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AUTHOR West, Mary Maxwell; McSwiney, Eileen
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ABSTRACT

Asynchronous computer-based conferencing offers several unique capabilities as a medium. Participants can read and write messages at whatever time is convenient for them, groups can interact even though participants are geographically separated, and messages are available to readers almost instantly. Because the medium has served for over a decade in mainframe computing to support a sense of professional community among geographically dispersed groups in business and academia, researchers at the Educational Technology Center (ETC) examined whether computer conferencing could help solve a well-documented problem among secondary science teachers, namely, their isolation both from ongoing developments in science and science teaching and from colleagues with whom they might exchange ideas about the teaching of science. This document discusses the results of the first year of operation of the Science Teacher's Network; expectations, actual usage, network topics, factors which promote discussion and implications for network design and management. (CW)

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COMPUTER NETWORKING FOR COLLEGIAL EXCHANGE AMONG TEACHERS: A SUMMARY OF FINDINGS AND RECOMMENDATIONS

Technical Report

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Educational Technology Center
Harvard Graduate School of Education
337 Gutman Library Appian Way Cambridge MA 02138
(617) 495-9373

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Prepared by

Mary Maxwell West
and
Eileen McSwiney

Group Members

Chris Hancock
Moira Inghilleri
Eileen McSwiney
Dennis Sayers
Kathryn Stroud
Judah L. Schwartz
Thomas Vaughn
Mary Maxwell West

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Asynchronous computer-based conferencing offers several unique capabilities as a medium. Participants can read and write messages at whatever time is convenient for them, groups can interact even though participants are geographically separated, and messages are available to readers almost instantly. Because the medium had served for over a decade in mainframe computing to support a sense of professional community among geographically dispersed groups in business and academia, researchers at the Educational Technology Center (ETC) examined whether computer conferencing could help solve a well-documented problem among secondary science teachers, namely, their isolation both from ongoing developments in science and science teaching and from colleagues with whom they might exchange ideas about the teaching of science. These exchanges, if they deepened, might indicate that computer-based conferencing could be a vehicle for staff development, to revitalize as well as inform teachers' practice through engagement with others on important topics.

The Science Teachers' Network was established in December 1985 to learn how teachers would use a conferencing system that was designed and managed to facilitate discussion. ETC designed new conferencing software that would be easy to use for both personal and group messages and could run on a microcomputer (so that any educational group in the future could run a conference without an expensive computer). Seventy-five science teachers from eastern Massachusetts volunteered to enroll in the network with a number of guests and facilitators. The network was advised by five science department heads and managed by an experienced staff developer, a graduate student in educational technology, and four teacher moderators. The first year's research, described further below, found that the system was easy to use, that teachers valued the network, and that several factors influenced teachers' use (see also Katz, McSwiney & Stroud, 1987). In order to explore whether increased experience in network use might change the nature of use, the Science Teachers' Network was extended for a second year. In addition, in

order to explore whether a network could facilitate communication among teachers engaged in a common task, a second network was established to serve the participants in the ETC Laboratory Site Project, who were using ETC-developed teaching materials in five local schools beginning in September 1986. This group included 38 teachers, teacher/advisors, school support liaisons, and researchers. Because they attended monthly meetings, these network participants had more face-to-face contact than the Science Teachers' Network members had, and they also received hands-on training in the system in a preliminary meeting and school visits.

The nature and extent of members' interactions were assessed at three levels — for the conference as a whole, for each teacher, and for messages and message chains. The host computer was programmed to keep a log of all reading and writing actions. Therefore it was possible to know what messages teachers read, as well as what they wrote. In order not to violate the privacy of private mail, the machine did not record the content of these messages, only who wrote to whom, and when.

