

Environmental Barriers to Networking

William Spitzer
TERC, Inc.

The two preceding articles highlight some of the potential benefits that telecommunication can provide to teachers and students. Here, I examine what it takes to create and sustain a learning environment that includes telecommunication, and what barriers exist for both new and experienced users.

Factors that affect new users include technical literacy, the time it takes to learn a new technology, the variety of telecommunication software and hardware, ease of use of networks, network access, and perceptions of whether telecommunication is worthwhile. For experienced users, there are additional factors that affect whether and how they continue to use telecommunication. These factors include funding and politics, interpersonal relationships, perceived impact of network use, psychological and social barriers, time constraints, and the institutionalization of telecommunication.

The teacher essays address a number of these issues, and hint at some of the factors that lead to successful and purposeful uses. Further, the essays highlight themes that are important for the LabNet community as a whole.

Barriers for New Users

As described in the lead article, new users of telecommunication face many challenges, as portrayed in the fictional case of Erica. The following factors are critical in whether and how teachers appropriate telecommunication as part of their professional practice.

Technical literacy. Despite widespread use of computers and telecommunication in business and academe, many secondary teachers have little experience with computers—and even less with telecommunication. Norm Anderson believes that many teachers are reluctant to start using telecommunication because they lack training and experience in computer use:

I have not been able to get other teachers in my school system actively engaged in telecommunication. I believe the biggest problem is *not* knowing how to use the network.

Gerianne Walker writes: [Using] a telecommunication network would be much easier if computer-modem communications were more familiar to students and teachers... and the equipment were abundant and readily available." Sandra Rhoades comments that "the vast majority of the population—including teachers—is only semi-computer literate." Similarly, Tom Thompson observes: "Although many teachers in our area are computer literate, most have no experience with telecommunication."

Time to learn. Time is scarce for learning new technologies. Even a teacher who has used computer applications, such as word processors or MBL systems, might easily require 3 to 5 hours to get used to the features of a new telecommunication system. This could cost as much as \$60 in on-line charges.

The fact that there is a "meter running" is sometimes inhibiting to teachers who need to get on and explore the new system—doubly so if it includes large reservoirs of on-line text (e.g., database entries, forum discussions). A crucial skill to learn is efficient use of the software, but shortcuts are hard to understand until one understands how the system works. Thus, workshops on "shortcut tips" are of limited use for the new user. The sense of economic restriction is heightened by the fact that telecommunication does not yet fall into the usual categories of expenditures for school systems.

The time needed to learn a system is greatly extended by sporadic use. A teacher who gets on-line once a month very likely will have forgotten many of the facts gleaned in the last on-line session, which are a necessary part of the "at-your-fingertips" feeling that helps a user get around quickly and efficiently. Thus, each infrequent session is likely to feel like a cold start, until the teacher realizes that more frequent use is an important element of efficiency and of profitable network interaction.

Variety of hardware and software. Another impediment to the use of telecommunication is the variety of equipment and software that is available. Among the machines currently used by teachers are the Apple II series, IBM and IBM-compatibles, Commodore and Amiga systems, Macintoshes of all types, as well as

older machines. Recall Sandra's experience with teachers in Georgia: "Versatility requires that the network be compatible with a wide range of computers." This variety creates serious compatibility problems, which are exacerbated by the many proprietary software packages on the market. Some networks are designed to work only with one type of computer; while this may allow the development of an easy to use software interface, it excludes many potential users. As Tom said:

PSINet uses specific software to deal with [the ease of use] problem. The only drawback was that the software is only available for MS-DOS computers for the moment.

Even where compatibility problems can be solved, they add significantly to startup time. This experience was important for a number of teachers involved in LabNet. For example, one struggling LabNet teacher remarked:

I have a Zil modem and a Mac at home that I'm comfortable with, but I've got a different system, an Apple IIe and Prometheus modem at school, and I haven't found a way to upload files yet . . . so it's a matter of getting to the manual and finding the right sequence. (a 1990 interview with a LabNet teacher)

Ease of use. Software designers are too rarely sensitive to the time demands on teacher-users and the profound effect of learning time on the acceptance of a given system. For example, one study of e-mail systems found that different interfaces required as few as 2 or as many as 12 hours of training before users achieved proficiency. Ease of learning was directly related to the acceptance and use by teachers in schools across the different systems. As Sandra commented, "the friendlier the system, of course, the more likely people are to use it and to experiment with the many options available on a complete system."

