

**A Descriptive Study of Telementoring Among Students, Subject
Matter Experts, and Teachers:
Message Flow and Function Patterns**

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Suggested Keywords:

telementoring, educational telecomputing, subject matter experts, electronic mail, message flow and function, speech acts

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Abstract

This descriptive study of the online communications of 10 teams of subject matter experts, classroom teachers, and K-12 students focused upon the functions, frequency, and flow of electronic mail messages exchanged in the context of curriculum-based projects. All correspondence among team members was automatically logged, then analyzed over time. Categories for message function were based upon a previously-published taxonomy, but emerged as data analysis progressed into 21 specific classifications.

Results indicated that:

- 1) Subject matter experts and teachers "talked" more on-line, respectively, than students, even though students' inquiry was the focus of each online project.
- 2) Participants' roles as expert, teacher, or student were associated with greater and lesser frequencies of certain message function types.
- 3) Requests or reports directly related to curriculum content comprised a surprisingly small portion of total message functions identified.
- 4) When viewed longitudinally, "reporting" and "requesting" functions followed very different frequency patterns.

A Descriptive Study of Telementoring Among Students, Subject Matter Experts, and Teachers: Message Flow and Function Patterns

More than 153 million people use externally networked tools and resources (NUA, 1999) in more than 212 countries (MIDS, 1998). The Internet is rapidly finding its way into businesses, homes, and K-12 classrooms, growing at a rate of at least 100% per year (MIDS, 1998), or one new host, on average, every 30 minutes (Calcari, 1994). Seventy-five percent of its adult users are professionals in business or technical fields, and 61% have college degrees (Anaya, 1998). It has been used by university researchers, teachers, and students since the early 1980's (Kantor & Neubarth, 1994). In late 1997, 78% of a nationally representative sample of American K-12 educators reported having access to telecomputing facilities somewhere in their school buildings, with 27% of that sample having connections in their own classrooms (Bare & Meek, 1998). The Internet is therefore an international, virtual meeting place for increasing numbers of teachers, students, and subject matter experts.

In the year 2000, 95% of U.S. schools will have access to Internetworked resources and tools (Heaviside et al., 1997), and by 2002, 20.2 million children and teens will be able to use the Internet from their homes (Jupiter Communications, 1997). The Internet, therefore, can (and perhaps should) be used to provide curriculum-based, computer-supported learning environments for K-12 students as they work asynchronously with both subject matter experts and "learning experts," or classroom teachers (Lenert & Harris, 1994).

The Project

How might such cross-institutional, telecollaborative (Harris, 1995) teams be brought together? One response lies with the *Electronic Emissary Project*, launched in early 1993. The Emissary is a "matching service," pairing subject matter expert (SME) volunteers with K-12 teachers and their students who are studying in the fields of the SMEs' expertise. In doing so, it helps to establish content-related, curriculum-based teleapprenticeships (Levin, 1987), or electronic mentorships (Riel & Harasim, 1994), through which *telementoring*, or "use of e-mail or computer

conferencing systems to support a mentoring relationship when a face-to-face relationship would be impractical," (O'Neill, Wagner & Gomez, 1996, p. 39) occurs. Emissary-supported projects are requested by teachers using an interactively accessible database of volunteer subject matter experts with custom-designed selection software (Jones & Harris, 1995). The Emissary is also a research effort, examining the nature of adult-child interaction and collaborative, asynchronous teaching and learning in primarily text-based, computer-mediated environments. The students in Emissary teams are encouraged to inquire about their curriculum-related topics of interest, which are also the subject matter experts' content specializations. The teachers in Emissary teams work with the SMEs, the students, and university-based "online facilitators"/research assistants to shape this interaction, helping participating teachers to incorporate it into the face-to-face K-12 classroom learning environment.

Although several projects in which students communicate electronically with adults have been documented (i.e., Duin, Lammers, Mason, & Graves, 1996; Lenert & Harris, 1994; Moore, 1991; Murfin, 1994; Ross, Morrison, Smith & Cleveland, 1990; Rueda, 1992), it is clear that there is much more to learn about these contexts for exchange. As Riel & Harasim (1994) noted, study of the nature of social interaction among the members of a networked community is one of three primary and viable approaches to research on educational telecomputing, resulting in "a better understanding of the overall community of users and their shared activity" (p. 97). These studies often apply qualitative methods, such as discourse analysis, to explore the nature of online communication among community members with similar goals. This study is one such attempt.