The implemention and research both tracked logistical and social factors expected to influence participation. Members' previous computer experience, location of their computer, phone costs, and other factors possibly affecting the ease of use of the technology was examined. Network management efforts included facilitation and monitoring of social aspects of network use (cf.Feenberg, 1985). For example, network moderators welcomed newcomers with personal messages, introduced them to others, reiterated network inquiries that went unanswered, and held two in-person get-togethers. Teachers were also interviewed about their perceptions of their professional work and professional social lives. For example, they were asked what they considered the main difficulties they faced in science teaching (only 10 percent mentioned "isolation") and how often they met with other science teachers both inside and outside of school. A questionnaire assessed the extent of their previous acquaintanceship with every other member, as well as their perception of members and guests as "experts."

Results

Similar Expectations, Variable Use

When asked how the network had served or not served their interest, teachers most frequently mentioned "keeping in touch" with colleagues and obtaining specific information. Each of these themes was mentioned by about half of network participants.

While 90 percent of the members reported that the network was a very valuable resource, actual use varied widely. About 60 percent continued use, and of these, a quarter were very active users (logging in two or more times per week). Half of continuing users logged in an average of once or more a week. Similarly, a quarter of continuing users were active writers, sending one or more messages a week. Teachers read at least ten times as many messages as they wrote. Some teachers were mainly "readers," continuing to read forums but sending few messages.

Network Topics

The research demonstrated the potential of the network to provide exchanges on topics of interest among mainly unacquainted persons: 40 percent of messages were addressed to group discussion topics; of these, half were responses to inquiries or comments on earlier points. Furthermore, common interests clearly brought unacquainted persons into interaction: the majority of teachers wrote to as many previously unknown persons as known persons, clearly following topical interests, not just acquaintanceship.

Two unexpected characteristics of the network messages emerged — their specificity, and their ambiguity. Both have management implications discussed further below. Most exchanges concerned very specific points with discussion of more general topics emerging less often. This continued over the two years of the Science Teachers' Network and thus was not merely a characteristic of new users. Furthermore, the concepts of network use that teachers offered spontaneously in interviews confirmed their interest in quite specific information.

Some examples are shown below.

Sample Messages
Science Teachers' Network

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msg no. 1604 filed 11:40 AM Feb 10, 1986
from rose
to nb
re: Photography Course
At Taunton High we are planning to offer a photography course through the science department to average and below average juniors and seniors. Can anyone recommend a suitable book for student use in such a program? Thanks in advance for your suggestions!

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msg no. 1284 filed 4:49 PM Jan 14, 1986
from charlie
to chemis
re: TESTING EFFICIENCY OF CHEM FUME HOOD
Today I was psyched up to test my hood with some "smoke balls"--made in Taiwan (35 cents), however this was vetoed by higher authorities. Is there any suggestion for other methods of testing out fume hood?
/CHARLIE

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msg no. 1525 filed 2:19 PM Feb 6, 1986
from helen
to bruce physics chemis
re: IR radiation
A further comment - about why objects at room temperature do not emit visible light: At room temperature the energy of motion of a typical atom or molecule will be of the order of magnitude kT. This applies to any kind of motion; vibrational, translational, rotational, etc - as we learned in thermodynamics, there is 1/2 kT for every degree of freedom. The value of kT at room temperature (300 K) is about 4 x 10^-23 J. A transition of this energy will produce a photon whose wavelength is about 5 x 10^-5 m (using lambda = h c / E), a typical wavelength for infrared radiation. Visible photons have wavelengths about 100 times greater (yellow light = 500nm), or energies 100 times greater. There is no visible light in the spectrum of heat radiation form abjects at room temperature because there is no sizable population of states at the right (i.e. high enough) energies.=

The network was a successful vehicle for exchange of information on specific topics such as these. For example, the last message was a reply to the question:

> How is it that thermal energy is converted to infrared radiation? What I need is a good atomic level explanation! How about it? Any ideas?

In a week this inquiry received five replies from four other teachers.

