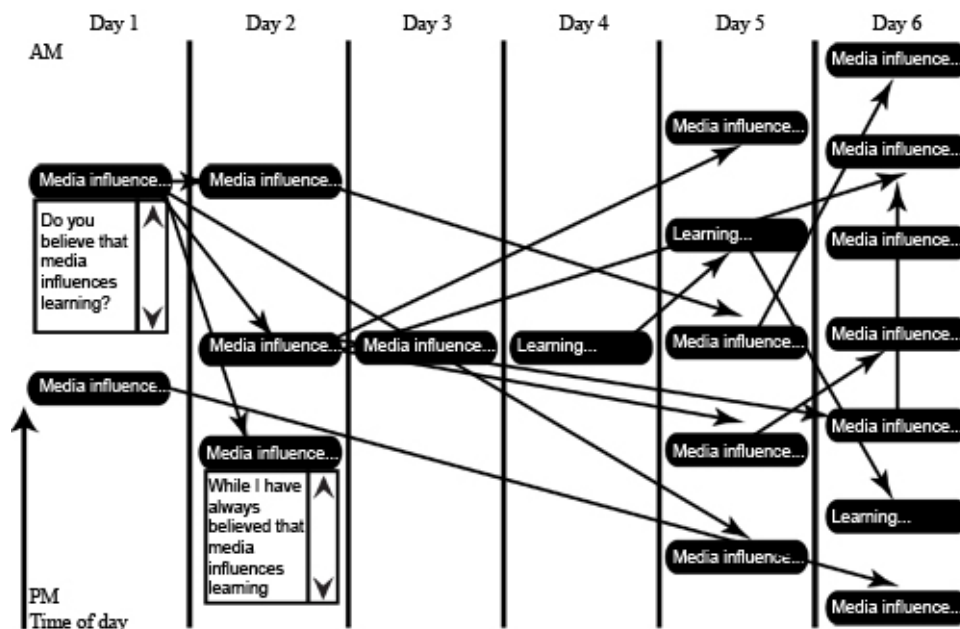


Figure 2. Rendering of MTRDS' map of discussion

### *Technologies Used in MTRDS*

MTRDS employs PHP, Extensible Markup Language (XML), and Flash (MX 2004 Professional) in an Apache or IIS Web server environment as its main underlying technologies. PHP hypertext preprocessor is a server-side scripting language used primarily for dynamic Web development. MTRDS uses this technology to parse discussion forum data and to generate XML, the common data source between PHP and Flash. MTRDS employs Flash ActionScript to visually display the data obtained from the XML file generated by the PHP script.

### *File Processing Using PHP*

Discussion forum messages are obtained from the WebCT forum interface. WebCT compiles selected messages, which can be downloaded as a text (.txt) file. Text files contain the following key parameters: message ID, branch from (identification of message and the message it is tied to), author, post date, subject, and body. When the user uploads a discussion file obtained from WebCT, it is submitted to the central location on the Apache

Web server. The PHP parser processes the content of the file and extracts all relevant information. The parser generates an XML file into which it places all the extracted information. See Appendix A for additional information about the PHP parser and XML file.

After the XML file is generated, an HTML page containing the Flash movie is called and the map is generated. When the Flash movie is called, it acquires the *xml* file and creates an array of *Message* objects for its internal processing. A custom *Drawing* class written in ActionScript contains all the basic tools required for drawing the map (e.g., *drawSquare()*, *drawLine()*, *drawArrow()*, *drawText()*, etc.). Another class, *weekView*, is then used to perform the actual processing and drawing of the message nodes and links.

The entire Flash movie is constructed using three frames. The first frame processes the XML file and generates the array of the *Message* objects. The second frame instantiates the *weekView* object and calls the *renderMessages()* function that draws the actual map. This frame also includes controls to move back and forth in the time line. The third frame contains no objects and serves only as a tracking point for moving in the timeline.

