THE "ABC'S" OF TECHNOLOGY ADOPTION: COLORADO ELEMENTARY TEACHERS GETTING WIRED[1]

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ABSTRACT

This paper is based on participant observation and interview data gathered between 1999 and 2000 during technology outreach work with K-12 educators. The data suggests that technology adoption is not a simple linear process, but an ongoing negotiation of a number of factors. In the K-12 educational settings observed, we found those factors to include: a teacher's own evolving technical identity and teaching philosophy; ideological messages from colleagues, administrators, parents and students; and structural factors such as administrative policies, teacher preparation time, issues around classroom management, and the technology itself. This qualitative analysis of computing and Internet technology negotiation adds depth to existing macrosocial data on technology availability in K-12 schools. In addition, the analysis framework developed lends itself to detailed and informed technology decision making for K-12 schools, as well as providing structure for further research.

INTRODUCTION

Janet is a 40-year-old second grade teacher. She has attended two district sponsored technology trainings, but most of her computer skills have been developed through what she calls "playing with the computers." While Janet is proficient with word processing, email and Web surfing, she has not really considered having all 27 of her second grade students on the Internet at once. Still, Janet feels it's important for her students to use the computers. Most don't have computers at home. So Janet takes them once a week to use educational software games in their new computer lab. Janet knows that the students love the computer time. They often ask her if today is "computer day." But computer day is often stressful for Janet. She doesn't have time to fully explore how to best integrate the lab time with her general curriculum. In addition, student computers often crash and immediate technical support is not available. Janet knows that the district, parents, and her principal want her to increase her use of technology with her students. Yet Janet does not feel good about her students always doing the same thing in the lab. She knows that there must be other resources and activities available. Still, Janet's limited Internet exposure and time constraints have prevented her from expanding her use of computing and Internet resources in the classroom.

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Janet's story is a construct based on the situation of many teachers. In this paper, the many factors affecting Janet's technology use are explored and examined in detail. This paper is based on field and interview data gathered between 1999 and 2000 in connection with the Virtual Chautauqua performing arts online project. Virtual Chautauqua was an outreach grant project of the University of Colorado at Boulder in conjunction with the Colorado Council on the Arts. The project developed a web site for Colorado performing artists that incorporated streaming audio and video performance clips. Virtual Chautauqua also included a database that allowed teachers to develop online lesson plans incorporating performance clips, instructions for students, and class bulletin boards.

K-12 educators received training on the use of Virtual Chautauqua's online performing arts content and interactive forums. Teachers shared their own lesson plans with others through the Virtual Chautauqua education database. In-classroom assistance for students and teachers using these resources was also provided.

In this paper we focus on how teachers negotiate computing and Internet technology use in their classrooms. We situate this work within the literature on technology diffusion, understanding that any effort to explain the technology diffusion must be done so with attention to the social context in which the technology itself is being presented. We provide a lens focused on ground-level computer and Internet encounters of a group of elementary teachers in Colorado. At a policy level, a better understanding of these situations may provide guidelines for meeting future information technology needs in the schools.

TECHNOLOGY DIFFUSION

Prior to the 1980s, the diffusion research held a largely functional perspective: different groups and cultures adopt new technologies when they find a use for them. The classic diffusion work of Rogers considered the social psychological factors of various groups who adopt technology at different points in time. This work assumed that technology spreads linearly and without question as illustrated in Rogers' (1962/1983) typology of diffusion: innovators, early adopters, early majority, late majority, and late adopters. Research then tried to attribute characteristics to each of these groups. Technology was always seen as good and this assumption lent itself to categorizing late adopters with the low social status of "uneducated and low income."

This work also looked at stages of adoption for each of these groups. Again, this patterned linear process outlined awareness, interest, acceptance, trial and adoption (Copp, Sill and Brown 1958). Within this process of adoption, Ogburn (1951) described a mismatch in the spread of technology and the beliefs, norms, values, and language that accompany a new technology. This "cultural lag" may partially explain the disjunction between availability of information technology and low levels of everyday use. Yet Ogburn's work largely skips over the culture embedded in the technology itself that may or may not lend itself to adoption by different groups of people. For example, prior to the boom in Internet technologies, computers were largely vehicles for independent activities. The Internet ushered in a social component to computing that in turn interested groups who may not otherwise have been heavy users, such as stay at home parents and senior citizens.

Silverstone's (1994) model of the consumption process departs from the earlier functional frameworks. His five points in the consumption process are: imagination, appropriation, objectification, incorporation, and conversion. The last dimension mentioned refers to the incorporation of technology into the everyday presentation of self. One has reached "conversion" when a particular technology such as email becomes closely linked to one's identity or status.

This newer research on technology diffusion often takes a much more critical perspective on technology and its use. The work tends to focus on power and equity related to technology and how it is adopted by, or often imposed upon, different groups of people. This work provides a glimpse of the actors and social factors behind and within the technology. It begins to bring this social component of the artifact itself back to the discussion.

The work of Douglas and Isherwood (1979) goes beyond simple descriptions of diffusion. They describe the meaning of the technology in the lives of individuals Other work has followed this path and seeks to not only explain adoption, but also to locate technology in the lives of the users. For example, in Ling's (1999) work with Norwegian teens, he found that the mobile telephone is more than a means of communication. The mobile phone encompasses many nuances of status. The brand of phone itself is a status symbol. Programmed numbers of friends and acquaintances are electronic notches etched in the intricate fabric of popularity. In addition, use of the mobile phone changes the lives of teens to "hyper-coordinated" switchboards that log the movements of friends and family.

Within the educational arena, the diffusion of computer technology can be understood within similar frameworks as discussed above. In the following sections, we illustrate how K-12 teachers participating in the Virtual Chautauqua project negotiated computing and Internet technology in their classrooms. We focus on factors in the educational setting that contributed or detracted from the likelihood of a teacher actually using the technology. In doing this we also elaborate on disjunctions between imagined use of the technology and the actual use allowed by the context of Colorado teachers' everyday lives. The next section situates technology diffusion in Colorado K-12 schools within a broad framework gleaned from several national surveys conducted by the Department of Education and *Education Weekly.*

PUBLIC SCHOOLS AND INTERNET ACCESS

The U.S. Department of Education's Office of Technology has developed four pillars of school technology: hardware, connectivity, professional development, and content. A quantitative illustration of how U.S. schools stand today on these pillars allows us to understand in an abstract manner the technological situation facing teachers.

HARDWARE AND CONNECTIVITY

By Fall, 1998, 89% of U.S. public schools were connected to the Internet. This level of access represented a significant increase from 1994 when only 39% of schools were online (NCES 1998 p.1). By Spring, 1999, Colorado appeared to be ahead of the curve: 95% of Colorado schools reported having Internet access (*Education Week* 1999).2 Without a further

2 *Education Week 1999 National Survey of Digital Content.* This study relied on a stratified random sample of 15,000 U.S. elementary, middle and high school teachers. More than 1,400

refining of the definition of connectivity, however, even those schools with only one Internet-connected computer are included in this snapshot of access.