Discourse Analysis: Speech Acts

Online interaction, or *composition as conversation* (Murray, 1985), exhibits features of both oral and written discourse. This new hybrid is

more formal than face-to-face conversation and telephone conversation, but less formal than written memos and documents... [It is] semipermanent; can be partly planned; is subject to time delays; and lacks visual paralinguistic and nonlinguistic cues. The interaction of these characteristics results in complex turn-taking, with the turn-taking principles of oral discourse being violated; indication of topic shift; glossing of reference items to avoid ambiguity; less fragmentation than in oral discourse; and the use of graphical representations of paralinguistic cues. (Murray, 1985, p. 206)

Previous research (i.e., Ahern, Peck, & Laycock, 1992; Beals, 1992; Goldman & Newman, 1992; Levin, Kim, & Riel, 1990; Rueda, 1992) seems to favor analyzing electronically communicated texts in terms of speech acts (Austin, 1962; Searle, 1969), or the actions that language is used to perform, such as "the sky is blue" being an act of assertion (Schiffrin, 1991). Speech act theory holds that "utterances can be both grouped together, and separated from one another, according to their underlying speech act functions" (Schiffrin, 1991, p. 6). More recent applications of speech act theory acknowledge that several utterances can combine to represent one speech act, and a single utterance can represent several speech acts (Brown & Yule, 1983). Determining the act(s) that a particular text represent(s) involves examination of the context(s) in which the utterance occurred. Since electronic statements in their message contexts are simple and convenient to gather in their entirety (Beals, 1992), it appears that selection of speech act analysis is appropriate for discursive studies of network interaction that aim to uncover the functional nature of electronic communication. Speech act analysis was used to generate the results of this study.

Previous Studies of Electronic Discourse

Since educational use of text-based telecommunications tools is a relatively new venture for most K-12 teachers and students (Heaviside, et al., 1997), there is little research published to date that documents educational telecomputing in the elementary, middle-level, or secondary classroom. Of that limited offering, very

little has examined the nature of social interaction among participants in a networked community, and even less the characteristics of exchanges between adults and children. Instead, there has been considerable attention paid to the design and structure of different networked environments, and increasing interest in the knowledge, skills, and attitudes that using computer-mediated communications tools engenders in students and teachers (Riel & Harasim, 1994).

Studies of Communication Involving K-12 Students

The focus for this study is the nature of online, Internet-based interaction among adults (classroom teachers and remotely-located subject matter experts) and students in school settings. Seven other studies were located that addressed similar topics. Moore's (1991) study of fifth-graders' literature-centered electronic dialogues with educators enrolled in a graduate-level educational computing course showed that students and teachers reaped benefits from the interaction much like what has been reported for the use of paper-based dialogue journals. Specifically, patterns of effective questioning, response modeling, and student-centered discussion in authentic contexts emerged as the online dialogues continued.

Duin, et al. (1994) studied 8 college student mentors' strategies for and perceptions of offering constructive feedback on ninth-grade students' successive essay drafts. Findings indicated that mentors formed predictable, but individually unique patterns of response to students' works over time that did *not* correspond with their precommunication plans for comments, and that mentors with teaching experience offered more feedback than those without. Also, those mentors who were less likely to request feedback from others on their own works, by their own admissions, offered *more* constructive comments to students than those who regularly requested response from peers. Finally, the study showed that mentors clearly learned more about writing as they helped students to develop their written products.

Murfin's (1994) investigation of communications among eight adult scientists and eight middle school students who had no previously acknowledged interest in science, all of whom communicated using an electronic bulletin board system,

documented many of the logistical and motivational difficulties often encountered in adult-child telementoring (i.e., Harris, O'Bryan, & Rotenberg, 1996). Murfin's study also gave preliminary evidence that personality type, as measured by the Myers-Briggs Type Indicator, might not be directly related to online behavior.

Ross, Morrison, Smith, & Cleveland (1990) explored online academic tutoring by graduate teacher certification candidates for at-risk sixth graders who had access to telecomputing facilities both at home and at school. Part of the data analysis included determining the "type" of message sent ("Social," "Assignments," "Tutor Business," "Tutee Problems," "Reminders," "Explanations," "Grade Reports" and "Miscellaneous"). These researchers found that messages containing social content were sent most often (n=274), with assignment-related messages sent somewhat less often (n=104), and reminders, explanations, and grade reports sent least frequently.