Access. Those who could most benefit from telecommunication often have the least resources and access. Local telephone access is often critical to keeping costs down, but rural users often need to dial long-distance to reach network services. Sandra observed:

Start-up and maintenance fees should be as low as possible. Rural teachers have extremely small budgets. . . . Many elementary teachers in Georgia have an annual science budget below \$100. Yet, these are the very teachers who most need

the networking capabilities of a telecommunication system.

[PSINet] has few local telephone numbers, and these are only in urban areas. . . . Communication . . . by intrastate long distance can be expensive.

Is it going to be worth it? As Norm points out, new teachers "are not going to spend money from their budget simply to be on a network they really don't know how to use." Furthermore, many teachers are afraid of uncontrolled telecommunication costs. Tom: "They still remember hearing the horror stories of someone racking up hundreds of dollars of network charges while chatting." However, Jack Cadigan believes that costs will decrease: "[W]ith the mercurial growth and improvements taking place . . . and the competitive access-time charges being constantly lower, this negative aspect is becoming of less import."

When she wanted to start using the LabNetwork, Geriann needed to "[launch] a political campaign to convince my principal, superintendent, and school board that LabNet was a program worth investing in." She used the isolation of her rural school as an argument to become connected to a larger community:

There was something appealing in the idea that our school would be part of a national program that would put us in touch with other schools, other scientists, other teachers—with a community of interested parties that did not exist in Elmira.

However, when Geriann tried to introduce several colleagues to using LabNet, she found that, despite their initial enthusiasm:

I'm not certain that they were convinced that students would benefit from this type of classroom experience. In addition, they viewed the process of engaging in a project with students and using the network as a big deal, something they had never done before, and I believe that they may have been intimidated by this or uncomfortable with the process of navigating through uncharted waters.

Issues for Experienced Users

Is it worth it to stay involved? Now that I'm using it, what next? Once teachers have overcome the initial hurdles, several factors seem to be important in

sustaining network use and embedding it within a teacher's professional life.

Funding and politics. Sustaining involvement may require continuing efforts to convince members of the school community (e.g., administrators, school board members, parents) that telecommunication is worth continuing support. For example, Geriann "demonstrated the ways that I have used LabNet in my classroom, explained that LabNet has provided financial support for our school's program . . . and my students have made presentations on their use of the network for their projects." She says that administrators now "see something inherently important in linking our rural school with a community devoted to improving science education."

Interpersonal relationships. Norm writes that the main reason he has continued his LabNet involvement "is the fact that I have personal contact with the leadership involved in the network, along with the participants, many of whom I know on a personal basis."

Geriann writes that personal relationships with others on LabNet has "kept me on line, motivated me to respond to messages, and encouraged me to feel free to post comments of my own. . . . [U]sing the network means continuing to work with people whom we trust, people with whom one easily can take risks. The familiarity that we share has allowed us to expose our areas of expertise, as well as our weaknesses."

Geriann believes that lack of such personal relationships may have hindered the sustained involvement of several of her colleagues whom she tried to involve in LabNet:

My colleagues did not have the experience of working with the LabNet community during workshops and training sessions. . . . [T]here were no familiar names and no faces to associate with any of the messages that they received.

Impact. For Geriann, her experiences with LabNet have been an important influence on her career, and "have not only impacted my students, my colleagues, and my administrators, but the entire school community." Further, "student experiences with PESL and LabNet have fostered a genuine school-wide interest in the science program."

Tom writes that telecommunication "is like being in a room full of very talented teachers who are sharing all these wonderful ideas." He cites specific benefits of the network as an efficient resource:

Recently, I received 47 papers from 12 different states on PSINet. (Two papers were information

. . . I needed to complete my science budget for the next year.) I got all of this . . . at a cost of about \$1.80. That's quite a return on the investment.

A parent once asked me for ideas to include as competitions in the local science fair. . . . With a brief message on LabNet, I was able to provide this parent with a list of some very good ideas. I estimate this saved me about 2 hours of time searching through back issues of magazines and my files.

The *sine qua non* of the LabNet experience for most teachers was that they were talking to their peers: other practitioners of the craft of physics teaching. This kind of interchange provides "resources" in the usual sense—ideas for activities, answers to science questions, and so on—but also the resource of perspective that comes from shoptalk.