Table 1: Highlights of Hardware and Connectivity in Schools

	Colorado	National Average
Connectivity	95% *[M4]	89% ^
Ratio of students to Internet- connected computers	13:1 *	12 to 13:1 ^
Higher Speed Lines	82% *	65% ~
Projected average cost of implementing technology plan in each district	$1,720,924 ~	$1,926,353 ~
Total expenditure per student	$5,766 ~	$6,237 ~
% of schools in district that have directly benefited from E-Rate	49 ~	41.7 ~

* (*Education Week* 1999)
^ (NCES 1998)
~ (NCES 1999)

A more accurate indicator of the availability of Internet access in the schools is the measure of students per Internet-connected computer. According to the President's Committee of Advisors on Science and Technology (1997), a ratio of 4 to 5 students per computer represents acceptable school access. By Fall, 1998, medium sized and large schools averaged 12 to 13 students per computer *with Internet access*. Small schools fared better with an average of 9 students per computer with Internet access. Schools whose student bodies were poorer or had larger minority group representation had less access (NCES 1998 pp.1-2). By Spring, 1999 Colorado schools appeared in sync with national averages: the state teachers reported 13.1 students per Internet connected computer. And as reflected in national data, the ratio was not as

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teachers responded.

promising in high-poverty Colorado schools, where 18.2 students shared a single Internet connected computer (*Education Week* 1999).

The Department of Education predicted that rates at which classrooms are connected might continue to rise due to E-rate (education rate) funding made available through the Telecommunications Act of 1996. District technology coordinators in 32 states reported that more than 41% of their schools had taken advantage of e-rate funding. In Colorado, almost half the schools had benefited from e-rate funds (NCES 1998). Colorado expects to spend approximately $1.7 million in each district or $5,766 per student to implement their technology plan. These figures are slightly lower than the national average for technology expenditures.

Access can also be understood in terms of quality and/or speed of connectivity. In 1996, 74% of the schools with access relied on dial-up Internet connectivity. By Fall, 1998, 65% of schools were using higher speed dedicated lines. Large schools were more likely to connect via a dedicated line than small and medium sized schools (79% compared to 63% and 64%) (NCES 1999 p.2). Again Colorado appeared to fare well on measures of connectivity quality. In Spring, 1999, 82% of those with access had some type of connectivity other than dial-up with modem; in addition, 60% of those with Internet access reported T1 connectivity (*Education Week* 1999).

CONTENT, TEACHER TRAINING AND TECHNOLOGY USE

According to an *Education Week* survey (1999), there are several key factors that contribute or detract from the likelihood of teachers integrating Internet content into their classroom instruction. While time available for class preparation has long been an issue for K-12 teachers, other factors are specifically aligned to the state of Internet access, content quality, and the extent and types of teacher training.

Content type and quality: One of the central concerns of administrators and teachers is Internet content itself. Survey data indicated that teachers have difficulty dealing with content on many levels. Most content is designed as supplemental; therefore, it is difficult for teachers to integrate it into their lessons. Almost half (48%) of the teachers who have looked for Web content for instruction said it was difficult to find sites or services to fill specific classroom needs. Still, slightly more than half of Colorado schools have at least half their teachers using the Internet for some aspect of instruction. The difficulty that teachers express in finding content may relate back to the overall issue of searching for and finding content on the Internet: the needle in the haystack phenomenon. The *Education Week* data suggested that teachers would prefer sites more comprehensively designed around teaching a particular topic. The greatest percentages of teachers say they used the Web to provide students a valuable research tool (47%) and because it is interesting and motivating for students (34%). It appears that the most popular use is as yet another reference tool (along with books, encyclopedias, and magazines) for students.

Ratios of Internet computers to students: The number one reason for not using Web or software for instruction was computer availability. More than two-thirds (69%) of teachers reported too few Internet-connected computers in relation to numbers of students. Those teachers with more computers per students were more likely to rely on digital content. At the very least, having many students share a few computers requires planning for and maintaining multiple activities in a classroom as students wait for their turn online.

Preparation time for class: K-12 teachers face many demands on the scarce time allowed for class preparation. Many times in-school open periods are filled with parent contacts; grading; faculty, student, and administrative meetings; administrative duties; and "scrambling to get ready for the next period." Any serious planning often happens in the evenings at home. That is likely why 36% of teachers reported lack of time to prepare as a serious impediment to integrating Internet content into their instruction.

Technology training: Teachers with more technology training felt better prepared to integrate technology into their classrooms. Almost half the teachers responding (45%) indicated that a lack of training on "integrating technology into the curriculum" was a substantial barrier. General technology training was important. But even more important was training that specifically worked on helping teachers connect Internet content to their own classroom needs and goals.

Technical support: Almost half the teachers (49%) reported insufficient technical support as a substantial barrier. The idea of technical support goes beyond basic training. If a teacher is working online and is having trouble printing because of configuration problems, she may be at a standstill until someone is available to assist her.

These national surveys provide a glimpse at the technological arena negotiated by American teachers today. Yet this quantitative data is limited in its ability to illustrate the nuances of a teachers' daily use of and relationship with technology. The data collected during the implementation of the Colorado Virtual Chautauqua project provides more detailed insights into the processes of teachers' technology use: How would teachers like to use technology? How do they perceive their own and others' use, and non-use, of technology? What factors must they negotiate in attempting to integrate Internet technology into their classrooms and curriculum?

METHODS

PROJECT BACKGROUND AND DATA COLLECTION

The data in the following sections was collected from Colorado K-12 educators between 1999 and 2000 using field research methods and semi-structured interviews. The interview data from nine teachers was gathered in Spring, 2000. The teachers were involved in a statewide performing arts and Internet technology outreach project called "Virtual Chautauqua." Most of the teachers participating were from small towns and rural areas in Northeastern Colorado.

The mission of Virtual Chautauqua was to bring performing arts to isolated communities via streaming audio and video Internet technologies. A central goal of Virtual Chautauqua was to connect Colorado performing artists with students and teachers in rural K-12 schools. The Virtual Chautauqua web site for Colorado performing artists incorporated digitized performance clips. In addition, the project developed an online database specifically designed for K-12 teachers. This database allowed teachers to incorporate a series of clips with online instructions and electronic discussion forums for their students. The lesson plans and activities created by one teacher were immediately available for use by any other teacher with Internet access.