Multiple techniques for analyzing messaging among adults and students in six countries involved in the Intercultural Learning Network (ICLN) were used by Levin, Kim, & Riel (1990), including "message act" and "message flow" analyses. The instructional functions implied in the electronic texts that the adults and students in this project exchanged were reported according to the IRE (teacher initiation, student reply, teacher evaluation) sequence suggested by Mehan (1978). Levin, Kim, & Riel found that very few of the message threads that contained instructional functions followed an IRE sequence. Also, although 71% of the evaluations contained in the ICLN messages were uttered by adults, a "substantial number" (p. 206) were made by students, and "less than half (39%) of the initiations were made by adults" (p.206). Message flow analysis showed that different projects displayed peak activity at different times during the entire course of exchange.

Goldman & Newman (1992) examined the electronic discourse that was formed between sixth grade students and their teacher within a common classroom, and compared it to the face-to-face communication that occurred among the same participants. They found that metacommunication was frequently used and the types of exchange employed were similar in the two forums. It also appeared that

students and teachers were conscious of differences in status and hierarchy in their communications in both contexts, but, like the results of the ICLN study (Levin, Kim, & Riel, 1990) mentioned above, students initiated interactions more frequently in electronic exchange than in face-to-face communication, and teachers offered evaluative comments less frequently online than face-to-face.

Similar awareness of status differentials was apparent in the communications that Moore (1991) studied, and, interestingly, in the public electronic communications of health-care workers (Saunders, Robey, & Vaverek, 1994). In this study, doctors communicated more frequently with nurses than nurses with doctors on task-related topics, and in ways that mirrored face-to-face communication. Yet it did not appear that occupational status was reflected similarly in socioemotionally-oriented electronic communication.

Rueda's (1992) study of online discourse between learning disabled students in grades four through six and their teachers in seven special education classrooms showed that although there was a high level of interactivity, communication was dominated by teachers. Rueda coded each sentence or phrase of each message as one of 19 language functions, such as "requesting personal information," "reporting opinions/feelings," or "reporting general fact," then compared the numbers of function types in three groups. Teacher-initiated and student-initiated messages that led to extended topic chains formed the first two groups. Teacher-initiated messages that did not lead to extended topic chains formed the third group. When considering all of the messages exchanged in this project, Rueda found that teachers wrote more, asked more questions, and introduced more new topics than students did, but they were also more conversational and informal in online exchanges than in face-to-face communication.

Rueda (1992) also noticed that those communications between learning disabled students and their teachers that were more conversational in style were also maintained longer (for more "turns") than those that reflected a more traditional way for teachers and students to interact. Similar results with undergraduate students communicating with each other and their teacher in a

computer-mediated, hypertextually-organized conference were obtained by Ahern, et al. (1992). The results of this study indicated that a conversational style of interaction produced higher levels of student participation and more complex interaction patterns online than "questions-only" or "statements-only" styles of teacher talk.

What speech act patterns become apparent when *two* adults, one a teacher, and one a subject-matter expert, interact electronically in a computer-mediated, text-based context with K-12 students? What can those patterns suggest about the nature of this unique context for temporally unbound, geographically dispersed, computer-mediated learning and teaching?

Sample

This was a study of the electronic communications of ten learning teams that corresponded during the spring 1993 semester as part of the Electronic Emissary Project. In February of that year, 33 "matches" were requested by classroom teachers on behalf of their students, with 18 (55%) of those slated for full-class participation, and 15 planned for the benefit of individual students enrolled in a single high school's academic enrichment program, each working on a research topic of special interest. Ten (56%) of the 18 full-class teams maintained e-mail contact for the duration of the semester and were studied. Table 1 shows demographic information about each of these teams.

Table 1

Team Demographics

Team Name/ Topic	Number of Students	Grade Level	Classroom Location	SME's Location
Computers	~65	K - 3	Weslaco, TX	California
Astronomy	21	4th grade	Fort Worth, TX	Missouri
Navigation	22	5th grade	Amarillo, TX	California

Middle Ages	~30	6th & 7th	Houston, TX	Illinois
Civil Rights	16	9th	San Angelo, TX	California
Literature	60	9th	Deer Park, TX	Washington
Waves	30	9th	Hart, TX	.Mass
Geometry	30	10th	Waco, TX	Kansas
Medicine	24	10th	Deer Park, TX	Texas
Plants	3	10th	Comstock, TX	Florida

During this initial semester of the Emissary project, technical and procedural assistance were provided on an as-requested basis only. In all later phases of the project, active online facilitation and message monitoring were arranged for each learning team, and were provided by doctoral students specializing in educational telecomputing. An initial summary of recommendations for practice emerging from such facilitated telementoring can be found in Harris, O'Bryan, & Rotenberg, 1996.