The group also noted, as did Black et al. in 1983, that discussions developed around ambiguities in message content. Perhaps because there is no quick way to clarify r. anings in this medium, as there is in live conversation, the ambiguities that naturally occurred in the written messages were the basis for participants to chime in with various interpretations. For example, this message

> I am having increasing difficulty getting large enough static charges by rubbing a plastic rod with silk. Any suggestions?

received seven replies, which developed two aspects of the message (1) *why* the static didn't develop; and (2) what other ways teachers can demonstrate static.

What Factors Promote Discussion?

Teachers' concepts of the network, as well as their actual messages, suggest they wanted to share "information" and "ideas." Most exchanges among unacquainted teachers were short ones on specific topics. There were also some more extended exchanges in which opinions were expressed, and there were a few heated arguments about pedagogy. Whether these affected participants deeply enough to change their opinions or to constitute significant professional revitalization is hard to say. There is no direct evidence of this in the discussions, nor did teachers mention such deep changes in interviews. Most messages were inquiries and replies on rather specific points.

Discussions among teachers who were better acquainted, however, suggest by comparison with the others that an information-sharing orientation may be a safe interaction strategy for unacquainted professionals which would change in different social circumstances. A group of teachers who had trained together at the Harvard Graduate School of Education the year before requested

membership in order to keep in touch. Their strong social motivation was evident in their messages, which contained greetings, reports of contact with other group members, and offers of help and sympathy. These teachers offered topics of a personal nature, reflected in the topic lines they composed: "emotions," "feedback," "reflections." Message sequences followed a single evolving topic rather than several unrelated topics. A new independent network started this year at Harvard for teachers in that program and it has been heavily used — 1500 calls in two months. These teachers share their experiences in graduate school together and their transition to new jobs around the country — more powerful common experiences than the other members of the Science Teachers' Network.

It is interesting, however, that the greater acquaintanceship and involvement in a common task of the Laboratory Sites participants did *not* result in more public discussion than occurred on the Science Teachers' Network. On the contrary, only 15 percent of Lab Site messages were public, compared with about 40 percent in both years among the science teachers. The average number of messages written per member was about equal in the two networks, as was the total number of messages, but use differed. This is explained in two ways. Lab Site teachers were less dependent on the network for general discussion because they shared experiences at their monthly group meetings. Some said they found it "hard to banter" on the network. The Lab Site teachers wrote inquiries and comments privately to their resource leader rather than to peers because their leader was previously experienced with the new materials and peer use varied because of schedule logistics. As in the Science Teachers' Network, information was needed, but called for private communication in this case.

Implications for Network Design and Management

Adding these observations to those of other network researchers suggests that anyone wishing to establish a collegial exchange network should consider the motivation for participation, deriving from both the social conditions and task conditions present in a network group. Social needs and task needs both

motivate use. The research suggests that network communications might follow the same model that one would expect to predict level of communication in face-to-face activities, as shown in Table 1. Both social and task dimensions are to be considered roughly continuous variables in this model. Either social motivation or task demands seem to elicit communications; where both are low or unstructured, the lowest amount of communication is predicted, measured either as percent of the group who participate, or level of participation by individuals.

Task Basis for Communication	*Social Basis for Communication*		
		Unacquainted	Acquainted
	Common Task	High	High
	No Task *(common interest only)*	Low	High

TABLE 1. Level of Network Participation Expected Under Different Task and Social Conditions.

The ETC and other collegial exchange networks have found wide variation among members in frequency of network use. Managers of collegial exchange networks based on common interests but no common tasks should not expect all members to participate. Perhaps 100 percent participation should be expected only if the group has strong social needs or pursues a joint task requiring their collaboration and which cannot be accomplished without the network communications. Although electronic communication is convenient, this convenience alone is not enough to promote interaction throughout the

group. There is enthusiastic use by a portion of the group, and this may be enough to serve the goals of some kinds of networks.

