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ABSTRACT

In 1991, educators at the Curry School of Education at the University of Virginia began developing ideas for integrating telecommunications into the instructional practices of public school teachers using Virginia's Public Education Network. Teachers from across the state were invited to participate in a telecommunications project called the Electronic Academical Village, consisting of a variety of electronic resources developed for elementary, middle, and high school teachers. Teachers had the option of utilizing existing resources or initiating projects which corresponded to their curricular needs. During the first two years of the project, patterns of use emerged. Although the teachers had training, support, and access to equipment in their classrooms, some were not participating. Six individual case studies were developed based on teachers' levels of participation in telecommunications projects. Three had relatively high levels of participation, and three had low levels. Data from the individual cases of high and low users were compared using cross-case analysis. Findings indicated that teachers who were integrating telecommunications into their teaching practices valued the use of an interactive learning network; figured out how to use it instructionally; received support from other users; and had access to computer equipment at home. Circumstances and experiences that did not appear to impact on use were the number of computers in a school and the principal's level of knowledge and interest in telecommunications. (Contains 27 references.) (Author/JLB)

Circumstances and Experiences That Lead to Incorporating Telecommunications into Teaching Practices

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Abstract

In 1991, educators at the Curry School of Education at the University of Virginia began developing ideas for integrating telecommunications into the instructional practices of public school teachers throughout the state of Virginia using Virginia's Public Education Network (Virginia's PEN). Teachers from across the state were invited to participate in a telecommunications project called the Electronic Academical Village. The Electronic Academical Village consisted of a variety of electronic resources developed for elementary, middle, and high school teachers. Teachers had the option of utilizing existing resources or initiating projects which corresponded to their curricular needs.

During the first two years of the Electronic Academical Village Project, patterns of use emerged. Although the teachers had training, support, and access to equipment in their classrooms, some were not participating. Why was this so? What circumstances and experiences led some teachers to incorporate telecommunications into their teaching practices, while others did not?

Six individual case studies were developed based on teachers' levels of participation in telecommunications projects. Three had relatively high levels of participation, and three had low levels. Data from the individual cases of high and low users were compared using cross-case analysis.

The findings indicated that teachers who were integrating telecommunications into their teaching practices valued the use of an interactive learning network and had figured out how to use it instructionally. They received support from other users and had access to computer equipment at home. Circumstances and experiences that did not appear to impact on use were the number of computers in a school and the principal's level of knowledge and interest in telecommunications. The findings from this study might be useful for those who wish to promote the use of interactive learning networks to enhance instruction.

Circumstances and Experiences That Lead to Incorporating Telecommunications into Teaching Practices

Papert (1993) posed the following analogy:

> Imagine a party of time travelers from an earlier century, among them one group of surgeons and another of school teachers, each group eager to see how much things have changed in their profession a hundred or more years into the future. (p. 1)

The surgeons would be overwhelmed by the technological advances in the medical profession and although they might be able to guess the procedure being performed, many things would be unfamiliar to them. On the other hand, Papert suggested the teachers would find that schools, classrooms, and the delivery of instruction had changed very little in 100 years. He thought teachers "would fully see the point of most of what was being attempted and could quite easily take over the ciass" (p. 2).

Cuban (1984), Goodlad (1984), Kerr (1989), and David (1991) support Papert's analogy. David (1991) wrote:

> Schools are out of step with the times. Inside and out, schools today look very much the way they did a hundred years ago: the buildings, the size and shapes of classrooms, the divisions based on age, and the ways of "delivering" instruction have changed very little. Yet the world has changed remarkably. Families, jobs, social organizations, and entertainment look nothing like they did at the turn of the century. From inside a school, however, one would hardly know that visual images, rapid motion, technology, and change are pervasive in the world outside. (p. 37)

Hall (1991) remarked, "As I have observed and analyzed the various 'movements' in education, I see us continuing to cling to the worst features of the one room school house" (p. 32). Why is this so? Cohen (1987) suggested that most children develop traditional attitudes about teaching and learning before they enter school, and the teacher-

centered model of instruction has become ingrained into students, teachers, administrators, parents, and members of the community.

