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Students and Learning

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As my colleagues and I said in our overview of the LabNetwork above, "Telecommunication for teacher enhancement, such as that explored in the LabNet project, is unique among so-called 'new educational technologies,' in that it affects what happens in the classroom indirectly. . . . This particular kind of telecommunication is for the teachers first and foremost."

We designed LabNet to serve teachers. Nevertheless, a handful of teachers wanted their students to have access to the LabNetwork. And not surprisingly, rural teachers were well represented. Telecommunication among high school students is still quite rare. Ironically, much more has been done with younger students. The Star School project Tom Thompson describes in his essay was for upper elementary students.

An even more stunning case-in-point is the National Geographic Society (NGS) Kids Network. In 1988, NSF funded TERC to develop a network-based science program for grades 4–6. NGS joined the enterprise as TERC's publishing partner. The first units were distributed in the fall of 1988. By the end of the 1991-1992 school year, roughly 190,000 students in almost 8,000 elementary schools in all 50 states had collected and shared data via a network with 12 to 15 other schools grouped in small research clusters around the country. They worked on units like: *Acid Rain, Weather in Action, What's in Our Water?, What are We Eating?*, and *Too Much Trash*? And this was a supplemental curriculum, not mandated or even listed by state departments of education. Furthermore, beyond the rapid spread in the United States, 27 other countries have participated in one or more of the units.

The dramatic success of this project demonstrates the enormous potential benefits of a carefully targeted investment in early science education. And it foreshadows one of the most important ways in which NSF can contribute to the improvement of precollege science teaching: funding the development of a national telecommunication network to serve teachers and students in grades K–12.

An inspection of the case data presented in the five essays, particularly Geriann Walker's and Tom Thompson's, suggests two robust themes worthy of exploration: the impact of the telecommunication experience on students' skills, and its impact on student's attitudes.

Telecommunication and Student Skills

There appear to be three skill areas, as reported in the case essays, that are affected by the telecommunication experience: thinking, reading, and writing skills; group skills; and basic computer skills.

Thinking, Reading, and Writing Skills

Facility and fluency with words is the hallmark of an educated person and correlate highly with life success. In a recent essay, *Cyberspace Innkeeping: Building Online Community*, John Coate (1992) says:

> When you log into an online service, you use new tools for an ancient activity. Even with all the screens and wires and chips and lines it still comes down to people talking to each other. The immense potential of this partnership of computer technology and human language is in this blending of the old and the new.
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> Language is so ancient a currency of communication that people of the Northern Hemisphere, from Europe to India, know of their common tribal roots mostly just by the remnant commonalities of the languages. Through all these thousands of years (sign language excepted), language has been either spoken or written. But online conversation is a new hybrid that is both talking and writing, yet isn't completely either one. It's talking by writing. It's writing because you type it on a keyboard and people read it. But because of the ephemeral nature of luminescent letters on a screen, and because it has such a quick - sometimes instant - turnaround, it's more like talking. And this is where the online scene is such an adventure. The act of conversing over computers is such a new twist that the lasting term for what it is has not yet been coined. (p. 1)

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Telecommunication, then, has certain characteristics that make it the communications medium of choice for supporting the high school science teaching community, including students engaged in inter-school projects:

Telecommunication is fast. But unlike the telephone, and more like the mail, telecommunciation permits a delayed response. This is obviously of great importance when demanding schedules are at issue.

Telecommunication is inclusive. Whereas the mail function tends to be person-to-person, an electronic forum can include many voices and a wide range of points of view.

Telecommuniation is self-recording and reusable. Unlike a phone call, fax, or piece of mail, an electronic message can be easily saved, edited, and reused as needed. A project suggested today can be begun as collaborative research tomorrow.

Telecommunication is ubiquitous. Wherever there is a computer hooked to a modem, immediate contact can take place: the school office, the classroom, one's home.

Telecommunication is neutral. The medium is not the message: In the telecommunication "piazza," discussion can be about anything. The content comes from *users.*

Telecommunication is self-regulating. Leaving aside bad taste and criminal activities, telecommunication is self-regulating. Poor questions or trivial answers on a forum will be ignored (or chastised in the privacy of personal e-mail).

Telecommunication is egalitarian. Users react more to the content of a message than the status or location of the sender.

