Problems with Integrating Computer Technology into the K-12 Educational Curriculum:
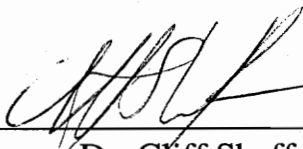## A Study of the Use of the Internet and Video-Conferencing in a Fifth Grade Classroom
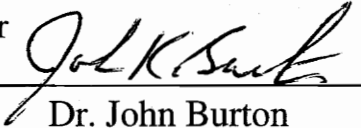
by

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1. Abstract

Through a National Science Foundation (NSF) grant, Virginia Tech was given funding to connect local schools to the Internet and provide teachers with computers and related technology in their classrooms. In the process of introducing this technology into the schools, we encountered many common problems that school districts face when placing computers in the classrooms.

This paper begins by discussing the effects that computer technology has on teaching methods and the learning process. It shows how teachers slowly move toward a more constructivist approach to teaching as they become more comfortable using and applying the technology in their classrooms. It also shows how children begin to individualize their learning with the use of technology. Instead of each student learning the same lesson, computer technology allows children to spend more time in areas that interest them and freely explore and learn on their own. The first half of this paper concludes by reviewing the many problems faced by school districts and teachers when computer technology is introduced into the classrooms.

The second half of the paper is devoted to a video-conferencing project in which many of these problems were encountered in a real classroom situation. The current state of video-conferencing technology is discussed along with problems encountered while using it in the classroom and its potential for the future.

2. Acknowledgments

I would like to thank the following people for their contributions and support during this project: Dr. Roger Ehrich, my advisor; Dr. John Burton and Dr. Cliff Shaffer, committee members; Melissa Matusevich, teacher at Montgomery County Schools and instructional coordinator for the project; Susan Hood, Cheryl Roberts, and Tamra Oliver, teachers at Montgomery County School District whose classes participated in the project; Terrye Latting, teacher at Sunset Elementary School in Bellevue Washington whose class participated in the project; Mike Bibeau and Paul Mather, Virginia Tech graduate students who helped with the project; all the other administrators and teachers at Montgomery County Schools who donated their time to learn how to use and apply computer technology in their classrooms; and finally, to all the students that participated in this study.

3. Table Of Contents

4. Introduction

The Blacksburg Electronic Village (BEV) is a cooperative project of Virginia Tech, Bell Atlantic of Virginia, and the Town of Blacksburg, that links the citizens of the Blacksburg to each other and to the worldwide Internet. One of the goals of BEV is to interconnect every aspect of the community including government, businesses, schools, and citizens.

Although BEV has been a success, some of its goals have not yet been realized, including the integration of the K-12 schools into BEV. To help plan for a solution to this problem, the National Science Foundation (NSF) provided a grant to Virginia Tech to connect the schools to BEV and to educate the teachers and administrators on using computer technology and the Internet. This report is a result of nine months of work with the Montgomery County Public Schools as part of this grant. With the grant money, several computers were purchased for use by the Montgomery County School District. Along with this equipment, T1 network lines were run to five of the nineteen schools giving them direct access to BEV and the Internet.

A portion of the grant money went to several projects conducted by Virginia Tech students. One of those projects was to conduct a video-conferencing session in a fifth-grade geography class to study the effects that the video channel has on long-term retentivity of the information presented. Unfortunately, many problems plagued this project and although the class and the video-conferencing session did take place,

there was not enough time remaining in the school year to study its long term effects. However, through observations of the class, the video-conferencing sessions and the short-term results, insight was gained into the problems of using this technology in the classroom.

During the nine months of work with the schools and teachers in trying to make the video-conferencing study a success, several problems with introducing and using computer technology into the classroom have been discovered. This paper describes the problems encountered and potential solutions.

The first section of the paper discusses how introducing technology into the classroom effects the way teachers teach and children learn. The second section gives a general overview of video-teleconferencing and discusses the video-conferencing project.

5. Computer Technology in K-12 Classrooms

Technology has revolutionized our society and culture, and now the educational system is trying to catch up. "Although the schools are embedded in our culture and reflect its values, the technological changes that have swept through society at large have left the educational system largely unchanged." [STRO92] The revolution in the classrooms began with the introduction of television. "Television rediscovered and recast the world as a direct experience, liberating it from the confines of text and static illustrations." [STRO92] Television, however, was only used as an "add-on" to traditional teaching methods. It did not revolutionize or reform the educational system.