The project research team worked directly with teachers, both presenting the project and providing technical assistance on its use. This project design lent itself to data collection through participant observation methods. In these dual roles, we often worked together in making presentations to teachers and then reconstructing the meetings through field notes. Usually one

research team member would create an initial draft of notes and others would add to those notes prior to their entry into the qualitative data analysis program, NUD*IST (Richards and Richards 1994). We used the program to systematically sort and organize themes that emerged in the data.

INTERNET TECHNOLOGY IN THE SCHOOLS

As discussed above, technology adoption is not a simple linear process, but an ongoing negotiation of a number of factors. These factors include a teacher's own evolving technical identity and teaching philosophy; ideological messages from colleagues, administrators, parents and students; and of course structural factors such as administrative policies, teacher preparation time, and the technology itself. During the process of introducing teachers to the Virtual Chautauqua online performing arts project, researchers witnessed the complexity of technology negotiation for K-12 teachers in Northeastern Colorado.

TEACHERS AS TECHNOLOGISTS: TECHNICAL IDENTITIES AND THE ROLES OF TEACHERS

An educator cycles through many roles in the course of the school day. Teachers are guides, organizers, lecturers, disciplinarians, counselors, and mentors. A teacher holds her breath in hopeful anticipation as a student struggles to sound out words in a sentence. Another teacher comforts a child on the playground who has just skinned a knee. These roles, so common to the teacher, are entered and exited almost seamlessly.

The role of technologist is a newer hat for teachers to wear. For many teachers, the transition into the technologist role is rough at best. Teachers encounter unique emotional, organizational, and intellectual experiences in using computer and Internet technologies with students. These experiences form a teacher's "technical identity." This identity is in part informed by a teacher's own beliefs about herself as a technology user, as well as her perception of the relationship between computer technology and her teaching philosophy.

Teachers and Technology Skills

Mountain View Elementary is a gendered work environment not unlike most elementary schools in the United States. Among its 47 teachers and teachers' aides, three are men. Almost all the nine teachers interviewed said that they were comfortable using the computers for Web surfing and email. Still, from within the ranks of faculty, the person who was the internal formal technology resource was male.

Almost all the full-time classroom teachers (14) and one art teacher at Mountain View actively participated in using the Virtual Chautauqua performing arts website. The perceptions of their own abilities ranged from that of resident expert to cautious user. While all communicated a positive attitude toward computers, some were cautious about and frustrated by the process of integrating the technology into their work with students.

The Experts: When Mountain View Elementary teachers talked about technical support resources, they were usually referring to either a male faculty member, spouse or district technical support person. Two faculty members in particular identified themselves as more knowledgeable than the rest of the faculty. Yet these two faculty members had different approaches to their status as expert users.

Juan was a thirty-something male Hispanic second grade teacher. Through his participation in a statewide program, he had undertaken the role of a technology coach to other teachers in the region. He attributed his technological skill level to his own initiative in seeking out training. Almost all the teachers interviewed identified Juan as a key technical resource. He confirmed that he had a lot more computer training than other teachers and that he was indeed the in-house "computer guy."

At an informal level, Lori was also a resource for teachers. She also felt she knew more about computers and the Internet than other teachers at the school, with the exception of Juan. Yet she was less assured about playing this role:

> We have our little hierarchy. I can tell, like they think when the Internet's off I can find it for them. I've helped them with some stuff like that. Or like how to get the disk out in there when it's not on the right screen. Like, what do you have to do? So, I'm not an expert, but I know more than a lot of people do around here. Which is not good (laughing)…. It's not saying much if I know more and I'm where I'm at. You know what I mean? That's not good.

Though Lori identified herself as a technical resource, she did not play this role to the extent that Juan did. She did not have the official title, so it is likely that other teachers felt they should use Juan as their resource. At the same time, Lori seemed more concerned about addressing her own technical questions. Rather than feeling the responsibility to help other teachers as Juan did, she expressed annoyance that the skill levels of other teachers sometimes made her own goals more difficult to reach.

Juan was self-assured and embraced his resource role. Lori doubted her technical expertise. She used humor to distance herself from the resource identity that she felt jeopardized the soundness of her peers' technical support system. Other research (Virnoche 2000) has noted that male organizational members in the female-dominated human services sector gravitated both formally and informally into the technical expert role.

The Competents: All the other teachers that we observed and interviewed using computers and the Internet could be classified as, at the very least, competent. All had accumulated enough base knowledge to make learning new computer-related skills fairly easy. Most of the teachers had little or no formal training outside a few district in-services and a recent class taught by Juan that focused on integrating the new lab technology into their teaching.

Distinctions could be drawn in terms of the number and range of software programs with which teachers were familiar or in terms of absolute hours per week spent using computers and the Internet. Yet most telling, given a common general competency among teachers to figure things out, was how they felt about their own ability to do this. As in the case of the experts, distinctions between teachers in this group could most clearly be drawn based on their degree of comfort with technology.

Irregardless of objective skill levels, each teacher needed to feel comfortable with her ability to use the lab while performing other roles necessary as an early elementary teacher, not the least of which is keeping the attention of the kids. As Lori noted: "You're not going to do something you're uncomfortable with your whole class. It'll totally be a mess."

Early in the work with Mountain View teachers, a few teachers communicated that what they really needed was some basic Internet training. They could not think about using Virtual Chautauqua online before being comfortable with the Web in general. Prepared for a rudimentary overview of the Web, two researchers organized a small after-school session attended by eight teachers and the principal.

Within minutes of beginning the session, we found that "getting up to speed" on the Internet required little from us. We pointed out how to launch the Web navigator software. The teachers proceeded to "click around" and explore. Teachers quickly engaged in an informal co-learning mode of pointing out to one another different resources and strategies for using the Web. This "safety in numbers" phenomenon has also been documented in other research (Virnoche 2000). It suggests that group-learning and team-teaching structures may be particularly conducive to more rapid and comprehensive technology diffusion in schools. In less than 15 minutes, a collective sentiment emerged that they were ready to learn about Virtual Chautauqua.

A teacher's technical identity is a critical variable in how quickly and to what extent she will use new technology on her own and with students. Those with technical identities that include fewer skills but greater self-confidence were more likely to learn on their own and "risk" using the technology with students.

Sally was planning to buy her own computer soon, but was not completely comfortable with her skills. She said with a laugh: "It's mind boggling. Especially for someone like myself who is not as computer literate as she would like to be." Sally's discounting of her own skill did not match her abilities or the extent to which she used the technology in the classroom. In fact, Sally had been one of the first teachers to use Virtual Chautauqua with her students – only a few days after she had developed her online activity.

Teaching Philosophy and Responsibilities:

Technology as Portal and Prerequisite

Part of a teacher's decision to use technology in the classroom involves her personal teaching philosophy and her feelings of responsibility to her students. Almost all the teachers at Mountain View Elementary emphasized the resource strength of using the Internet. Many also noted the importance and unique opportunity that classroom computing in and of itself provided for their students.