And we have teacher data from rural settings that support this view of the medium as an enhancer of thinking, reading, and writing. Tom says, "I have found that, when using a network, students become more precise in the questions they ask." This is echoed by both Geriann—"student messages are more apt to yield a response if they include specific questions"—and Jack Cadigan—"E-mail lends itself readily to the composition of thoughtful responses, rather than single, quick responses. As a result, its very nature fosters expression and thoughtful reflection rather than rote learning." Tom gives us a practical example:

> Many families around Dayton rely on the timber industry for their livelihood. A simple survey broadcast on PSINet showed many people had no knowledge of the issue. Students at Dayton were really surprised that what was so important to them was of little importance to others. All of that for a few dollars in long-distance phone calls.... Telecommunication was the only source for this information.

The impact on thinking, reading, and writing skills is detailed further by Geriann: "Students seem to care more about the way that they report their projects when using LabNet. They edit their messages carefully and rewrite them—something they don't always do with the writing that they turn in to me."

Given the continuing emphasis on problem solving and other higher-order cognitive skills, telecommunication deserves careful scrutiny as a medium for improving thinking, reading, and writing skills.

Group Skills

Jack says: "Collaboration on projects not only provides a realistic model of modern research methods, but tends to motivate and energize the students involved." And Geriann adds: "If [students] are working in groups, they all seem to want to have a say in what their message contains; it is not acceptable to just let one person do the writing."

From the teacher's point of view, decisions about this dimension have important consequences for both classroom management and pedagogy. In a class of 24, work-team groupings of 2, 3, or 4 students means the difference of 12, 8, or 6 projects to monitor and reports to read—no small variation in a teacher's workload. From the standpoint of "doing science," collaborative teams reflect how most scientists work. Competition can be shifted from among students to among teams, a healthy antidote to excessive individualism.

When students look at whom they are grouped with, quite different issues arise. Is he or she smarter than I am? Is this a friend, someone I don't know, or an enemy? How well can I work with this person? For young people, answers to these questions can be consequential. Looking at the LabNet experience, I have seen a variety of practices: Some teachers like groups of two, some three (although few larger); some assign students randomly, some ask students to pick their own partners; at least one pairs the student with the highest academic record with the student having the lowest, the next highest with the next lowest, and so on. One teacher specifically pairs members of the opposite sex ("They tend to learn more from each other and [such pairing] provides an opportunity for a better interaction between partners.")

Basic Computer Skills

Jack tells us that an "advantage of telecommunication is that it encourages—early on—computer literacy in students: keyboarding, word-processing skills, and so forth." This is a truism. The important point is that, in this case, basic skills are being learned *indirectly.* The

end is to communicate with others; the means—knowledge of a computer and skill at making words. I return to the theme of indirect learning below.

Telecommunication and Student Attitudes

Student attitudes represent a less clear domain than student skills; they run to the "student as person." What is the responsibility of the school and teacher? This has always been, as it is now, a difficult question to answer. Nonetheless, the school experience in general and the telecommunication experience in particular seem to specifically affect students in two ways: How they view themselves and how they view the world around them.

Students' View of Themselves

Geriann reports: "Students delight in sharing personal information about themselves and their school. They look forward to getting responses to their messages, and are disappointed if there aren't any." She continues:

> When telecommunication is involved, they feel part of something whose significance transcends the classroom. They are engaged in their own process of communicating with others and evaluating their work. The key is that it is their own. Students aren't just turning in a project for a grade or for me to read. It is something that is theirs and that they are sharing with a community of which they are a part. This evokes a different type of enthusiasm for the work they are doing; it validates their work and gives them a reason to respect it. They are learning to learn from others, just as real scientists do, just as we all do outside of the classroom.

And Jack elaborates:

> Not surprisingly, telecommunication is a particularly active tool for many of the high school students at CCS. Students are encouraged to telecommunicate with their teachers and their peers. . . . In general, CCS students feel less intimidated about sending a quick letter by e-mail to a teacher than they do about picking up the phone and calling. . . . For those who live in isolation, whether due to physical location or social isolation, e-mail serves a purpose beyond its value as a means of communicating with a teacher or a vehicle through which to conduct research or submit lessons. It becomes a social tie and results in friendships developed at both the peer level as well as between students and teachers.