Among unacquainted teachers the topic of talk seems to be a very significant influence on participation, gaining salience and leverage in the interaction process. This, in itself, is not surprising, given that participants have no established social basis for communication. There are, however, two particular features of how topics appear that have implications for choosing network applications and for managing them: (1) the reliance on *specific* topics among unacquainted members; and (2) the impact of message ambiguity on topic development. Unacquainted people interacting through writing on a computer network may resort to specific topics in order to compensate for the lack of ability to rapidly clarify meanings as they do in face-to-face exchanges. Since rapid clarification of meanings is impossible, ambiguities remain in a message, and, as Black et al., (1983) notes, a topic can be developed along multiple threads. Each of these features has practical consequences for collegial exchange.

Membership Policy

If unacquainted members need to communicate about specific information, network design must build in the critical mass of expertise and interest needed for interactions to be sustained. The more specific and varied members' interests, the larger the membership should be. For a collegial exchange network of mostly unacquainted members to succeed, where members have common interests but no common task to structure interactions, managers should estimate whether there is enough interest on core issues and whether these issues can be discussed effectively in written exchange and with variable response time. A large membership is recommended to meet the specific, possibly diverse, interests of members. For ETC's Science Teachers' Network, more than 75 members might have been beneficial; given the rate of use, perhaps 200 enrollees (or 100 active users) would have been ideal. Guest experts provide additional knowledge resources but must be chosen to match members' interests. The large membership

approach maximizes the information sharing potential within the group, which may be a prerequisite for discussion to emerge among unacquainted persons.

Choosing Tasks: Capitalizing on Ambiguity

For task-oriented networks such as the Lab Site Network, planners should consider the fundamental communication needs of the task and whether they are compatible with features of the medium — whether members *need* to talk with each other, whether variable and uncertain response time will benefit or hinder the task, whether the tasks can be carried out effectively through written exchanges without the opportunity for rapid clarification of meanings, and whether the task can benefit from diverse interpretations and wide group access as the medium allows. ETC and other research on topic development suggests that tasks needing diverse interpretations, through expansive and perhaps even playful interactions, might thrive in this medium (see also, Black et al., 1983; Levin, Kim, & Reil, 1988; Waugh et al., 1988). Sociological research comparing group problem solving tasks in face-to-face groups with that by computer conferencing found wider group participation in the computer conferences (Kerr & Hiltz, 1982).

The constructive use of ambiguity in message content, an ambiguity sustained by the medium's asynchronicity, may facilitate the expression and integration of different points of view into a discussion. Face-to-face interactions may allow ambiguities to be quickly resolved, but the lack of opportunity to do so in asynchronous electronic interactions is not necessarily a weakness of the medium. Human beings are expert at negotiating ambiguity constructively. Our ways of negotiating social interactions in daily life (see, for example, Goffman, 1974), as well as our enjoyment of literature, drama and poetry, are built upon our ability to interpret and delight in verbal ambiguity. How written electronic interactions can best build upon this quality needs to be explored by examining the development and success of different kinds of network tasks and topics. Analyses of this kind are being made by Levin and Miyake (see Waugh et al., 1988).

Serving Teachers' Needs: System Design

Teachers' interactions on the two networks suggest that they seek a host of practical and specific information that they can apply immediately to their teaching work. The ideal system would be low cost and easy to use as an information system and social system. The ideal information system would probably include well-indexed information databases as well as lists of teachers and scientists who agree to act as resources on various topics. In so far as specific topics are important, sensible indexing is critical. At the same time, although topical interest may be the essential common ground that allows interactions to begin among unacquainted professionals, many teachers also valued social aspects of their interactions. The system must also make conversation easy. The existing systems (for example, EIES and Cosy for mainframes, Bank Street College minicomputer system and *Common Ground* microcomputer system, *Compuserve* and *The Source* subscription services) all offer some strengths and some weaknesses in their facilities. The systems alone, however, provide only the medium for *activities*, which themselves must be thoughtfully designed to meet teachers' interests and to support the demands of their work.

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