Technology as Portal: The teachers at Mountain View emphasized the many types and variety of resources that were now available to them and their students through their Internet access. The Internet served as a portal to information and opportunities far beyond what most teachers could offer through traditional textbooks and supplemental classroom instructional aides.

They used the computer and the Internet to reinforce concepts introduced in the classroom, provide opportunities for reading, pursue additional information on specific topics, and to aid in their development of classroom materials. It helped them emphasize to their students why it was important to be literate in both Spanish and English. One teacher helped a student particularly interested in Orca whales find whale web sites. Another teacher used the Internet to look up the Spanish names for the phases of the moon and to answer a student question about scallops' eyes.

Teachers also felt that the variety of culturally diverse resources was important for affirming students' own ethic identities and exposing them to new cultural experiences. This was

true for the Internet in general, and was sited by many teachers as an important factor in their decisions to use the specific resources available through Virtual Chautauqua.

> If … the performers do not represent the student population, it is not going to be used. If I had not seen a lot of Spanish artists, I would not have done the project. Because I saw there was a consciousness, an effort to bring diversity into our artistic community, and that (diversity) represents our students. Someday they might be part of that community. That's the reason I got hooked into doing it because I saw the variety, diversity in it. My kids would really like to see that.

Some teachers thought the use of the Internet and computers also presented a particular type of learning activity that emphasized self-reliance and freedom for students. In the lab setting, there was usually one teacher and about 25 students each at his or her own computer. Jill, a first grade teacher, noted how the Internet was conducive to allowing her students to explore. Kate, who taught art at a middle school and at Mountain View, also liked the freedom that computing and the Internet provided because each student could pursue their own interests and choose his or her own activity.

Yet because the Internet represented such an untamed frontier of information, it was important to several teachers that mechanisms for maintaining control were present. For Jill, the ability to create her own Virtual Chautauqua Web page, selecting which art her students saw and adding her own comments and instructions, helped her to tailor the Internet to her needs. Yet for Paula, this tailoring also meant decreasing the chance that students might see or hear something inappropriate. Pre-selecting surfing options also meant saving time by keeping students on task.

In some cases Virtual Chautauqua linked to full artist Web sites maintained on other servers. At one of our teacher trainings, Paula saw first hand the problem this could potentially create. The Colorado Chamber Players Web site had been hacked. Paula clicked on the link to their Web page after listening to a performance held on the Virtual Chautauqua server. She was disturbed and amazed by what she saw. She called me over to look and several other teachers crowded around her terminal. A one-paragraph epitaph replaced what had been the full Web site. The language was racist and misogynistic and proclaimed: "Beware, you have been hacked." Paula later stated that she had appreciated the exposure to the Internet and the Virtual Chautauqua site, but that this experience had actually dissuaded her from using the site with her kindergarten class: "What I learned was about when that site was hacked … It made me realize that it's not as secure as we like to think it is … And that really scared me away."

Technology as Prerequisite: At Mountain View Elementary, the teachers noted that most of their students did not have computers and Internet access at home. Implicit and explicit in their discussions was the notion that access to the technology was important in itself. Even for children at this young age, basic computing skills were a prerequisite for what would be expected of them in their upcoming educational future and beyond. According to Paula, a kindergarten teacher:

> My kids in my class… when I asked who had computers, two of them did. At the beginning of the year… Well, two in each class. So it would've been about four out of about forty. You know, and that's - I think it's from the population of this school as compared to, you know … [schools with wealthier student populations].

Mountain View was a pre-K-2 bilingual literacy center and home to 540 students. Most came from minority and low-income families. Several of the teachers felt a responsibility to expose even these young children to computer technology. If they did not become at least familiar with computers at this level, it would be just one more stumbling block for them at the next level.

Teachers that mentioned the importance of access for the students were quick to emphasize that "technology for technology's sake" was not good enough.

> I balance the learning with the free exploration. Just giving them access to something they do not have at home, just like books and papers. I have issues with that going on. So here at school, I always have that in mind that, yes, we are going to learn that [the lesson objective], at the same time, I create an interest using this machine which will carry to later in life.

Jill also noted that there needed to be clear goals on just what technological skills were expected of their students at each level:

> So I think that that has to be established. Like what are the goals for each grade? And you know, what do you want to accomplish this year and not try to take on too much. Be realistic about it. Because, you know, it is just something that takes time.

A few teachers also noted that the computer could be used to encourage higher levels of thinking and as an outlet for creativity. One teacher also suggested that the Internet could encourage "new ways of teaching." And one teacher pointed to "other teachers" (we did not meet these "others") who simply used the computer as a prize for good behavior. We were told that threats of "computer time" demerits were a strong incentive for quickly quieting a chaotic classroom of first graders.

"LOUD AND CLEAR": NEGOTIATING THE TECHNOLOGY MESSAGES

In the United States, President Clinton in 19xx called for the wiring of all primary and secondary schools. Millions of dollars have been channeled into funding the Telecommunications Act of 1996 and its provisions for educational rates (e-rates) to assist schools with funding connectivity. E-rate dollars are even attached to additional federal funding opportunities (NTIA requirements, 1998) that require schools to apply for this funding before receiving other grant opportunities. And as discussed above, Colorado has certainly engaged the momentum, touting 95% connectivity for schools as of 1999 with almost 50% of its schools receiving e-rate funding. All of these activities create a general "message" about the role technology should play in education.

Yet for the thousands of teachers who face the issues of everyday technology use, the messages are filtered through simpler channels than presidential addresses and federal legislation. The primary messengers are district administrators, parents, fellow-teachers, principles, and family members. And one must not underestimate the power of the pint-size messengers - their own students. The messages that they deliver are overwhelmingly slanted to getting teachers to integrate computing and the Internet into their teaching, though a few cautionary notes remain part of the discourse.

The Push Toward Technology:
Messages from Above

All the teachers interviewed at Mountain View Elementary agreed that "the district" encouraged technology integration. The district was the most faceless of all the messengers. When teachers talked about "the district," they referenced things like mass email messages, technology training, and the allocation of financial resources to state-of-art computing equipment and Internet connectivity. They clearly understood that the district wanted them to be using the technology with their students.

The district was backed by community support formalized by a vote for a large bond issue funding new technology for all the schools. Paula noted that the district's push for technology was not uncalled for or overzealous:

> Well, the district is for it. You can see that they're for it with what's going on. I mean, they have brand new computers. They just want to keep up with what's going on in the world. I don't feel it's an overbearing pressure at the expense of other things, but there's definitely encouragement.

The district also offered many technology-related classes and in-services. In fact, there were so many that one teacher said she believed that they now had compiled an entire "book" of computer classes that she could take. The offering was part of the message that teachers should build their computing skills. As Lynn put it:

> It was just a fantastic opportunity that why would you not, you know. There are different tech classes offered all the time and we get, you know, it seems like one email a week on new classes being offered. Unfortunately I've not been able to sign up.