The teacher-centered model and the lock-step approach to instruction are no longer adequate. Active learning strategies must be incorporated into the planning and delivery of instruction, and instruction should center around an integrated curriculum. Students should be given opportunities to take responsibility for their own learning and to see results based on their strategies (Wang & Palincsar, 1989). If change is to occur, teachers must have the flexibility to make decisions about the change based on circumstances, and the time to think about the innovation and how to use it (David, 1991).

Technology, when integrated into the curriculum, has the potential to break the "lock-step" mold (Collins, 1991). Technology engages students in learning things relevant to them and facilitates small group instruction. Researchers (Becker, 1992; Irving, 1991; Sheingold and Hadley, 1990) found that when technology was integrated into instructional practices, teachers became coaches or facilitators who guided and monitored student learning. Student assessment changed from individual performance on tests to assessment based on products, progress, and effort. Students researched topics of interest and consulted with other students, teachers, and experts from around the world. The social structure of the classroom changed from competitive to cooperative and repeated failure was eliminated.

The development of learner-based software has contributed to the relevant use of computers in classrooms. Through the use of learner-based software, students focus on process rather than product thus creating a three-way interaction between the teacher, computer, and student as illustrated in Figure 1 (Bull and Cochran, 1991). Through telecommunications, students and teachers extend this three-way interaction and increase their realm of experiences as they tap the expertise of peers and experts around the world (David, 1991; Levinson, 1990; Sheingold, 1991).

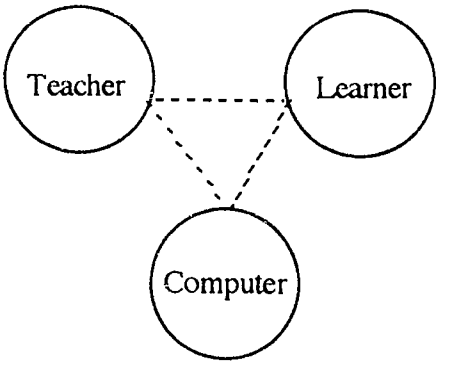

Figure 1 Three-Way Interaction
(Bull and Cochran, 1991, p. 52)

However, providing teachers and students with hardware and software is not enough. Becker (1992) discovered that teachers needed assistance with integrating technology into teaching practices, and Kerr (1989) and Riel (1989) suggested that teaching models be developed which demonstrate what is possible under real conditions.

Computer-Assisted Instruction

As schools began to embrace computers, questions surfaced: Who are the users and how are computers being used? (Cuban, 1986). In 1984, Shavelson, Winkler, Statz, and Feibel conducted a study to determine how teachers were using computers for math and science instruction. They categorized computer-using teachers into four groups: the orchestration group, the enrichment group, the adjunct instruction group, and the drill and practice group. Teachers in the orchestration group were familiar with software and were comfortable integrating the use of computers into their teaching practices. The enrichment group used computers to enrich subject areas other than math and science and encouraged students to use computers for word processing. The adjunct instruction group consisted of teachers who used computers to augment specific subject areas and/or lessons, and members of the drill and practice group used computers for drill and practice only.

Shavelson, Winkler, Statz, and Feibel (1984) reported that patterns of use seemed to be unrelated to the amount of computer experience or a teacher's knowledge of subject matter. Patterns of use, however, did reflect knowledge of software. They found that teachers in the drill and practice group were significantly less informed about software than teachers in other groups and were the least likely to integrate the use of computers into teaching practices.

Sheingold and Hadley (1990) conducted a study of exemplary computer-using teachers. They found that three things contributed significantly to the successful integration of computers into teaching practices: teacher motivation and commitment to student learning, the amount of support teachers received from the school division, and the accessibility of equipment. They found that teachers who were integrating computers into instructional practices had spent a considerable amount of time learning how to use computers and had become comfortable using them. The teachers in the Sheingold and Hadley study reported that the use of computers had caused them to teach differently and more effectively:

> Many have incorporated the technology into their teaching practices in ways they believe have transformed their practice - for example, making their classrooms less teacher-centered and more student-centered, getting students actively involved in doing projects and creating products, helping students to do more thinking and interpreting, giving students more individual attention, and allowing students to work more independently. (Sheingold and Hadley, 1990, p. 31)

Sheingold and Hadley found that time was also an important issue. Based on their results, they estimated that it took between five and six years for teachers to master the use of computers and incorporate computer-assisted instruction into their practices. They speculated that this time period might decrease as teacher education programs trained pre-service teachers to use computers in classrooms.