### **MTRDS' Functionality: Benefits and Improvements**

The authors asked five instructors to evaluate the functionality of MTRDS. The instructors implemented it for their classes or research. They were asked to state benefits of using the program for their teaching or research needs and to identify problems they encountered and/or features that need to be incorporated. For clarity, the instructors who evaluated MTRDS will be hereafter referred to as users. In addition, the authors demonstrated the program at two academic presentations attended by teaching and research professionals. During the demonstrations, attendees reviewed MTRDS and offered suggestions about its design and functionality. The evaluative exercises provided useful information about the program and ways to enhance it. The following summary highlights several beneficial features of the software that users identified. It also lists problem as well as features not currently available that users perceived as important improvements.

#### *User Observations: Existing Beneficial Features of MTRDS*

- *Observing communication characteristics:* Smith and Fiore (2001) point out that CMC software environments often "...obscure information about threads' temporal patterns, population, and structure..." (p.139). Users found that because MTRDS displays discussion messages temporally-spatially it readily conveyed information about interactivity; thread dominance and development; message continuity, sequencing, and ancestry; links between messages; and isolated messages, which is not easily observable in traditional discussion boards (Smith & Fiore, 2001).
- *Message context:* Many popular discussion boards present users a hierarchical arrangement of message titles grouped by thread. The titles are links to the message content and in some ways serve as an index. Generally, when the user clicks the link to read a message, the hierarchy of message titles disappears and, to an extent, removes a context (time, date, placement in index, etc.) with which to understand the message. The context surrounding messages, such as the time and date of a post and its place in the thread can provide valuable information to help students understand a message. MTRDS allowed users to see the structure of the overall conversation while reading messages, which enhanced the message context. As users read a message, they observed how spatially separate by time and date the message was from other posts within the entire discussion. Users could determine the thread in which the message existed and its placement in the message chain. In addition, they could identify where that thread and message existed in the entire discussion.
- *Temporal behaviors:* Maps helped users identify the temporal behaviors of online discussants and, when necessary, moderate them to positively effect communications. Users noted that they could easily identify student participation patterns in the context of a discussion. For instance, when viewing a map after a discussion occurred, one instructor observed how a discussion leader responded sequentially to each student posts over several days. The instructor speculated that the response pattern, while useful for individual students, may not have engendered group cohesion and dialogue, an aim of the discussion activity. Moreover, the map illustrated low learner-to-learner interactions and discontinuous conversation. The instructor reflected that had he shown the map to the discussion leader during the discussion, it would have conveyed his pattern of responding and perhaps allowed him to see that his communication patterns potentially inhibited group interaction. Moreover, the map articulated the leader's pattern of responding

rather than of initiating dialogue, which the map would have made clear to him and could have helped him alter his communication behavior.

- *Temporal-spatial representation:* When comparing MTRDS' display of discussions with other discussion board displays, one user suggested that it is analogous to providing a person who is lost directions in the form of a geographical map rather than in text or written form. Whereas many traditional discussion boards present information textually with messages sequenced linearly with limited temporal or spatial information, MTRDS, similar to a geographical map, afforded users a spatial (and temporal) dimension of the discussion that offered insights about how discussions evolved. It also allows one to efficiently surmise the overall flow of a discussion.
- *Indicators of communication dynamics:* The communication patterns represented by MTRDS provided indices of when communications were of a monological or dialogical nature. Figure 3 illustrates a rendering of a discussion conducted by an online guest lecturer (for clarity, figures 3 and 4 were reduced to black and white drawings to indicate the overall flow in the discussions). Message nodes expanded horizontally from the initial node (column 1) as activity increased. The thread initiated by the guest dominated for several days. Only on the fifth day several new threads appeared. One can see message nodes extend over seven days, the number of posts each day, the time of each post as well as direct and indirect references to messages. It also reveals when discussants discontinued threads. One could examine the concluding thread message in an attempt to ascertain why the topic ended and another began. Overall, the segment of the discussion presented in figure 3 illustrates consistent thread development and substantial learner-to-learner interaction. Figure 4 presents a segment of an activity in which students introduced themselves at the beginning of an online course. Student partners interviewed one another and each student posted the partner's introduction. Relative to the discussions depicted in figure 3, the activity illustrated in figure 4 is minimal and somewhat discontinuous.