Lynn's caveat concerning her inability to take advantage of what she perceived to be a fantastic opportunity was not uncommon. Availability of training resources did not necessarily translate to teachers actually taking the courses. Later we will discuss some structural factors that complicated the negotiation of training.

Teachers also get messages from parents about making sure their kids have time working with the computers. The teachers thought that most Mountain View parents just wanted their children to learn about computers. Jill said that even though many parents don't know about computers themselves or have them at home, they feel that it is important for the kids to learn. They want their kids to learn about computers and want to know how much time they will have with the computers.

> I have a lot of parents that really, have really said, you know, "I want my child to learn the computer" and you know, "How often are they going to go into the computer lab." There is. But unfortunately, some of the population of the, you know, these kids, they don't have access to computers. But yet the parents like know the importance of it like even though they may not have a computer at home, they like realize the importance of becoming computer literate and just, you know, having access to computers.

Other parents of Mountain View students were very computer literate. These parents brought in suggestions for software, asked specific questions about the types of activities the

children did on the computers, and requested to have email communication with their children's teacher. All of these requests communicated the need for the teachers to have or develop a certain level of proficiency with the computers.

The principal and the teachers themselves at Mountain View completed the circle by pushing teachers into technology-infused classrooms. Teachers shared Web sites with one another, generating an interest among themselves in the potential of online resources. And in getting teachers to take advantage of the schools technology resources, as well as to use particular technology tools, like Virtual Chautauqua, the principal was a key messenger.

Benita was a petite Mexican-American woman with an energy level rivaled only perhaps by the children who ran on the playground of her school. She had been a migrant child herself and spent 12 to 18-hour workdays trying to transform a school that had few resources when she arrived. Building a technology-rich faculty and student population was just part of the larger picture.

During faculty meetings she brought up the importance of using the technology and trying out Virtual Chautauqua. During an in-service training held by Juan, Benita stated to her faculty that she wanted them all to be "technology-wise" and to take advantage of having a technology coach, Juan, in the building. She also asked Juan for a list of teachers who were not bringing their students to the lab on a weekly basis. "I want to encourage it," she stated in front of most of the faculty. She also encouraged teachers to take part in Virtual Chautauqua trainings, and it was she who suggested that we hire substitutes to allow teachers to attend training during the school day. Going one step beyond the technology cheerleader, she aided Virtual Chautauqua outreach workers by physically tracking down her teachers and leading them to Virtual Chautauqua trainings, never stopping the message: "This is going to be great. The kids are going to love it."

The Pull Toward Technology:
Little Hands Lead the Way

As much as the teachers felt compelled to use computers and technology by their co-workers and superiors, they were equally pulled into technology use from within their classrooms. Their own students delivered perhaps the loudest message about classroom technology use. And these messages were infused with raw emotional enthusiasm in the eyes and words and jumping tactics of elementary-age children.

> At 12:45 p.m. on a cool March day, 19 children filed into the computer lab at Mountain View Elementary. This was a second grade class of ten girls and nine boys. Almost all the faces were some hue of golden brown and hair was dark. Their speech switched easily from English to Spanish. Kate, their art teacher, happily instructed them to take seats. The noise level in the room boomed as they rushed to their assigned computer stations as if playing a game of musical chairs.
>
> A few children wandered around. They had forgotten where they were supposed to sit. Kate helped them to find a computer. Kate welcomed the students and told them that today they were going to see two dances, listen to a poem about a kite and hear guitar music. She told them to think about the colors and shapes that they would see. With the crayons and paper laid out next to their computers, she said that they should draw those shapes and colors.

Several children said to Mary, "I don't understand. How are we going to do this?" Their eyebrows wrinkled as they tried to figure out how they would draw these things. Mary told them, "You'll see."

Kate told them to put their headphones on. Then Kate, Mary, Marnie and Matt started to help the children through clicks on Kate's lesson plan. "Click on 'kite.' Now click on 'play.' Click on 'acoustic stick.' Now click on 'play.'" At first the kids would sometimes say, "I don't hear anything." Mary would point to the line in the RealAudio window that says "buffering, xx seconds remaining." "Watch here. Espera. See. Only a few more seconds and it will start. It is coming."

And they would watch and wait usually only for a few seconds. Then a smile would spread across their faces, as their eyes got bigger. "I can hear it." Then a head would begin to bob. A little boy kept time to the guitar music with his pencil on the desk. "Teacher, teacher, help me." "I want to see the dancers on my computer like she has on her computer. Help me get the dancers." "Mira, mira!" … "I want to see another one. How do I see another one?" "I want to see the dancers again. I want to hear the guitar again." "I don't like this one. I want to hear a different one." (Field Notes: March 1, 2000)

Yolanda was a second grade teacher and, though she had been using computers with her students for some time, she was hesitant about using the Internet and Virtual Chautauqua. It was her students' reaction that brought her across the river of uncertainty:

They were waiting for Tuesday. They say "Oh, computer day! What do we have to do today?" And we had to listen to music from Africa…with music that is part of the Chautauqua that you kind of helped me to do, I mean, that was amazing because the kids were alive. They were just alive and you could see the people were - I mean it was more interesting for the kids first grade, first graders, I think that really motivated them to do stuff on the computers.

Another teacher said that if kids did not like the computers so much, she probably would not often use them. The kids ask if it is computer day. According to Paula, who gives her students five choices for free time, the computer slots always fill up first. And on top of that, the teachers certainly feel a certain "duty" to allow the children time with the computers. Here the teachers' philosophy to expose the children to things they can't get at home came through.

Flashing Yellow Lights:
Approaching the Internet with Caution

Despite the overwhelming impetus for teachers to integrate technology into their classroom teaching, there remain cautionary messages that temper teachers' technology use. These messages come in the form of "permission slips" required by the district for students to go online. And for teachers whose students are using the technology for the first time, the look of fear in their eyes must carefully be negotiated.

The very idea that students need a permission slip to go online communicates a perception of "potential danger" (and liability) akin to loading a school bus of second graders for a trip to the zoo. Some students never brought back a signed permission slip during the 1999-2000 school year in which we were working with Mountain View. That was the first year that Internet permission slips were used. Sally thought perhaps next year there would be fewer problems with permission slips:

> I think when parents hear Internet, they somehow turn on the TV or they read about the horror stuff that's on the internet, that I just think that some parents, especially with young children, even though they trust us to do well by their children, they are worried that "Well, could they accidentally get into it? Could there be a possibility of them getting into something?" And I think that's where they're coming from when they're looking at "Do I sign this form or do I not sign this form?"