Becker (1992) expanded on Sheingold and Hadley's work and examined the differences between exemplary computer-using teachers and typical computer-using

teachers. He found that several environmental characteristics appeared to increase the likelihood of exemplary use. The first characteristic was a network of computer-using teachers. Becker noted, "One of the largest differences between exemplary computing teachers and other computer-using teachers is simply the total number of teachers at their school whose students use computers for their classes" (p. 10). Exemplary teachers practiced in environments where they could learn from others and taught in schools that had more computers per capita.

The second environmental characteristic involved using computers for purposeful activities. Exemplary teachers taught in schools where computer activities were consequential, such as publishing the school's newspaper or yearbook. Also, exemplary teachers were twice as likely to be at schools where students had been using word processors to complete school assignments for three or more years. Other environmental characteristics included support from a full-time building or district computer coordinator, access to formal training in how to integrate computer-based instruction into specific subject areas, resource-rich environments, and class size. Becker noted, "Class size was the largest independent predictive effect between exemplary and other computer-using teachers" (p.15).

Exemplary teachers reported that their teaching practices had changed as a result of using computers in their classrooms. They were placing greater emphasis on small-group instruction and were incorporating a wide variety of software into the curriculum. Becker wrote, "If there is one thing that seems to distinguish exemplary computer users it is that, in their classes, students' use of computers is woven integrally into the patterns of learning and instruction through which the curriculum is given meaning" (Becker, 1992, p. 25).

These studies investigated how teachers used computers in classrooms and the characteristics affecting use. Shavelson, Winkler, Statz, and Feibel (1984) identified how teachers were using computers for instruction. Sheingold and Hadley (1990) investigated how exemplary computer-using teachers were using computers in classrooms. Becker

expanded on Sheingold and Hadley's research by examining the differences between exemplary computer-using teachers and typical computer-using teachers in regard to the school and classroom environment. Backgrounds, experiences, practices, and perceptions of teaching with computers were also reported.

Telecommunications

Telecommunications involves using a computer network system to communicate with others electronically. Teachers and students can collaborate on projects or share ideas electronically through electronic mail and conferencing. This provides teachers and students with opportunities to extend learning experiences across time and space. Riel (1989) explained, "Educators using these tools have begun to redesign lessons, encouraging students to become both teacher and learner in the new system" (p. 261).

Telecommunications encompasses three aspects: information, conversation, and instruction (Rosenberg and Elsbree, 1989). The informational and conversational aspects are both user-driven. The conversation component includes electronic mail (e-mail) and electronic conferencing for users' purposes. The third component, instruction, is different from the other two because it is teacher-driven. This component relates to incorporating telecommunications into instructional practices and includes data-based searches, collaboration on curricular projects, and electronic mail and conferencing related to specific issues.

Precursor to Present Day Telecommunications Networks

Perhaps the first model for teaching with technology was created by Celestin Freinet, a French educator (1896-1966) and founder of the Modern School Movement (Cummins and Sayers, 1990). Freinet combined reading and writing activities with the most advanced printing technologies available to educators at the time: the mimeograph

machine and the movable type printing press. The curriculum centered around student writing. Freinet required his students to keep journals, which he referred to as "life books." The books were exchanged with a classroom at another school via the postal system. Eventually this project grew from a few teachers at one school to a network of thousands of schools in thirty-three countries. Exchanges between schools were not just one-on-one pen pal exchanges, but class-to-class partnerships between teachers and students working on joint curricular projects. Freinet's work is important because he employed the educational technology of his day to enhance instruction and created a model for networking that was the forerunner to present day electronic conferencing.

Studies of Telecommunications Networks for Instruction

Irving (1991) studied the use of telecommunications as an instructional tool and focused on whether curriculum could be enriched by unlimited and immediate access to online data bases. The participants were elementary and secondary students in Great Britain. She found that through the use of telecommunications, learning became more practical and relevant, and students focused on content, rather than on isolated facts and skills. The emphasis shifted to application and the development of conceptual understanding as students built concepts based on their own discoveries. The use of telecommunications also facilitated cooperative learning as students solved real problems.