Data Analysis Procedures

The Emissary project used several custom-designed Unix scripts (short programs) to route messages among participants in each team. These same scripts archived copies of all messages exchanged and allowed the project's technical administrator to manage the system. When messages were sent to an Emissary team's address on the project's server, each incoming message was copied and saved, basic information on the message's routing and temporal attributes was collected, and then it was automatically forwarded to the electronic mailbox of the other team member(s). In this way, all messages, separated by team and ordered chronologically, were available for review and analysis by the researchers. Data collection was done with participants' full prior knowledge and consent.

Two types of data were generated. The first data set was formed by the Emissary's automated mail program (Jones & Harris, 1995) and yielded information on numbers of lines, words, and characters contained in each message.

The second data set was generated by the researchers analyzing each message for its direction, or "flow," and speech acts, or "functions." Only mail messages that included new information transfer between participants were examined.

First Data Set

91.4% (320) of the total number of messages exchanged were sent among team members from groups that communicated for the full semester, and 8.6% (30) were sent by members of the remaining teams. Only full-semester communications were used for data message function and flow analysis. Table 2 shows the number of messages exchanged per full-semester team, along with the mean number of words for each. Please note that numbers of messages and average message length in words were not consistently related.

Table 2

Average Message Lengths by Team

Group Topic	No. of Messages	Length in Words	
		Mean	Standard Deviation
Literature	10	287.10	278.68
Geometry	16	288.50	227.81
Middle Ages	61	298.62	226.25
Plants	71	352.35	427.38
Medicine	15	363.13	238.54
Waves	21	411.19	301.96
Navigation	17	490.88	585.58
Computers	17	536.35	385.86
Astronomy	28	609.92	704.84
Civil Rights	64	1063.59	814.49

Note. Listed in order of increasing average message length by team.

Second Data Set

Message flow. Creation of the second data set began by identifying the six possible message routes, or "flow types." During data analysis, each message was assigned a message flow type. Table 3 shows the numbers of messages of each flow type that were sent, and the percentage of the total number of messages exchanged among members of these ten teams.

Table 3

Message Frequency by Flow Type

Message Sender	Message Recipient(s)	Total Sent	Percent
1) Subject Matter Expert	⇒ Teacher	78	24.4%
2) Subject Matter Expert	⇒ Students	70	21.9%
3) Subject Matter Expert	⇒ Teacher and Students	21	06.6%
4) Teacher	⇒ Subject Matter Expert	76	23.8%
5) Student	⇒ Subject Matter Expert	56	17.5%
6) Teacher and Students	⇒ Subject Matter Expert	19	05.9%

Note. The total number of messages sent among the members of the 10 teams examined was 320.

The most common message flow types were SME ⇒ Teacher (24.4%) and Teacher ⇒ SME (23.8%). This can probably be attributed to the fact that teachers and SMEs were asked to communicate with each other for 1 - 2 weeks before the students joined the exchange so that the goals, forms, and intent of the impending exchanges could be agreed upon, and also for 1 - 2 weeks at the end of the exchanges so that project summaries could be collaboratively composed. Messages that flowed from SMEs to Students (21.9%) and students to SMEs (17.5%) ranked third and fourth, respectively, in proportion to total messages exchanged. Taken together, these figures indicate that the adults in these teams sent more messages than the students did, and the SMEs alone originated slightly more than half (52.9%) of all of the messages exchanged overall. The teachers addressed approximately the same proportion of messages to the SMEs (23.8%) as the SMEs did to the teachers (24.4%) and to the students (21.9%). The SMEs sent the most messages altogether, and their communications were generally longer than those

sent by teachers and students. It appears that the SMEs, overall, were communicating the most in these exchanges.

Message lengths for all flow patterns ranged between 20 and 3,106 words, with an overall mean length of 532.16 words and a standard deviation of 585.05 words. Of all participants, SMEs sent the longest messages, especially when they were addressing students, and students sent the shortest messages, except when they were writing to SMEs along with their teachers.

Message function. After message flow type was assigned, we read each message to determine the speech acts, or functions, that it contained. *A single message typically contained more than one perceived function.* Rueda's (1992) 19 functions were tested in initial coding trials for comprehensiveness and mutual exclusivity. They were amended and appended to form 21 functions organized into Rueda's original three function classes ("Reporting Information," "Requesting Information," and "Other"). The resulting message function categories are shown below in Table 4, with corresponding examples taken from Emissary project data supplied for each coding category.