In the last few years, the educational community is slowly attempting to introduce computer technology into the classroom. Computers are being viewed as the key to revolutionizing the educational system. Computers have the capability of doing this. However, there are many problems that must first be overcome. Computer technology needs to be seen as more than a tool or resource; computer technology must become an integral part of the classroom curriculum. For this to take place, the traditional teaching methods must be reformed.

5.1 Computer Technology and School Reform

Most people believe that introducing computer technology into the classroom will be a "quick fix" to our nation's educational problems. In the past, too much emphasis was placed on having computer technology available to the children rather than training the

teachers in the use of this new technology in their curriculum. Computers alone will not revolutionize schools; computers are only tools that need to be integrated into the curriculum.

There are two ways that reform can take place in our schools, either by augmenting the traditional "passive" teaching methods or by moving to a more "active" learning environment. [CAMP92] In the first method, more can be demanded from the traditional "textbook-based curriculum" that is currently used in most k-12 educational settings. Unfortunately, adding computer technology to the traditional teaching methods will not have a great affect on how and what children learn. "If the present system is failing to produce the type of educated students that the nation needs, then automating those same processes will not change the educational outcomes. Lack of efficiency is not the problem, but a lack of depth and quality. Having students learn superficial information faster will not improve education." [CAMP92]

We need to move to a "student-centered" approach to education. With this method, the learner engages in "active learning rather than passive acceptance and regurgitation." [CAMP92] The teacher takes on a new role as the "facilitator and organizer of problems for the students to study, discuss, and solve; and technology supports this philosophy by providing rich resources for students to use as they construct their personal knowledge bases." [CAMP92] Using computers and computer technology in the classroom steers the teacher towards a constructivist approach to education. Constructivism is the "belief that one constructs knowledge from one's experiences,

mental structures, and beliefs that are used to interpret objects and events." [MATU95]
The children drive the learning process while the teachers become "coaches rather than dispensers of knowledge". [CAMP92] Technology is used as a catalyst for this change in teaching and learning methods.

"The argument of whether schools should have computers is moot, since computers are already in schools in great numbers. The issue now becomes how to make the most educationally beneficial use of them. Using technology as suggested by the first type of reform movements will not produce the desired results. Doing more of the same will only produce more of the same. Automating current educational practices will not affect the quality of learning." [CAMP92]

5.2 Teaching with Computer Technology in the Classroom

Reform of our educational system will not take place overnight and certainly not without resistance. Although computer technology alone will not revolutionize our educational system, introducing the technology into the classroom will slowly change teaching practices. Teachers will move away from the traditional "passive" teaching methods to a more "active" approach. This was clearly demonstrated in the Apple Computer's Apple Classroom of Tomorrow (ACOT) project. [DWYE91]

"Our children have been raised in a world of instant access to knowledge, a world where vivid images embody and supplement information formerly presented solely through text. They are used to an environment where they control information flow and access,

whether through a video game controller, remote control, mouse, or touch-tone phone."
[STRO92]

Computers, the Internet, and other technologies give children immediate access to information used in their everyday lives. Computers allow the use of wordprocessors, spreadsheets, and educational software in the classroom, while other technologies allow the exchange of information between classrooms and individuals, instant access to on-line databases and information services, and interactive audio and video. Computer technology must become an integral component of the educational curriculum.

Children are stuck in an awkward position, "they move toward the future, but the institutions responsible for educating them are locked in the past". [STRO92] Reform is needed to realign the classroom with society. "Not by simply thinking up clever ways to use computers in traditional courses. Such exercises relegate technology to a secondary, supplemental role that fails to capitalize on its most potent strength. What is needed is a guiding philosophy that suggests principled changes in the curriculum and effective uses of technology as part of these changes." [STRO92]

5.2.1 Stages of Instructional Change

To study the effects of introducing computer technology into the classroom, Apple Computers funded the *Apple Classrooms of Tomorrow* (ACOT) project. The goal of this project was to "explore, develop, and demonstrate powerful uses of technology in teaching and learning." [DWYE91] The teachers entered the project with traditional didactic approach to teaching and slowly moved to a more constructivist approach as they

integrated the computer technology into their teaching methods. This change occurred in several stages as the teachers became more comfortable using and applying the technology in their classrooms. The project demonstrated the course of instructional change over several years when teachers were put into a technology rich classroom environment.

As computer technology is integrated into the classroom, teaching and learning progress through five stages: Entry, Adoption, Adaptation, Appropriation, and Invention. Each of these stages is described below.