Irving also found that when telecommunications was integrated into teaching practices, the teacher's role changed. "Teachers acted as guides and facilitators, checking search strategies from printouts and assessing children's knowledge of the topics they were researching." (p. 222). Irving's findings were supported by the viewpoints of Thompson (1991) and David (1991).

Riel (1989) compared four models for teaching with telecommunications: American Telephone and Telegraph' s (AT&T) Long Distance Learning Network (LDLN), CMS Free Educational Mail Systems (FrEdMail), the McGraw-Hill Information eXchange (MIX), and the National Geographic Kids Network (Kids Network). She investigated participation in electronic conferences and reported that an integral part of a group's dynamics consisted of response opportunities and response obligations. Response opportunities were dependent on the accessibility of electronic equipment (computers, modems, and phone lines) and the ease of accessing and using the system. Response obligations were either explicit or tacit depending on the network. Riel suggested that when considering a model, policy makers analyze the strengths and weakness of each model and the needs of the community to be served. A balance must be reached when considering a novice's need for structure and an experienced teacher's need for options. Control of how to use the network and network activities should be diverse and be able to attract participants.

Marker and Ehman (1989) conducted a study of thirteen school districts in Indiana who were implementing the use of AT&T's Long Distance Learning Network Project (LDLN). Marker and Ehman found that school administrators underestimated the complexity of the implementation process. Not enough time was devoted to the training of teachers, and too many aspects of telecommunications were jammed into a single one-day training workshop. The teachers were unable to learn specific technologies, develop classroom applications, and teach at the same time. Support was sporadic, and many teachers became frustrated and developed negative views toward technology. Marker & Ehman suggested that when trying to adopt an innovation such as this one, it is critical to select teachers who "believe in the potential benefits of technology" (p. 28) and include them in the planning process.

To increase the use of technology in classrooms, Kerr (1989) suggested that teachers be given the opportunity to explore how technology could fit into their daily

routines. He explained, "We should not be trying to supplant the models and practices that teachers have developed but instead develop models of teaching-with-technology" (p. 10).

The Electronic Academical Village Project

In 1991, educators at the Curry School of Education at the University of Virginia began developing ideas for integrating telecommunications into the instructional practices of public school teachers throughout the state of Virginia using Virginia's Public Education Network (Virginia's PEN). Teachers from across the state were invited to participate in a telecommunications project called the Electronic Academical Village. The Electronic Academical Village consisted of a variety of electronic resources developed for elementary, middle, and high school teachers. Teachers had the option of utilizing existing resources or initiating projects which corresponded to their curricular needs.

Participants were elementary classroom teachers who had been recommended by their school division as being positive toward technology and innovative in their teaching practices. Participants had a Macintosh computer, a modem, and a dedicated phone line in their classrooms, and they received monetary compensation for attending training workshops.

During the first two years of the Electronic Academical Village Project, patterns of use emerged. Although the teachers had training, support, and access to equipment in their classrooms, some were not participating. Why was this so? What circumstances and experiences led some teachers to incorporate telecommunications into their teaching practices, while others did not?

Research Design

Six teachers were asked to participate in this study, and selection was based on the levels of participation in project activities. Three had relatively high levels of participation,

as demonstrated by frequent contributions to electronic conferences and the initiation of additional networking activities, and three were selected based on their lack of participation in Electronic Academical Village projects. Individual case studies were developed and consisted of guided interviews with the teacher, his/her principal, and the facilitator who had been assigned to the teacher for technical and curricular support. (See Figure 2.)

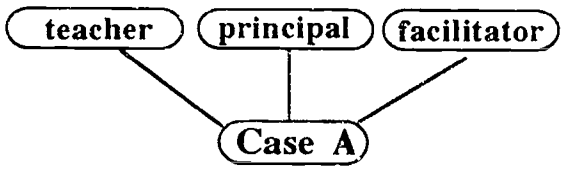

Figure 2 Components of an Individual Case

The high users were Anna Adams, Betty Brown, and Catherine Caprio. Adams and Brown were elementary teachers; Adams taught fifth grade, and Brown taught third. Caprio was a middle school resource teacher for gifted students. The low users were Doug Duncan, Emily Edwards, and Frances Frost. Duncan and Edwards taught fifth grade, and Frost was a middle school science teacher. All teachers had a Macintosh computer, modem, and phone line in their classroom, with the exception of Caprio, who was waiting for a phone line to be installed.