Table 4

Examples of Message Function Classifications

Reporting Information

Content Information

- "In principle radio waves could be diffracted just like light, and if put through a prism the different frequencies (colors) could be separated out..."

Procedural Information (content-related "how-to" information)

- "Trenchers [recipe]:
 1. Dissolve yeast in warm water.
 2. Combine ale, yeast, sugar, salt, and egg in a large bowl..."

General Information

- "We are also at the end of first quarter..."

Directions (non-content-related "how-to" information)

- "No, you may **not** call me Annie! Geesh! Unless you want me to call you Ricki, Mikey, and Nannie? :)"

Personal Information

- "I am in my office M-F 8-5 EST and am reachable there directly by phone or e-mail during those times."

Idea/Opinion/Emotion

- "Great flick, even if the 'irresponsible scientist wreaking havoc with nature regardless of consequences' attitude kinda puts my trews in a bunch...Oh well. Its fun."

Resource (book, video, or other resource information)

- "I would suggest Holt's 1988 edition of Physical Science, ISBN 0-03-014397-7."

Feedback (non-content-related suggestions, evaluations, etc.)

- "In regards to your question, we should send extra copies."

Requesting Information

Content

- "Can radio waves be diffracted (like light) or put through some kind of electronic "prism" to separate the waves (again, much like light)?"

Procedural Information (content-related "how-to" information)

- "How did they take out the protein that the dinosaurs needed to survive and put it in their food to control the dinosaurs?"

General Information

- "Let me know if [the messages] come through (that doesn't really make sense does it?).?"

Directions (non-content-related "how-to" information)

- "Can we call you Annie?"

Personal Information

- "What kind of sports do you play?"

Idea/Opinion/Emotion

- "Here are some ideas. What do you think?"
-

Resource (book, video, or other resource information)

- "Do you have any books that would help?"
-

Feedback (non-content-related suggestions, evaluations, etc.)

- "If the formatting of this text entry needs adjustment, please let me know."
-

Other Functions

Salutation (greetings and closings, not including signatures)

- "Hello Barb -"
 - "Welcome."
 - "Hey gang."
-

Planning (project planning)

- "For the first 5 days, I would like to continue exploring light and color, their properties and characteristics, special effects and interrelationships."
-

Thanking

- "Thanks for the great questions!"
-

Complaining

- "The students didn't like having their spelling and grammar corrected and are unhappy."
-

Apology

- "Please accept my apologies for the delay of this message."

An initial set of 17 messages was selected for independent analysis by both researchers, and the results of the analyses were compared. Two additional message sets containing 25 messages each were subsequently checked, and coding decisions discussed, to discover and increase interscorer agreement, and therefore assure the trustworthiness (Lincoln & Guba, 1985) of the study's results. The message function categories were also revised and agreed upon during this preliminary stage of analysis. Interscorer agreement on independently coded, randomly selected, common segments was first measured at 70%, but with continued peer consultation, rose to 83%. Then the entire message bank was analyzed using the message flow and function categories that had been agreed upon during the first three data reviews.

Results: Message Function Patterns

Function Classes and Types

As Table 5 shows, more than 90% of all messages sent among team members contained some information reporting. Approximately 50% of all messages requested information. Almost 80% of all messages also showed evidence of salutation, planning, complaining, apologizing, and/or thanking, the message functions that comprised the "Other" class.

Table 5

Message Frequency by Function General Class

Function Class	Frequency	
	Number of Occurrences	Percent of Messages Described by this Function Class
Reporting	291	91%

Requesting	158	49%
Other	254	79%

Note. The total number of messages sent among the members of the 10 teams examined was 320. Each message was coded as containing *one or more functions*.

Further breakdown of these totals and percentages by specific message function is displayed in Table 6.