Sometimes teachers are not sure why parents do not return the permission slips and do not know how the parents feel about their child using the Internet. With some parents, it is clear that they do not want their children online. This included several children whose parents did not want them online for reasons concerning their religious affiliation.

Even after the permission slips are in place, the teachers still must face the reactions of their own students. As illustrated above, the students are generally enthusiastic about the technology. But for some students, especially those who have not been around computers, the technology is daunting at first. Juan observed: "I have some children that have just moved from Mexico and they do not feel comfortable with these machines that are so visual and so interactive." Yolanda also was sensitive to the overwhelming feeling that some small children have with the technology:

> In the beginning they were so scared. They don't know how to, I mean how to do - everything is new. They don't even know how to touch the letters. They have no experience typing anything, how to look for - I mean we spent a lot of hours trying to... And they learn how to use, how to get into the Internet, how to use - I mean this music and stuff. They didn't know anything. No previous experience. No previous knowledge with this at all.

SHOOTS AND LADDERS:
STRUCTURAL CONSIDERATIONS IN TECHNOLOGY NEGOTIATION

While Colorado schools may very well have a ratio of 13 students to 1 Internet computer, we saw great variation behind this seemingly orderly statistic. At one school in a large Front Range city, two members of the research team spent more than an hour just trying to find a place

to work with a teacher on Virtual Chautauqua. The teacher had thought they could work in a lab, but there was a class in the lab. The computer in her classroom was not connected to the Internet. They went to a Journalism lab, but the computers were not set up for sound. In the library, five new iMacs should have been connected to the Internet. But the group found that someone had disabled the connectivity because it was unstable and was believed to be contributing to the ongoing crashes of the computers. One last attempt for access was made on a PC in a corner of the library. While it was connected to the Internet, this PC was too old to run RealAudio. The hunt for an Internet-connected and RealAudio-ready computer was abandoned. Still interested in the project, the teacher involved decided to pursue building an online lesson from her home computer.

In tandem with the messages that teachers receive about technology, they also encounter many structural factors that affect their use of computers and the Internet. As illustrated in the above example, teachers negotiate through the technology itself, administrative practices that gatekeep that technology, everyday classroom management issues, and technology training.

Technological Factors:

The Lure of Fast, Friendly, Flashy, and Waiting

Thirty bright blue and white iMac computers hummed in the Mountain View Elementary computer lab. The lab was separated by a half-wall of glass from the atrium at the center of Mountain View Elementary that also served as the library. The library was a large open area with small chairs and tables, and neatly organized bookshelves, with paper "bugs" and other artwork decorating the walls. The library was a focal point for Mountain View, but the computer lab was its showcase. What teachers now liked about their new lab was the general sense that the computers were fast, fairly easy to use, had access to some good software and Internet content, and that there were 30 of them available for them to use with their students (Table 2).

Table 2: Technological Factors Affecting Teacher Use of Technology

	Issues	**Preferences**	**Problems**
Speed	Of connectivity and processors	Faster is better	"Too slow"
Operation	Proper system operation; as well as user ability to get systems to operate properly	"Friendly" and easy-to-understand operation; it does what you expect it to do	Too complicated; too many steps; unwelcome surprises
Content	Quality; volume of information or numbers of software programs; variety of information	High quality; age- and language-appropriate content	Too much Internet content; not enough age-appropriate and bilingual software and content
Access	Numbers, types, and location of computers available	New and conveniently located; one for each student	Older and incompatible systems; no computers in classrooms

` The issues of speed and access had to a great degree been addressed at Mountain View Elementary by the time we were working with the teachers. There were still some compatibility issues between home systems owned by teachers and in-school technology. And one teacher did mention that it would be nice to have a new computer on her desk instead of an old one that was not compatible with the new computers in the school. But for the most part, teachers were focused on issues related to operating the given systems and the content available on them.

Even the shiny showcase at Mountain View had its operating problems. When the school doors opened in Fall, 1999, the district technology staff had been challenged to be sure the computers in the lab worked correctly. It was a bit of a joke among the teachers. Apparently they had spent weeks looking at the computers and not being able to use them.

On the day we were scheduled to do Virtual Chautauqua training for teachers, the RealAudio program was not installed on the lab's server, which would have allowed all thirty of the iMacs to access it. Instead, we downloaded the RealAudio program to the lab's teacher station and showed the clips through an LCD projector mounted on the lab's ceiling. As we played clips that the teachers requested to see and hear, the stream frequently broke up and the "net congestion" message appeared in the RealAudio window. One of the teachers asked: "Is it just our computers, or is it always like that?" Everyone chuckled, given the history of their lab, and assumed they had a bad setup. They, of course, had one of the best facilities: state of the art iMacs networked onto a T1 line. We took responsibility for the less than perfect quality and suggested that the transmissions should improve when we moved the clips over to a speedy new server at the university.

When working on the Internet in particular, content and speed issues are sometimes perceived as operations problems. When the system is just not working, or it does not look right, teachers get uncomfortable with the technology. Common problems associated with Internet and computer use, such as unpredictable connection quality or seemingly random system crashes, become major hurdles when multiplied across a class of 25 young students. So even if teachers have done everything correctly, their discomfort and lack of experience or confidence in dealing with technical problems, as discussed in the section on identity, may lead them away from using the technology.

Another issue that hampered teachers' use of the technology was a lack of appropriate software and Internet content. When using the lab with their students, most teachers stuck with a few pieces of software made available by the district and deemed appropriate for their grade level, such as Reader Rabbit and Carnival Countdown. Teachers complained of a lack of software for addressing certain needs, such as early or basic literacy and Spanish literacy, as well as a lack of time to fully explore and learn about all of the software made available by the district (do we want quotes?). Content and the malleability of content of Virtual Chautauqua was an attractive feature for teachers. They were able to create their own bilingual Internet content within their Virtual Chautauqua lesson plan as well as locate, limit, and easily present artistic content relevant to their current teaching.

Administrative Control:

Technology and Red Tape

In addition to the technological factors teachers negotiated, they also encountered a layer of administrative factors that complicated the process of using technology at school. Teachers

dealt with legal issues, scheduling of computer time, security measures, and processes of finding technical assistance.

Legal Issues: Teachers faced liability and logistical concerns due to the legal issues surrounding student use of Internet resources. The control measure was the permission slip. Yet when students were not given parental permission to use the Internet, teachers were then faced with logistical dilemmas of separating Internet users from non-users. This was just enough to keep Lori from using the Internet with her first grade students:

> I didn't because I didn't feel comfortable enough really walking them through and I had so many kids that never returned forms. And I felt, you know, we didn't have the list ourselves - that was kept in the library, which I'm not really sure why - but it was just too hard for me to figure out who had their permission from their parents and who didn't. You know, and where do you really sit them so somebody else can't see if they're not supposed to be.