Of the high users, Adams and Brown and their facilitators, Albert Ashe and Brad Bergman, were in their second year of involvement with the Electronic Academical Village Project. Caprio and her facilitator, Casey Cavanaugh, were both new to the Electronic Academical Village Project the year this study was conducted. Edwards, a low user, was also in her second year of involvement with the Electronic Academical Village Project as was her facilitator, Edgar Evans, but they had not worked together the first year. (Emily had transferred to a new school and was assigned a facilitator who was closer to her school.) Frost was also a new member of the Electronic Academical Village Project, but her facilitator, Fred Feldon, was in his second year of facilitating. Both Duncan and his

facilitator, Darlene Dubinska, were new members of the Electronic Academical Village. Chart 3 illustrates the high users and their facilitators. The * indicates that the person was new to the Electronic Academical Village.

Case 1	Case 2	Case 3
Anna Adams	Betty Brown	Catherine Caprio *
Albert Ashe	Brad Bergman	Casey Cavanaugh *

Chart 3 High Users and Their Facilitators

Chart 4 outlines the low users and their facilitators. Again, the * denotes the people who were new to the Electronic Academical Village Project.

Case 4	Case 5	Case 6
Doug Duncan *	Emily Edwards	Frances Frost *
Darlene Dubinska *	Edgar Evans	Fred Feldon

Chart 4 Low Users and Their Facilitators

All of the facilitators were high school science teachers with the exception of Darlene Dubinska, who was a high school math teacher, and Brad Bergman, who was the technology supervisor for his school division. Of the five facilitators who were teachers, Albert Ashe was a department chairman, which reduced his teaching load, and Fred Feldon taught at a Governor's School with an abbreviated teaching load. Casey Cavanaugh, Darlene Dubinska, and Edgar Evans all had full-time teaching responsibilities.

All of the facilitators, with the exception of Darlene Dubinska, were high users of telecommunications and were comfortable incorporating telecommunications into their teaching practices. Dubinska had not used telecommunications before her involvement in

the Electronic Academical Village Project and was overwhelmed at first, but she took responsibility for her role as a facilitator and enrolled in a telecommunications and distance education course at a university near her home. She wanted to become more knowledgeable about telecommunications to assist the teachers in her group. Although she had not used any telecommunications projects with her classes, she reported that she was comfortable in doing so.

All of the data were collected through guided interviews which were conducted at the schools of participants, or in the district office for Brad Bergman. Data were collected from February 5, 1993 through April 2, 1993, and included eighteen one-hour interviews. Interviews with the teachers centered around gathering information about how they were incorporating telecommunications into their teaching practices and the concerns they had about doing so. The interviews with the principals focused on gathering data about the use of Virginia's PEN by the teachers and students in their schools. Principals were also questioned about their awareness of the possibilities of use for Virginia's PEN, the accessibility of the network to students and faculty members, and their feelings about telecommunications in general.

The interviews with the facilitators gathered data on the types of assistance they had provided for the teachers and how they were promoting the use of the network. The facilitators were expected to assist teachers by implementing content-related projects in the Math and Science Pavilion of the Electronic Academical Village. For example, Casey Cavanaugh initiated a project on recycling at the request of the teachers in her state-wide group, and Darlene Dubinska implemented a project on climates. Interview questions centered around the involvement of the teachers in their local group, the involvement of teachers in their state-wide (project) group, and their general feelings about the Electronic Academical Village and Virginia's PEN.