Table 6

Frequencies of Message Functions by Class

Reporting Information

Function Category	Frequency	
	Number of Occurrences	Percent of Total
Personal Information	192	24%
Idea/Opinion/Emotion	180	23%
General Information	161	20%
Content	99	12%
Directions	98	12%
Procedure	26	03%
Resources	21	03%
Feedback	17	02%
794 total occurrences in 320 messages		

Requesting Information

Function Category	Frequency	
	Number of Occurrences	Percent of Total
Content	74	34%
Directions	48	22%
Personal Information	27	13%
General Information	22	10%
Feedback	20	09%

Procedural	15	07%
Resources	7	03%
Idea/Opinion/Emotion	3	01%

216 total occurrences in 320 messages

Other

Frequency

Function Category	Number of Occurrences	Percent of Total
Salutation	201	50%
Planning	89	22%
Thanking	75	18%
Apology	34	08%
Complain	7	02%

406 total occurrences in 320 messages

56% of all messages exchanged contained requests for content information and non-content-related directions. Similar to patterns reported by Ross, et al. (1990) and Murfin (1994), information of a personal nature was the most commonly reported type, followed closely by reporting of ideas/opinions/emotions, then general information. 67% of all messages exchanged included one of these types of reports. The relationships between these two patterns is interesting. It is apparent that much information was reported that was not specifically requested, especially ideas, opinions, and emotions, which were requested in only 1% of all messages exchanged, but were reported in 23% of the messages.

Although 34% of all messages exchanged contained requests for content, only 12% reported content. This is probably because subject matter experts often

replied to questions included in multiple communications from students and/or teachers with single messages containing many content-related responses. Very few messages contained complaints (2%), while many more messages contained expressions of gratitude (18%). It seems that the teams corresponded in friendly, respectful ways.

Functions According to Flow Types

Occurrences in each general function class ("Reporting," "Requesting," and "Other") were also calculated, according to specific message functions and flow patterns. The most predominant message flow patterns in the Reporting class were SME-to-teacher-and-students, teacher-to-SME, and SME-to-teacher. 90.9% of the exchanges that contained information reports were, therefore, sent by adults, predominantly SMEs. The messages most commonly containing requests for information followed teacher-and-students-to-SME, students-to-SME, and SME-to-teacher flow patterns, comprising almost half (49.4%) of all communications that included requests. As was suggested to participants when they volunteered to participate in the project, requests for information were made predominantly by students, or students in collaboration with their teachers.

When students and their teachers wrote to SMEs separately, they most often reported general and personal information in their messages, but when teachers wrote *with* students to SMEs, there was a much higher incidence of ideas, opinions, and emotions being reported (53%, compared to 16%) than when students wrote by themselves (16%). Overall, SMEs reported personal information, content, and ideas, opinions, and emotions the most frequently of all types of participants. This may indicate that the exchanges tended to center themselves primarily upon the SMEs.

As might be expected, most requests for content-related information came from students writing by themselves (75%) and from students writing with their teachers (94%). It is interesting, though, that 14% of all messages from *SMEs*, addressed to students and teachers together, contained requests for content-related information, too. Informal observation of the nature of these exchanges suggested

that as team participants began to become comfortable with each other during extended communication, SMEs and teachers began to negotiate and share their roles, to some extent. Some SMEs asked content-related questions as a teacher might.

Salutations were used frequently among all members of Emissary teams. As might be expected, planning functions were displayed most often by teachers communicating with SMEs (54%) and SMEs communicating with teachers (38%), as was suggested by the Emissary staff when the teams began to communicate. It is interesting to note that the most thanking functions were included in messages written to SMEs by teachers and students together (74%). This percentage is quite a bit higher than the incidence of students, writing by themselves, thanking SMEs (36%). Then again, it should be noted that students, writing by themselves, never complained to SMEs, but when students wrote with their teachers, 5% of their collaboratively-generated messages contained complaints.

Functions Over Time

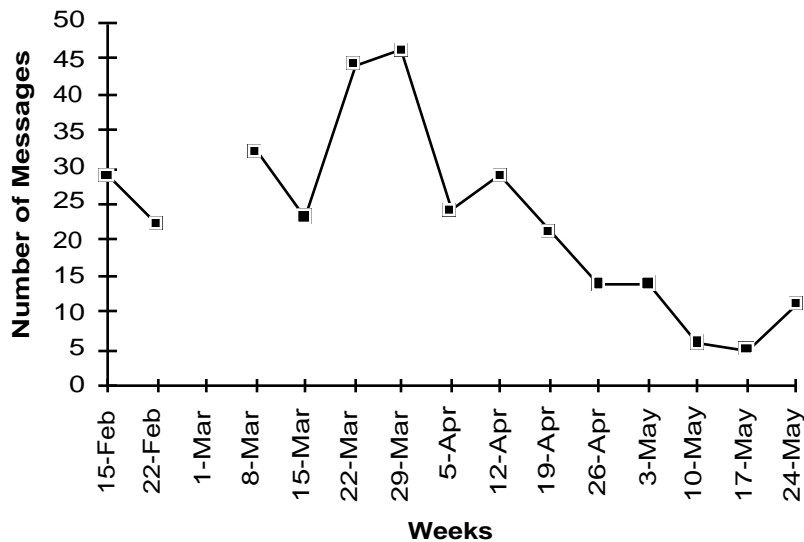
Overall pattern. Messages were exchanged among members of the ten teams during a 15-week period beginning on February 15, 1993 and continuing until May 24, 1993. The following graph (Figure 1) shows the number of messages exchanged for each week, which, for purposes of analysis, began on Monday and ended on Sunday. The week of March 1st, 1993 had no exchanges due to a server crash.