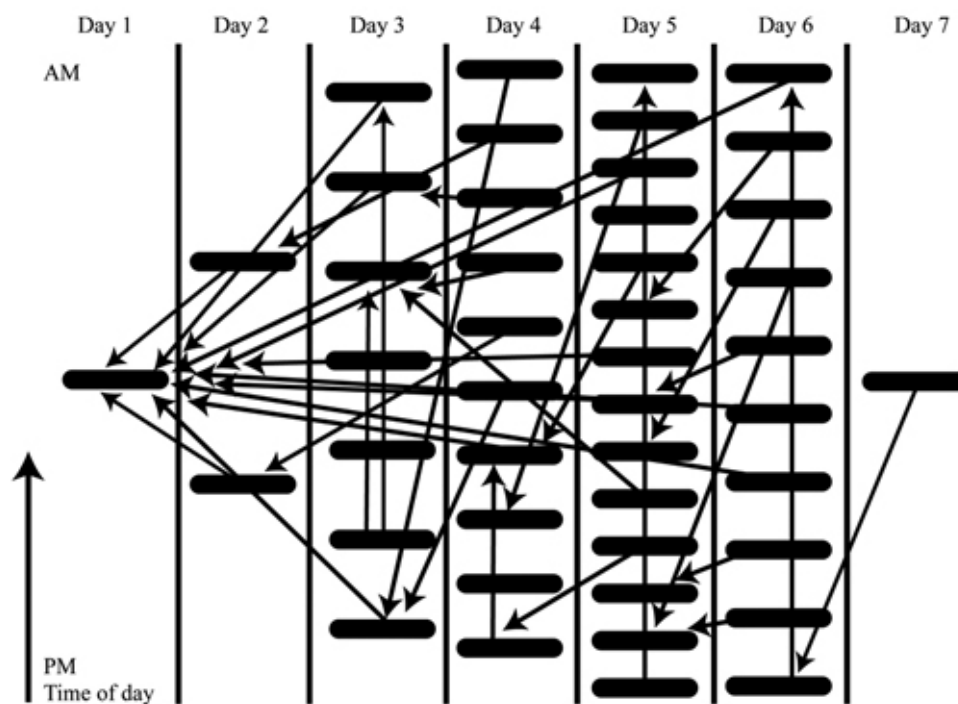


Figure 3. Rendering of discussion map: Guest Lecturer

#### Observations: Suggested Improvements

- Users wanted a condensed view of the representations so they could see as much of discussions as possible. This could be accomplished by incorporating a zoom feature that allows users control over how much of a discussion displays at one time. Currently, MTRDS presents message nodes by time (Y-axis) and date (X-axis). Nodes appearing at the top of the Y-axis for a particular date are older than those at the bottom. On the X-axis, nodes display from oldest to newest, moving from left to right. To display as many messages as possible at one time, while maintaining readability, several factors had to be considered. Only one week's (seven days) worth of messages display at a time. This number can be increased but the clarity of the map may be affected. The user scrolls to view the message nodes on subsequent days.