Ironically, Lori was the teacher discussed above as a technical resource for her colleagues. So even though she had the technical background, this administrative hurdle was enough to keep Lori from choosing to incorporate Internet use into her classroom.

Scheduling: Even for the teachers who made it past the issues of permission slips, there was still the issue of either scheduling lab time or managing the use of one or two in-classroom computing stations. Kate was the art teacher at Mountain View who also worked with yearbook production at a nearby middle school. She said that she sometimes had to "talk other teachers into having their time" to accomplish what she needed to with her students in the lab. Sally also noted the limits placed on her use of the technology at Mountain View because so many classes had to share one lab. Lori noted that, while the computer in her classroom worked well for developing materials: "As far as directly having the kids interact with the computer, you know, I'm still trying to figure out how to do that with one computer and twenty-some kids."

Security: The district was concerned with hardware, software, and network security for the Mountain View computer lab. These concerns stemmed partly from the relationship of these technologies to liability issues discussed above. Security measures, from locked doors to system passwords and server firewalls, protected the costly investment of the district. These measures protected the systems from the curiosities and mistakes of students and teachers, as well as outsiders. Yet these same measures sometimes made it difficult for teachers to accomplish their goals.

Although teachers had a great deal of control over what happened with their classroom computers, there were many more security hurdles related to their use of the shared computing lab. For example, while using the lab, one teacher wished that she could view her students' computer screens from the teacher station at the front of the room. This feature is, in fact, included in the lab management software installed at Mountain View. According to a district technology support professional, the feature is disabled in order to prevent teachers from possibly disrupting the normal operation of the lab. Such district-level control over lab software, as well as more common issues like forgotten email passwords, were security factors that were a part of in-school technology negotiation.

Technical Assistance: Finally, all the teachers quite frequently needed some type of technical assistance. This process was as much an administrative issue as a technical one. As

Kate pointed out, the process varies from school to school. In some cases, there is a technical support person in the building. At Mountain View, the teachers' primary level of assistance was from colleagues. When informal networks of colleague support failed to meet teacher needs, the teachers placed formal requests through the school secretary to a district-level technical assistant. Kate said that, "you can also leave a note for the one guy who comes once a week." Short of the presence of a dedicated in-building support person, any substantial technical glitch usually meant that a teacher abandoned the technology-related task at hand.

The Everyday Life of the Teacher:
From Preparation Time to Classroom Management

Beyond the uniqueness of the institutional factors, the everyday issues of being a classroom teacher also affect classroom use of technology. Two key issues include time constraints and classroom management. Teachers perceive these everyday teaching factors as both catalysts and constraints on their use of computer and Internet resources.

Technology and Time: Teachers face many time constraints. They have short periods in which to teach a given topic and little time allowed for preparation. They are always being asked to incorporate new and more material. At the same time, they are limited in pedagogical freedom by educational requirements attached to standards of learning.

To this extent then, teacher time constraints affect their ability to learn about new technologies, help their students learn to use the tools, and develop methods for incorporating technology resources into their curriculum. Also because of the limited time that teachers have with students, they feel that each activity needs to count. According to Cameron: "It has to serve more of a purpose than just "Oh, this is time for me to be away from the classroom….'"

The availability and participation of teachers in Internet-related trainings represented yet another factor contributing to in-classroom use. Teachers told us that there were many classes and in-service trainings on technology. Their availability was part of how teachers understood there to be support on several levels for technology in the schools. Yet teachers explained that participating in training often required time from their non-work life. Even when teachers try to participate in training because they perceive it to be valuable, participation often requires childcare negotiations with spouses or sitters and reshuffling other demands on their personal time. For these reasons, teachers told us that the provision of substitute teachers was a key factor in their participation in Virtual Chautauqua training. This provision created the work-time structure that required fewest negotiations on their part.

Time and its relationship to distance also affect teaching. Physical location may limit the resources that many teachers have available. For rural schools, a trip to a performance or art museum would require many hours of travel, lots of coordination, and considerable expense. Technology becomes attractive to teachers if they perceive it as providing them with access to desired resources.

During Summer, 1999, we presented Virtual Chautauqua to a group of northeastern Colorado teachers. One of those teachers worked in a community of less than xx,000 people. Her school was still waiting for Internet access. She relayed the significance of the Internet to her work as she began to realize what it offered:

I teach drama and journalism out in the middle of nowhere. We have no money.

I've taken my kids to a performance twice in six years. Are you saying that if I

> want my kids to see a pantomime or the balcony scene from Romeo and Juliet, they can see if performed on the Internet? Because they can't go to see a performance. Am I on the right track here? I am getting excited.

Computing and Control: Classroom management is a central issue facing K-12 teachers on a daily basis. Teachers often find themselves alone and facing large numbers of students with many readiness and skill differences. The extent to which a teacher believes the computer will exacerbate or ease these strains affects her propensity to adopt its classroom use. Kate found a substantial change in classroom management issues when her middle school yearbook and newspaper class was in an Internet-connected lab:

> What I found, too, last year when they did the yearbook and the newspaper they hardly ever had the computer lab - only sometimes - to go and write. And now that we're in a lab that's always hooked up to the Internet…. They're never bad like they used to be last year. I mean, if they have nothing to do, they're really quiet and they're just playing on the computer, especially on the Internet.

For Jill, who used math and drawing software with her students, use of the Internet with her students just presented too many unknowns. She felt she could not control them once they were each at their own computer.

> It was just like thinking about that management piece and that just seemed like "Oh, how am I gonna do this?" You know, with first graders, 27 of them and then...the other piece was the Spanish-English. Because of the bilingual. And then once you start explaining something in Spanish, like you've lost the English kids and if you go to English you've lost the Spanish kids. So it was just - basically, it was just a lot of management that was holding me back, too, from that.

Juan, the second grade teacher who was the star technologist in the school, opened his class's use of Virtual Chautauqua to the public. His classroom seemed in perfect order as Juan guided his students through various links on the Internet, but Juan reminded us:

> What you saw today it was 9 months' worth of work, you have to remember that for them to manipulate within Netscape like that for second graders in a second language - it was very good. So you have to remember that what you saw it was 9 months' worth of accumulation of work in the lab.

The age of students in a classroom likely affects the extent to which the computer can occupy attention and assist teachers with keeping order in their classrooms. Yet the computing activity itself affects its ability to help the situation. Individual software programs need to hold students attention. Online activity offered the potential to keep students out of in-classroom trouble making. Yet seemingly quiet surfing activities could be making a lot of "noise" online.

DISCUSSION

In this paper we have discussed the process of computing and Internet technology negotiation among a group of K-12 teachers in Colorado. We found that the process of technology negotiation was influenced by a teacher's technical identity, the messages that she or he receives about technology, and structural factors that facilitate or impede a decision to use technology in the classroom.