The graph shows an initial flurry of activity, building to a peak of interchange midsemester, then a gradual decline in number of messages exchanged, until the final week of the project, when project summaries were collaboratively written, and evaluation forms were completed by all adult participants and some students. This general pattern is similar in shape to the first half of the average yearly cycle of logons in global educational networking activities documented by Levin, Waugh, Chung, & Miyake (1992). The pattern presented by these authors was based upon frequencies of nine years of messages exchanged among adults and students involved in telecollaborative activity. The similarity may indicate that

logon and/or message frequency patterns may be shaped more by the temporal placement of a project within the school year than by individual project timelines and activity.

Figure 1

Overall Message Frequency by Week



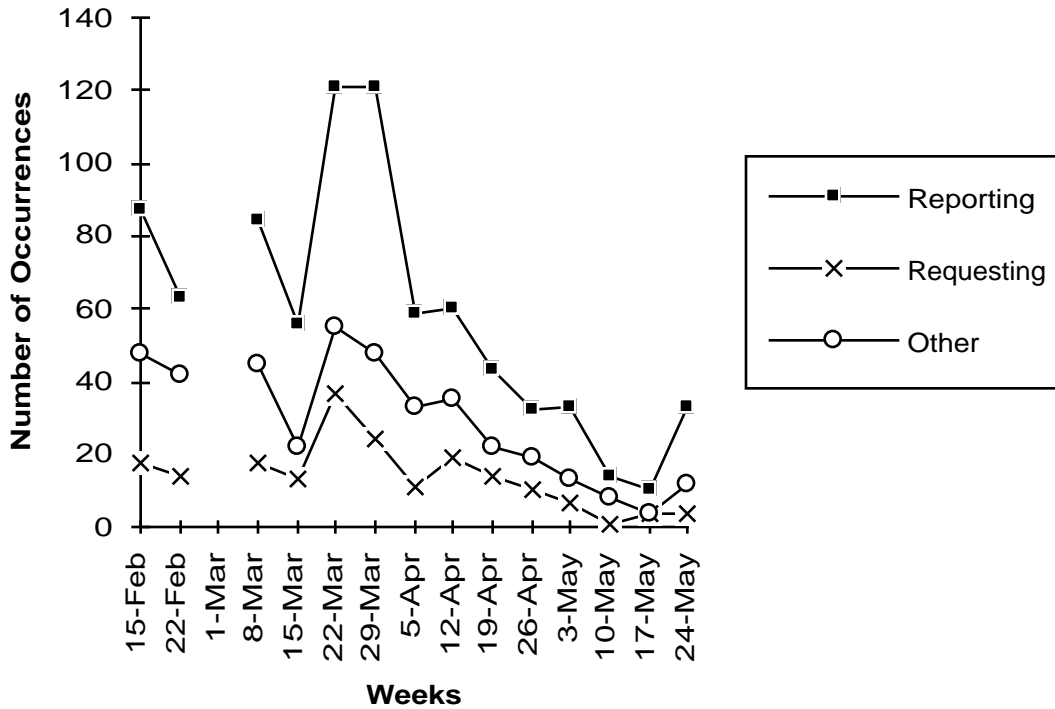
Patterns of message flow over time. When we examine the number of messages sent each week, separated by message flow type, we see several interesting patterns.

During the first four weeks of active exchange during the project, teachers and SMEs sent the most messages, and exchanged them with each other. This is understandable, since, as previously mentioned, SMEs and teachers collaboratively organized the project via e-mail toward the beginning of the semester. In the middle of the semester, students were much more active online than at the beginning or end of the period. During weeks six through nine, students and SMEs, "talking" with each other, were most active. During weeks ten and eleven, students were even more active than SMEs or their teachers in sending messages. Then, as

the project concluded, SMEs and teachers dominated the exchange, as project summaries and evaluations were prepared and sent.