Data from the interviews with the teachers were analyzed using the Levels of Use and Stages of Concern categories developed by Hall and his associates (Hall and Hord,

1987; Hall, Loucks, Rutherford and Newlove, 1975; Newlove and Hall, 1976). This method was chosen because it provided a comprehensive assessment of how teachers were actually using telecommunications and their stage of concern about use. This information was used to investigate the circumstances and experiences that led to incorporating telecommunications into teaching practices. Data from the principals and facilitators were also used to explore the circumstances and experiences that led teachers to incorporate telecommunications into teaching practices. The data collected from the interviews with the principals and the facilitators were analyzed using content analysis to identify common patterns and themes (Patton, 1990). Once patterns emerged, the data were organized into groups and reported. Triangulation was established by collecting data from multiple sources, and trustworthiness was established through member checking and peer debriefing (Lincoln and Guba, 1985; Patton, 1990; Yin, 1989). The participants' names and schools were changed to protect their anonymity.

Each case was analyzed and reported individually. After each set of cases was reported, a cross-case analysis for the high users and the low users was developed and presented. A final analysis of both the high users and low users was conducted, and the findings from these cases were used to determine the circumstances and experiences that led some teachers to be high users and some to be low users. Data analysis began on April 3, 1993, and continued until May 15, 1993.

Description of Findings

Based on the information collected on high and low users, the following circumstances and experiences appeared to contribute to the incorporation of telecommunications into teaching practices:

1. Valuing the use of an interactive learning network

2. "Figuring out" how to integrate telecommunications into the curriculum
3. Receiving support from other computer-using teachers
4. Having access to equipment at home
5. Being in transition

Teachers who were incorporating telecommunications into their teaching practices valued the network and overcame barriers for use. High users were described by their principals and peers as excellent teachers who were learners themselves. They were open to new ideas and willing to try new things to increase student learning.

Teachers who were high users invested time to learn how to incorporate telecommunications into instructional plans because they felt it was important to engage students in these activities. Brown, one of the high users, wanted to use Virginia's PEN with her third-grade students. However, she found that the available activities were not interesting, interactive, or meaningful to her students, so she developed interactive telecommunications activities to provide students with opportunities to create electronic dialogue with students in other schools. She created a state-wide conference on Virginia's PEN called Elementary Books. In this electronic conference, students and teachers across Virginia could write to the popular book character, Ramona Quimby, and Ramona (Betty) would reply to their letters. This project was so successful that Brown arranged for parents and other interested volunteers to portray other book characters such as Willie Wonka, Winnie the Pooh, and Bunnicula. Based on her efforts, students in her class and throughout Virginia were using the network for interactive learning.

The high users changed the way they presented instruction to accommodate the use of telecommunications. For example, Adams began using telecommunication activities with one small group of students because she was not confident enough to try it with more. After she gained confidence, she incorporated several telecommunications activities into instruction. As she did this, her classroom role changed. She moved from whole-group to

small-group instruction as students collaborated on projects and took more responsibility for their own learning.

High users had "figured out" how to integrate telecommunications into the curriculum, and this appeared to influence use. Albert Ashe, Adams's facilitator, stated, "You don't want it to be a stand-alone technology. It has to blend in with what you are already doing." The principals agreed. One stated, "I don't want my teachers to be using telecommunications just to be using telecommunications. There has to be some instructional need that it is meeting." However, to incorporate telecommunications into instructional plans, teachers had to be comfortable in using the technology themselves. Therefore, it was no surprise to find that teachers in this study who were struggling with basic technical procedures were less willing to incorporate telecommunications into teaching practices. For example, Frost, a low user, lacked technical expertise and was unable to participate in online projects with her students.

This leads to the third influence on use. High users taught in schools where other teachers were engaged in telecommunications activities and were using computers as multi-purpose tools. High users also taught in schools where students were producing videos and using sophisticated software to create school publications. High users also received support from their facilitators and attended the workshops of the Electronic Academical Village to form connections with other project teachers.

Unfortunately, the low users did not take advantage of opportunities to learn or initiate contact with those who were assigned to assist them. Edgar Evans, a facilitator, worked with several of the low users and he was frustrated in his efforts to help them. He sent his group weekly e-mail messages, but he rarely got any responses. To create more interest, Evans searched the Internet for shareware which he tried to use as "bait." For example, after finding a drawing program, he posted the following message:

> This is some great stuff here! It's in color. You all have an ink jet printer at your school, and you can use this with your printer. You can draw and print in color. Wouldn't it be great to have signs or banners in your classroom that are in color?