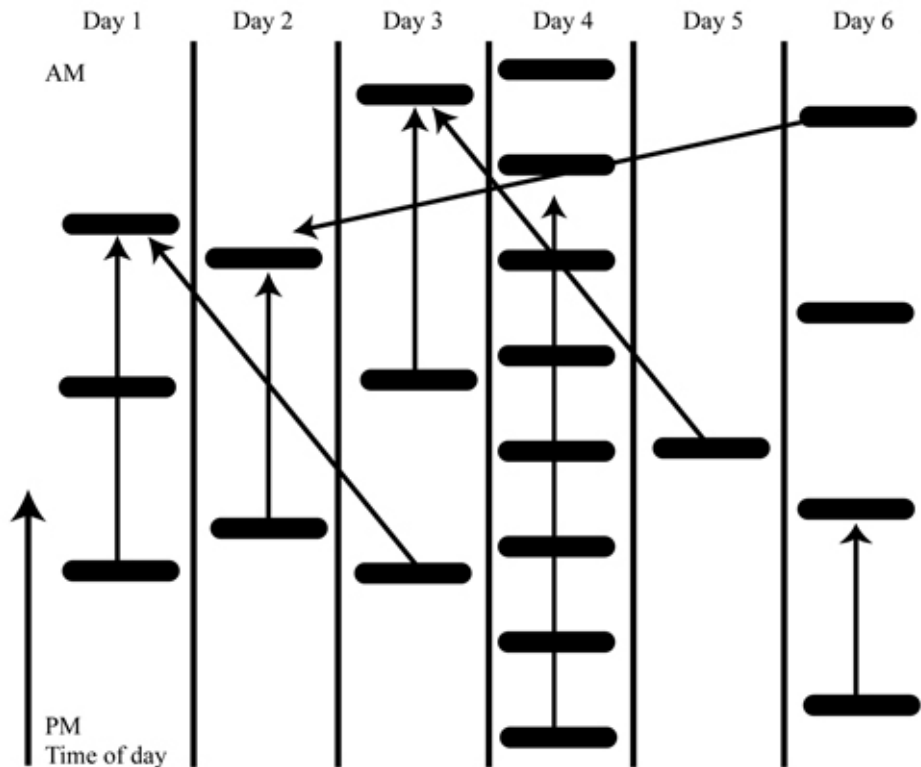


Figure 4. Rendering of discussion map: Student Introduction

- MTRDS displays only days that contain messages and skips “empty” days. For instance, if February 3 contained six messages, February 4 contained no messages, and February 5 contained ten messages, then February 3 and February 5 are represented on the map and not February 4. However, users pointed out that it would be useful to display days when there are no messages because it is informative and makes it easy for the instructor or researcher to ascertain periods of inactivity. One day of no activity versus several successive days of no activity is important data to interpret. Showing the “empty” days allows for looking at patterns of activity and non-activity visually.
- Users wanted the capability of isolating threads/topics or individuals. Each map presents the entire discussion including all threads, messages, and links, which can clutter the map when discussions become highly interactive. Users needed the capability to display selected threads or persons so they could more easily observe thread development or individual participation patterns.
- Researchers wanted to code or place labels on message content for analysis. For instance, as the representation is being viewed, a user could click on a message node and a drop-down list of codes would be presented. The code would allow the researcher to label or classify (e.g., evaluation, hypothesis, argument, etc.) the message. Coded information would be submitted to a database and available for additional analysis. This feature could allow one to study the semantic relations of messages to gain insights about group processes and communications.
- MTRDS does not distinguish a real response to a message from an unintended one. There may be a message that follows another but it is actually not a response to that previous message's content. The student merely used the previous message as a thread to follow. A student may either be genuinely following up the previous message's thought or may, in reality, be creating a new thread (a new discussion or topic). Those kinds of distinctions are meaningful and informative for the instructor or researcher, but, at present, the software is unable to detect them. It will require human interpretation and judgment to do so.
- Users wanted the ability to save the representations to be used in other applications

### **MTRDS: Implications from a Pedagogical Perspective**

During face-to-face educational discussions, instructors often moderate and astutely observe student patterns of communication, such as responsiveness, verbal and non-verbal expressions, topic development, conversational

dominance or apprehension, and participation level. Based on these observations, they use a variety of techniques (e.g., questioning) to facilitate communication and engage students. The verbal and kinesic signals available in face-to-face communications are, to a great extent, non-existent in online discussions (Walther & Tidwell, 1995). In the absence of such cues, instructors must rely on other means to effectively moderate communications. MTRDS can aid instructors by highlighting characteristics of online communications that are difficult to ascertain with traditional discussion boards. For example, Gibbs (2006) analyzed multiple online discussions with MTRDS, examining the overall topography of maps, the extensiveness of links among messages, and discussion duration. He found that complex maps with extensive node-links relations suggested learner-to-learner interactivity and when discussions exhibited consistent thread development over several days and message clustering around a thread it suggested focused activity about a topic. Conversely, thread segmentation and isolated messages were indicative of disjointed communications or short question-response interactions. Finally, color coding highlighted information about thread dominance and segmentation and allowed him to identify, over the entire discussion, when threads began and terminated. He was also able to identify specific points where threads diverged and the message content that provoked the divergence. In some cases, the maps enabled him to follow message chains assessing the content of messages and to isolate points of departure within conversations. Such a view of multi-threaded discussions will allow instructors to monitor divergent conversations. It indicates the divergence in the context of other messages and threads and provides instructors information to help them assess and possibly circumvent splintering or off-task conversations.