Message flow over time by function. Figure 2 shows the inclusion of message function classes in participants' messages over time. Clearly, most of what was being exchanged included reports of information; this was the most frequently observed function class in every week of the semester. Requests for information were made the least frequently during all weeks of the exchange, but they peaked in frequency during the sixth and seventh weeks of the project, when students and SMEs were dominating the exchanges. The general patterns for overall activity (as shown in Figure 1), and activity that included text classified as belonging to each of the function classes (shown in Figure 2) were rather similar in slope, although quite different in frequency.

Figure 2

Frequencies of Message Function Classes Over Time

Content-related procedures and resources were most frequently reported, and the patterns over time for these two functions, plus the reporting of personal information, ideas, opinions, and emotions, and general information seemed to mirror the general activity over time pattern shown in Figure 1. Patterns for content, feedback, and directions functions did not follow this pattern.

Ideas, opinions, and emotions were most often requested, and were the only specific requesting function pattern that followed, to some extent, the overall activity pattern displayed in Figure 1. General information requests were much more frequent during the initial three weeks of the semester, as participants were getting to know each other. Patterns of other request types did not seem to follow any predictable paths.

Salutations and planning functions were often included in messages sent at the beginning of the semester, and, along with thanking functions, were the only

speech acts in the "Other" category that followed the overall activity pattern displayed in Figure 1.

Discussion

What do we know about communications among the members of these ten geographically and temporally dispersed, electronic teaching/learning teams? Overall, the adults in the teams "talked" more than the students did, even though the project was organized around the notion of the importance of students being active inquirers. Interaction was mutually courteous and friendly. The most common speech acts observed involved reporting of information, especially personal and general information, and ideas, opinions, and emotions. Given that the projects were planned around the exchange of content-related information, this is a most interesting result, especially because it was mirrored in Murfin's (1994) study of telementoring, and is somewhat similar to what Upitis (1990) found when examining communications of elementary-level students involved in curriculum-based online projects without the direct participation of adults. The students in Upitis' sample often "strayed" from the teacher-designed, curriculum-centered purposes for online interaction to what they considered to be more authentic topics for exchange, involving mostly requests for and provision of personal information. Requests for information in this Electronic Emissary-mediated project were primarily content-related in terms of overall occurrence, but requests for ideas, opinions, and emotions were highest in terms of frequency from week to week, especially midproject. In general, patterns of requests for and reports of information were quite different from each other.

When students wrote to SMEs without the participation of their teachers, they used message functions differently than they did when they generated messages collaboratively with their instructors, and their activity was most frequent at midsemester. One wonders what might be observed, for example, if the project lasted longer than 15 weeks; might student activity, rather than adult exchanges, have dominated the project-long patterns? Also, what if students were

asked to plan and close the project, working primarily independently of their teachers? With greatly increased rates of home access to the Internet being supported by the emergence and growth of many commercial Internet service providers, we may have the opportunity to examine the answers to these questions in the near future.

How should these investigations proceed? Huff and Rosenberg (1989) advocate the automatic generation of electronic communications for use in studies such as this one, citing metanalytic findings in communications research, including their own, that indicate that self-reports of interaction are only about 50% accurate. They assert that any ethical problems caused by "online voyeurism" can be proactively prevented by obtaining participants' full and prior consent to have their electronic interactions monitored, as was arranged with this study. As these authors suggest, would that the process be so easy with collecting offline communications data!

It is this wish that leads to an issue which gives us pause when considering the results of this study. Electronically exchanged communication may be easy to collect, but is examination of its texts, even when studying exchange that occurs solely online, sufficient? Riel and Harasim (1994) suggest not.

In cross-classroom collaboration it is essential to study the online activity *and* the effects of the exchange on the social and instructional climate of the classroom. The work that gets done between the network exchanges motivated by the content of messages must be integrated as part of the object of study. Online messages are only a partial indicator of what takes place in a successful exchange in this educational approach. (emphasis added, p.109)

We would humbly agree. The results summarized in this piece can help us *begin* to understand the rich and complex dynamics that combine to create place- and time-independent opportunities for new instructional alliances with subject matter experts for K-12 teachers and students. We will be much better prepared to describe learning and teaching contexts in which powerful use is made of educational telecomputing tools when we can fit a detailed and clearly-conceived

view of online exchange *into* a similarly configured description of face-to-face interaction in the telecommunications-enhanced classroom.

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