He also found HyperCard stacks that prompted students to create a story as they progressed through the stack. Again, he wrote, "Hey! I just found something that creates a story. It gives the students the parts, and they fill in the gaps. Interested?" Evans assumed that they were not interested because he never got any responses.

In addition to not responding to offers of assistance, facilitators reported that low users rarely asked for help; however, some users may not have know how to get help. Frost reported that her facilitator had sent her an e-mail message asking her if she needed help. She wanted to respond, but she did not know how. She said, "I didn't want to try typing an "r" (to respond to a mail message) because I was scared that the message would get lost." She tried to address the message herself, but she was unaware of the correct procedure, and her messages were returned as being undeliverable. "I got real frustrated, and I didn't try anymore." Despite Frost's frustrations, she never asked for help. Brown, a high user, thought that many people did not know how to get technical help and gave up. She explained:

> It's like being out there on a space ship, and you are floating on a tether. There is a problem, and you need to come back and you are banging on the spaceship going "'Hello. Hey! Somebody, I'm having this trouble here. Hey! Is anybody there?" And that's really what you feel like. You feel like here I am out here on this tether, which is an electronic network. I'm out here doing these things, and I'm having trouble, and I don't know who is supposed to come and give me the help that I need.

Other factors also seemed to contribute to low use. The lack of computers at home curtailed the networking activities of the low users. All of the teachers who were high users had computers and modems at home as compared to only one of the low users. Being in transition also may have contributed to low use. All of the low users were new to their roles. Two were new to the teaching profession, and one, though a very experienced teacher, was in a new role as a technical support person at her school. In addition, two of

the low users were at newly-opened schools and may have been overwhelmed as they adjusted to new situations.

Circumstances that Did Not Seem to Impact on Use

Several circumstances did not seem to impact on use. They were:

1. The number of computers in the school
2. The principal's level of knowledge and interest in telecommunications
3. The actions of the facilitators

The number of computers in the school did not seem to influence use. The highest user, Betty Brown, taught at a school that was old and had little equipment. The second highest user, Catherine Caprio, taught at a school that was described as being "state of the art," but it only had one modem. Caprio conducted telecommunications projects with her students and uploaded the information from home. Of the low users, two taught at new schools where every classroom was equipped with a computer and a modem, but teachers did not use them. Based on these circumstances, it seemed appropriate to conclude that the number of computers, modems, and phone lines did not sharply influence participation in telecommunications projects.

The principals' levels of knowledge, interests in telecommunications, and styles of leadership also seemed to have little bearing on teachers' use. Of the high-using teachers, only one principal had an electronic-mail account, and he was an infrequent user. Of the low users, one principal was an active user, and the other principals had limited knowledge of Virginia's PEN.

The principals' styles of leadership also seemed to have little impact on teachers' use. For example, one principal of a low user was actively involved in telecommunications and conducted training workshops, while another principal of a low user arranged for

mandatory workshops on telecommunications. The principals of high users were varied in their knowledge and approach to telecommunications. Based on the data collected, no corresponding patterns between principals' and teachers' levels of use were evident.

It also appeared that the actions of the facilitators did not influence teachers' use of telecommunications. Two of the most active users had facilitators who were not actively engaged in leadership roles, and two of the most active facilitators were not successful. One facilitator lacked technical expertise and was not able to fully assist the teachers in her group.

The Concerns of High and Low Users

Four major concerns were expressed by both high and low users and their facilitators. They were:

1. Time
2. Access to equipment and local nodes
3. Training
4. Lack of specifically stated protocols

Time was mentioned by every participant. Participants were concerned with the amount time necessary to become familiar with the network and to plan lessons involving telecommunications. One facilitator, Edgar Evans, thought that interest reflected the amount of time someone was willing to spend to learn how to use telecommunications. He said, "You have to have a reason to spend the time to learn how to use it; a reason to check your mail once a night."