Psychological and social barriers. In Geriann's view, "psychological barriers to network use are at least as significant as any barriers due to technology, resources, or training." For example, students' disappointment when their messages go unanswered has sometimes made her hesitate to encourage student use. She also sees telecommunication as "a conspicuous event"—an activity that is not smoothly integrated into the classroom routine:

[S]tudents do not naturally or spontaneously use the network. Students write messages most often because I have assigned that task as part of their project work.

Time constraints. When introducing innovations in the classroom, teachers face the difficulty of incorporating the technology into the already packed daily routine. This issue was raised by a number of LabNet teachers who responded to a spring 1991 teacher questionnaire (Gal, Lockett, & Parrott, 1991):

One of my biggest problems was time. Six classes in a seven-period day. Training a new physics teacher . . .

LabNet is a great idea. The biggest problem is: We get too busy to plan and implement new ideas. I get swamped and fall back on the "old ways."

How much new do I want to bring in, and what am I going to have to get rid of to make room?

When respondents to this questionnaire who had not used the LabNetwork were asked why, the most common reason was time. It takes time to understand how the material from a network (information, discussion, and other resources) can fit into the rhythm of class preparation and conduct. Should the students be active on the network? Should I use the network as part of class time? If not, when and how will I get access? How will it cut into my use of other resources—and will that be a net loss or gain for me in my work?

Time remains an issue even for active users. Geriann notes that it takes her a week or two to reply to messages on the network. It is particularly acute for rural teachers in small schools, as Tom reminds us:

In a small high school, teachers frequently are strapped for time. Preparation for numerous lab classes and extra duties mean that anything new that consumes time must be really useful.

Institutionalizing telecommunication. LabNet teachers are often the pioneers of telecommunication in their area. But to really “push back the frontiers,” telecommunication must be supported by the educational infrastructure of schools, school districts, and states. Tom describes how telecommunication experience in his school has led to countywide and statewide support for networking:

I now have a computer in my room to use whenever I need. Each classroom now has a phone line. . . . The library now uses a modem to link students to . . . a regional network of libraries. . . . A new phone system was even installed to help in the expansion of telecommunication.

The Yamhill County Education Service District now includes . . . telecommunication services as a major focus in their technology plan. . . . Statewide, telecommunication is expanding partly because our state science coordinator has seen [its] benefits for the schools in our region.

States and school districts increasingly are investing resources in local, state, and regional networks. Although Norm laments that “I only know a few teachers in Iowa who are active participants on a telecommunication network,” he ends his essay by reporting that Iowa is about to set up a statewide network. In some cases, however, these systems are designed primarily for administrators and are less oriented toward supporting teachers. Sandra describes how PSINet in Georgia was useful for science supervisors but less

helpful for teachers who often had difficulty in using it and found little of use to them:

It can be accessed only with IBM equipment, whereas most teachers . . . had Apples. . . . The system has a bulletin board, but quite often there is little of value. . . . It was simply not worth the time, effort, and expense to these teachers to pursue telecommunication.

This can create a dilemma for teachers: They have access to the local network, but administrators may be less willing to give them access to another network that better meets their needs but at additional costs. And states that have taken the initiative in setting up statewide networks have so far been focusing on getting teachers “connected.” They are now facing questions about what to do next.

Future Research on Network Barriers

The teacher essays, as well as data from the larger LabNet community, reveal that the context in which teachers work sets important constraints on their initial and continuing use of telecommunication. As the technology advances, costs decline, and telecommunication use becomes more commonplace, a number of key issues will remain for teachers: Can I get access to something useful to me? Can I convince others of its worth? Can I find the time to use it?

In addition, there are several areas that are worth further study. The preceding sections on telecommunication use by teachers and students emphasize the network use has “indirect” effects on teaching practice and student learning. Are these benefits convincing to teachers? And are they convincing to administrators?

Furthermore, telecommunication use by teachers so far has largely been “grass roots”—individual teachers becoming users—and this may be a factor in supporting the use of networks for educational innovation and experimentation. Will this change with the creation of state networks, which could be used in more of a “top-down” fashion by the educational administration?

References

- Gal, S., Lockett, G., & Parrott, M. E. (1991). *LabNet teacher questionnaire report*. Cambridge, MA: TERC.