Geriann confirms the importance of students' feelings by addressing the notion of unrequited telecommunication:

> I know that I have hesitated to have students use the network because I can't guarantee that there will be an audience for their inquiries. . . . Students want to be acknowledged when they make the effort to use the network, and when this acknowledgment comes only from me and not from others in the LabNet community, they feel short-changed. In these cases, the feelings of validation, of belonging to a larger community, are replaced by familiar feelings of being invisible and unimportant.

And Tom agrees: "To be sure, not every student is eager to use telecommunication. Sometimes students suffer from stage fright. Even though they are really rather anonymous, they still fear what others will think of them." Clearly, the telecommunication experience has a potential impact on the way students view themselves.

Students' View of the World

And equally clear, there's a possible impact on how students see the world. This, arguably, is particularly important for the rural community. Tom says:

> My students attempted to get to know some of the other students on the network. They found that musical tastes were not that different between the East and West. There *were* schools actually smaller than Sheridan High School. And students from New York weren't all rude (but they didn't know anything about Oregon). Two of my students still correspond by mail with some of their electronic friends.

And from Geriann:

> Linked by telecommunication . . . students used the network to research their projects and solicit feedback on their experiments . . . [exchanging] messages and ideas with kids doing the same project in another LabNet classroom . . . learning to learn from others, just as real scientists do, just as we all do outside of the classroom.

Some Thoughts About Telecommunication and Indirect Learning

A critical debate today concerns the organizing principle behind the curriculum. Should it be logical or psychological? Should it proceed from what adults know, or what the child can learn? Scholars have spent considerable time sifting, organizing, naming, quantifying, ordering, and classifying information into the various divisions of knowledge—science, literature, history, and so on, with subdivisions ad infinitum. Why not have knowledgeable adults make curriculum for naive children?

The psychological or developmental argument proceeds from a different basis. It says that children need to be fully engaged in order to stretch their learning capacity to its fullest. Motivation is an important part of the learning equation. The task, the project, must seem real and important—the stuff of the adult world, not child's play. As an early scholar put it: "A project is a definite and clearly purposeful task, and one that we can set before a pupil as seeming to him vitally worthwhile, because it approximates a genuine activity such as men are engaged in real life" (Stormzand, 1924, p. 148).

Adults learn this way all the time. I have a problem to solve: What do I need to know to solve it? I am meeting a new client next week from the X Corporation, I'd better read their last annual report—and, say, didn't Smith formerly work for X? I'd better talk to him.... My company is sending me to France for two years; I'd better learn something about the country, maybe take some language lessons; and what was that about 1992 being a big deal in Europe? . . . I've been assigned to teach physics next year, and I only had three college courses in the subject; better call Jane M., she's been teaching it for years; perhaps there's a summer course at the local university; better review the textbook.... In each case, the learning is incidental to the presenting task.

Making factual knowledge and various kinds of skills the indirect consequence of carrying out an interesting, even challenging, task makes sense. Learning is pressed into service for doing. An early scholar of projects, H. B. Alberty, selected this kind of "indirect" learning as being at the heart of the project approach:

> The project method in education is that teaching procedure which aims at securing learning (i.e., the acquisition of knowledge, habits, skill, ideals, etc.) *indirectly* by means of activities which have the following characteristics: 1. The goal which is supposed to dominate the pupil and to lure him on to the accomplishment of the end, is not the *learning sought* by the teacher, but is some concrete result or accomplishment. 2. The learning essential to the satisfactory completion of the activity is always *instrumental* to the goal. That is, whatever learning is achieved is a by-product of the activity, and is not directly aimed at by the pupil. (Alberty, 1927, p. 82)

Telecommunication is a medium that may well support powerful indirect learning. Clearly, for students it is the act of communicating, rather than knowledge of the technology, that is most important. And we know, from both the Kids Network and LabNet, that it is highly motivating. So what should our research agenda be to further our understanding of the impact of the telecommunication experience on rural students' skills and attitudes?

Future Research on Network Use by Rural Students

The five general research questions below follow the structure laid out above, derived from the case data.

1. What thinking, reading, and writing outcomes for rural students are associated with the telecommunication experience?
2. In what ways does the telecommunication experience contribute to positive small-group dynamics of rural students?
3. Are basic computer skills of rural students (e.g., computer fluency, keyboarding, and software proficiency) markedly improved by the telecommunication experience?
4. How are rural students' views of themselves influenced by the telecommunication experience?
5. How are rural students' views of the larger world influenced by the telecommunication experience?

References

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