Projects completed thus far using MTRDS suggest that the visualizations convey relations among messages as well as the overall form or structure of interactions that unfold during discussions. They help identify whether discussions are interactive or one-way monologues as well as who initiates conversations and who responds. The temporal-spatial display of discussion data allows for identification of individuals who participate consistently and those participating sporadically. If grading is assigned for participation, the maps present a clear picture of involvement. Not only can an instructor determine if a student contributed and how frequently but he can assess the manner in which the student took part, which may serve as an indication of the student's involvement in a discussion. For example, in some instances, users of MTRDS generated maps that showed students who consistently posted at the end of message chains or who posting numerous messages on few days toward the end of discussions. Such patterns become evident when rendered with MTRDS and suggest minimal involvement in a discussion. They frequently do not engender dialogue with other participants and many of the messages become isolated.

MTRDS presents an audit of an individual participation. Discussions often begin with a message prompt, usually posted by the instructor. The content of messages nodes appearing in close proximity to the prompt will likely be related to the originating message. Conversely, it is plausible that message appearing lower in the message chain will be more dissimilar in content to the originating message than those appearing higher in the chain. Thus, as instructors observe a discussion in MTRDS, they will likely identify student posts that consistently appear lower in the chain. Such participation should be monitored closely because the student may be discussing issues noticeably different from those intended by the instructor.

The aforementioned issues are important from a pedagogical perspective because they highlight ways tools such as MTRDS can help instructors, discussion moderators, and students to moderate online conversation and to positively effect communications.

## **Summary and Conclusion**

Face-to-face class discussions usually occur during a limited period of class time. Instructors moderate conversations and observe participant interaction behaviors. They are able to observe the verbal and non verbal behaviors of students, which can help them efficiently and effectively manage a conversation. For instance, an instructor may quickly prompt a participant to engage him as soon as the individual does not actively participate or the instructor may curtail one who tends to dominate a conversation and exclude others. Because online conversations lack the visual and verbal cues of face-to-face communication, managing conversations can be more complex and inefficient. In addition, asynchronous discussions typically occur over several days and are mediated by computer software, which frequently conceals important information related to interaction patterns. The MTRDS project originated as an effort to develop a tool that would reveal the temporal aspects of online discussions and visually represent discussants' posting behaviors to help instructors, researchers, and students efficiently and effectively study and/or facilitate group discussions. Online learning environments are often disorienting to students and instructors. An instrument such as MTRDS may help class participants effectively monitor discussions and aid them in constructing meaningful interactions.

There are many potential advantages of having this software for instruction or research purposes, which were emphasized by users. While MTRDS needs refinement, it appears to have potential as a viable tool to help educators and researchers monitor, manage, and study communication processes in online environments. As the authors refine the software they plan to address the issues raised by the user evaluations.

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## Appendix A

The parser is designed to be extensible so that new modules can be written to support other formats (e.g., Blackboard). The basic mechanism of the parser is presented below. It uses an object called *Message* and creates an array of objects. When the array is complete, its content is then transformed and transferred into a XML file (*messages.xml*) on the server.

```
class Message {
    var $msg_id;
    var $branch_from;
    var $author;
    var $post_date;
    var $subject;
    var $body;
}

class Parser {
    ...
    function processFile($file_name, $file_type)
    {
        ...
        switch($file_type)
        {
            case 1 : module to process file type 1; break;
            case 2 : module to process file type 2; break;
            case N : module to process file type N; break;
            ...
        }
        ...
    }
}
```

### PHP parser

### XML Structure

The XML file generated by the parser has a simple structure for easy processing by Flash and to reflect the basic data requirements of a message forum.

```
<messages>
  <message id=ID>
    <branch_from>BRACH_FROM_ID</branch_from>
    <author>AUTHOR</author>
    <post_date>YYYY-MM-DD-HH-MM</post_date>
    <subject>SUBJECT</subject>
    <body>BODY</body>
  </message>
</messages>
```

### XML file structure