Access was the second major concern. The participants expressed concern over not being able to access their local nodes during the school day because the lines were busy. One high user was frustrated because her school had only one modem and not enough

phone lines. She explained that it was unusual to get a line out of her building, and when she did, she most often found that the phone line to the node was busy. She reported that it was nearly impossible to plan to use the network with a class of children because there was no way to predict whether they would be able to log on. One facilitator also described his frustration with a lack of phone lines. He had a computer, a modem, the connecting cables, and telephone jack in the wall, but the phone line didn't connect to anything. He called it the "Fisher-Price system."

Learning to use the network instructionally was also a concern, and participants suggested that instructional models be developed to assist new users. Demonstrations by teachers who were using telecommunications were recommended. Participants also suggested that training for high and low users be changed. More advanced users could collaborate on projects for implementation on the network while new users assisted each other with basic procedures. Step-by-step lesson plans for telecommunications projects were also recommended.

The absence of specifically stated protocols for posting was also a concern. Lack of stated rules caused teachers and students to post incorrectly. This resulted in different threads of the same discussion. Participants suggested that conferences be moderated and misposted articles be moved to the correct discussion strand. In addition, some postings were not appropriate to the thread of the discussion. Betty Brown gave the following example: Two classes might be in the middle of a discussion about rocks and someone writes, "I saw your posting, and I love rocks. I have a pet rock." She stressed that inappropriate postings were confusing and should be deleted. Without moderators, however, inappropriate postings stayed on conferences indefinitely. Participants believed that a lack of order created frustration and decreased the quality of discussions.

Relating Results to Prior Research

In this study, teachers who integrated telecommunications into their teaching practices valued the use of an interactive learning network because they recognized the potential the network had for enhancing instructional practices and increasing student learning. This was supported by Marker and Ehman (1989) who suggested that when implementing a technological innovation, it was critical to select teachers who were interested in using technology to improve instruction. Also, high users in this study had made changes to integrate telecommunications into the curriculum, and this was supported by Becker (1992).

Sheingold and Hadley's (1990) research also supported the following findings:

1. Teachers who were integrating computers into their instructional practices had spent a considerable amount of time learning how to use computers and were comfortable using them.
2. The key incentive for use among teachers was the desire to create an environment where students were engaged in their own learning and used computers effectively.
3. The focus of instruction had shifted from teacher-centered to student-centered and teachers' perceptions of student performance had changed.

The findings from this study did not entirely support those of Becker (1992). Becker reported that teachers who were considered to be exemplary computer users taught in more resource-rich environments. However, in this study, this was not entirely true. Two of the low users taught in newly opened schools which were described as being "state-of-the-art." These teachers may not have been incorporating telecommunications into their teaching practices because they were in transition, but neither teacher indicated that they were interested in using telecommunications in the future.

Suggested Research

Future research should focus on the relationship between a teacher's view of curriculum and the incorporation of telecommunications into teaching practices. Did the teachers who were successfully integrating technology into teaching practices change their views on curriculum, or did their views on curriculum support the use of telecommunications?

Further research is needed to discover what types of technical and instructional support are necessary to sustain long-term use of a telecommunications network. In addition, other research needs to focus on who to support. Although there is a strong push to use computers, some teachers are resistant. Research is needed to discover the characteristics that make teachers interested in using computers and incorporating telecommunications into teaching practices.

Further investigation is also needed to discover if transition is important. Is transition an important characteristic for not using telecommunications? If it is, should teachers who are in transition be excluded from telecommunications projects?

Finally, longitudinal studies of the impact of the use of telecommunications on student learning should be conducted. Considering the cost, is this a viable instructional tool? Would increasing the number of computers, phone lines, and modems directly affect student learning?

Conclusion

This study explored the circumstances and experiences that led some teachers to incorporate the use of telecommunications into their teaching practices, while others did not. The findings indicated that teachers who were integrating telecommunications into their teaching practices valued the use of an interactive learning network and had figured

out how to use it instructionally. They had also received support from other users and had access to equipment at home. Being transition appeared to have a negative impact on using telecommunications.

Circumstances and experiences that did not appear to impact on use were the number of computers in a school, the principal's level of knowledge and interest in telecommunications, and the actions of the project's facilitators.

The major concerns expressed by the participants were: time, access to equipment and local nodes, training, and the lack of specifically stated protocols on network conferences. These findings should be useful for all who wish to promote the use of interactive learning networks to enhance instruction.

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