As illustrated in the accounts of teachers who participated in this study, technology diffusion is anything but a simple linear process. The process includes a teacher's technical identity, or perception of herself as a technology user; encouraging and cautionary messages from colleagues, administrators, parents, and students; and structural factors such as administrative policies, time available for preparation and training, classroom management issues, and the nature and quality of the technology itself. Understanding these factors and appreciating the process of technology adoption has important ramifications for the theory, policy, and ethics of using computers and the Internet in the classroom.

The concept of technical identity incorporates a teacher's self-perception of ability and comfort level with her objective skills and personal feelings about technology use. As the general concept of identity attempts to capture the way in which individuals constantly renegotiate their relationships with their environment, the concept of technical identity attempts to describe the complexity of individuals' ongoing relationships with technology.

The role of technologist is a relatively new one for most teachers. While all those who participated in the training sessions at Mountain View Elementary possessed the basic skills necessary to use the site, their perception of themselves as technology users varied. Common among the teachers was the assertion that they needed to feel comfortable with the technology prior to using it with their students. As Sally stated, for many teachers, "it's a matter of just being around it and practice, practice, practice. Like you do for kids. Getting comfortable with it. The more you've learned, the more comfortable you are, and visa versa." Teachers' doubts about the stability of the technology and a fear of being stopped, mid-class, by a fatal technical breakdown, compounded these feelings of discomfort.

Another important factor in how teachers related to the technology involved feelings of responsibility and personal philosophies on education and teaching. Most of the students at Mountain View Elementary are minorities, including a large population of students with limited proficiency in English, many children of migrant workers, and many children from low-income households. Most of the teachers at Mountain View, as well as the principal, express a feeling of responsibility to provide these students with the best education possible, utilizing all available resources, and putting them on as equal a footing as possible with other elementary students in the district. One of the main reasons teachers gave for taking students to the computer lab was that those students who did not have computers at home needed to become familiar with their use. Many teachers also felt that computers, and the Internet in particular, were a valuable resource for enriching their own knowledge and teaching.

A significant factor in a teacher's relationship to technology is the variety of messages she receives concerning its importance and use. We observed many messages directed at teachers from inside and outside the school walls. Perhaps of most concern to the teachers was the strong vote of approval from their students, who did not hesitate to express their enthusiasm for their trips to the computer labs or use of a classroom computer. Other teachers, such as Juan, the technology coach, as well as their principal, openly and strongly encouraged the use of computers and the Internet with students.

The voices from outside the school were less clear. The district and community endorsed technology use, providing the technology through the passage of a bond issue. Yet the attempt to regulate students' Internet access with permission slips was a constant issue for teachers

attempting to use the Virtual Chautauqua site. Though the slips complicated technology use for the teachers, parents who signed and returned the slips sent a message of endorsement to teachers, while the inclusion of the slips in the yearly "packet home" might be seen as another expectation of use by the district.

Teachers must try to reconcile their technical identity and messages that they receive about technology with the actual structures in which they use computers and the Internet. Teachers operate within specific matrices of technological, administrative, and pedagogical structures such as time availability and classroom management.

A prevalent issue of Internet usage was locating and limiting sites and information appropriate for students. Though Virtual Chautauqua received praise for providing a limited and useful area on the Internet while maintaining a measure of freedom and interactivity, it was also obvious that teachers need to remain watchful while students use the Internet. As Paula discovered when she accessed a hacked page containing inappropriate and offensive language, one cannot fully rely on technology or outside personnel for screening content. The page in question made it past the Virtual Chautauqua and performing artist's staff, as well as the district's filtering software. In addition, more savvy students themselves bypassed a Virtual Chautauqua lesson and visited a Brittany Spears Web page. Less savvy students accidentally ended up on the CNN Web site with one wrong click.

Though obviously a somewhat unpredictable arena, the global reach of the Internet was particularly attractive to teachers working with this bilingual program. They also found that the Internet helped them address the ongoing problem of finding materials in Spanish. In general, they found the Internet to be a good source for supplementing their curriculum. They also found it helpful for assisting students to pursue individual special interests such as learning about Orca whales.

Beyond issues of content, basic technical problems continue to hamper computer and Internet use in the classroom. The teachers at Mountain View Elementary knew they were lucky to have a new lab with good computers and a fast Internet connection. Still, the district technology department had to struggle to configure the lab. Lab computers froze or crashed often enough that teachers asked Juan to keep a box of paperclips on the counter in the lab (needed to press the restart button on the iMac computers).

At other schools, teachers who wanted to use Virtual Chautauqua were prevented by a lack of hardware or Internet connectivity. Kate was unable to locate a computer at her middle school with both multimedia capability and an Internet connection. Some schools in more isolated areas, where the variety of performances shown on Virtual Chautauqua may have been most appreciated, were unable to access the site due to inadequate Internet connections. The issues of technology availability and Internet connectivity, focused on by programs such as e-rate, remain a concern. Further structural issues, such as the availability and timeliness of technical support and the instability of the technology, plague and frustrate teachers' use of computers and the Internet on a daily basis.

The framework used for approaching the data helped to organize the complex negotiations observed in this study. It also holds promise for theory building as future comparative research considers the process of diffusion with different types of schools and student populations, as well as in various non-educational settings. These types of studies will not only build theory in

technology diffusion, but will provide empirical data allowing for tailored educational technology policymaking.

This work also provides a grounding to the development of quantitative studies that could more readily gather data around these factors on a generalizable scale. Quantitative data, such as that contained in the *Education Week* and NCES surveys reviewed early in this paper, show a valuable wide-angle view of computer and Internet use and availability in schools. This picture informs researchers and policy makers about trends in educational technology and shows the effects of wide-scale programs such as e-rate funding. They also provide important information concerning the technological landscape in which teachers think about and use these teaching tools. Yet it is essential that future research recognize that each teacher brings a full range of feelings and experiences to the technology. It is the educator herself who will finally decide if, how, when, and why computers and the Internet are incorporated into her teaching and lessons. Research that validates and expands on the role of the teacher as an educational innovator will improve the soundness of policy goals and strategies for technology integration.

This work would be amiss without acknowledging the multi-level bias toward technology diffusion in the schools. This spirit of computerization (Sullivan 1999) has overpowered those other voices critical of wiring classes (Postman 1995; Talbott 1995). It is to the teachers' own credit that they shared a belief that technology for technology's sake was not a good reason to have computers in their classrooms. They felt a duty to use technology to strengthen strategies for meeting existing curricular goals. Yet this philosophy demanded greater time commitments from teachers – time that was often taken from the family and personal life of teachers. Policies, institutional structures and financial resource allocations that allow workday development time would best serve the responsible integration of technology in schools. Without such plans, it is likely that external pressures will overcome teacher preferences to use the technology responsibly If this happens, 100% of schools may be wired, but teachers and their students will be left unplugged.

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