Entry

The Entry stage begins when computers are first introduced into the classroom. Teachers, who usually have little or no experience using computers, are faced with a new tool and resource. They must learn not only how to use the new technology, but also how to overcome other problems such as classroom discipline, resource management, and personal frustration. [DWYE91]

Adoption

The Adoption stage begins when teachers begin to use the technology in their everyday curriculum. During this stage, computers are used as a support tool for traditional teaching methods and serve as electronic textbooks and worksheets. Educational software allows computers to become electronic tutors for the teachers to use in the classroom. "This software promotes learning through drill and practice, tutorial, educational games, simulation, problem solving, and computer-managed instruction."

[MANN93] In this stage, no changes are made to the teacher's original teaching methods; the new technologies are used only as an "add-on" to the curriculum.

Adaptation

When the new technologies become integrated into the traditional classroom practices, the Adaptation stage begins. Teachers and students use the computers as productivity and resource tools. Students support their traditional classroom work with the use of word-processors, spreadsheets, databases, and desktop-publishers. They learn that work can be completed faster and more efficiently using a computer; the computer is used as a tool to increase productivity. During the ACOT project, this stage was characterized by students staying in from recess, during lunch, and after school to experiment with the computers. [DWYE91]

During this stage, teachers also experiment with the computers. They began to give assignments on the computer and use the computer to complete everyday tasks such as grading, attendance, and lunch count. The computer becomes an integral part of the everyday curriculum.

Appropriation

The Appropriation stage begins when the new technology is completely integrated into the everyday curriculum. Teachers begin to master the use of the computer by solving technical problems and figuring out how to use the technology more efficiently in the classroom. Traditional teaching methods begin to change to a more constructivistic

approach. Teachers move toward project based learning and become "facilitators rather than dispensers of knowledge." [DWYE91]

The way students learn also changes in this stage. Students begin to learn on their own and "actively" participate in class. There is a movement away from competitive work towards collaborative work. "The children began to ask help from others in the class and interacted with each other more." [DWYE91] The students begin to teach each other.

Invention

The final stage of integration is when teachers not only completely integrate computers into their curriculum, but also change their teaching methods. Invention is when teachers use the new teaching methods in the classroom and truly believe that these teaching methods are correct. Teachers begin "questioning everything they have done in the past and wonder how they can adapt it to the computer. Then they start questioning the whole concept of what they originally did." [DWYE91]

5.3 *Learning with Computer Technology in the Classroom*

Research in child development shows that play and experimentation are valuable forms of learning. Play is a form of mental exploration which children create, reflect on, and work out their understanding. [STRO92] "A growing body of research on collaborative or cooperative learning has demonstrated the benefits of children working with other children in collective learning efforts." [CAMP92] Children not only reflect on their own ideas, but also the ideas of their peers. Peers are no longer competitors, but valuable information resources.

The teacher begins to serve as a guide rather than the dictator of knowledge. The ideas and interests of the children drive the learning process. Technology allows children to learn by doing. Traditional tools such as pencils and notebooks are still vital to the classroom environment, "but for children to assemble and modify their ideas, access and study information, they are inadequate." [STRO92]

Computers make a vast amount of information available with a keystroke, from CD-ROM encyclopedias to the growing amount of information available over the Internet. Computer technologies are part of the transformation of education; the vast amount of information available and the ever increasing rate of change make it impossible for children to learn a set knowledge base. Learning must become individualized. "Students must become information managers, knowing how to access, organize, and present information." [MANN93]

"Although some have expressed fear that traditional sources of information may be ignored or underused, our experience is that the opposite is actually true. Books, magazines, periodicals, newspapers, journals, and other so-called traditional print materials are integral information sources providing at-hand information that serves as a crucial complement to computer-based information sources." [STRO92]

Just as teaching methods change with the introduction of technology, so does the way children learn. Below are some areas where the learning process changes when computer technology is used in the classroom.

5.3.1 Individualized Learning

Computer technology supports individualized learning by providing a "variety of learning experiences in which the content and pace are customized and the environment is safe for exploration and error." [MANN93] Through the use of the World Wide Web and other hypermedia sources, the student decides where to go and what to learn. The children can spend more time in areas that interest them and freely explore and learn on their own. "Because of the trends toward individualized education, there is likely to be a secondary trend towards breaking the lockstep pattern of everyone learning the same thing in the same way at the same time." [COLL91]

5.3.2 Collaborative Learning

In a traditional classroom, students work individually and compete against one another for grades. In collaborative learning, "the distinction between teachers and students is blurred as they both actively participate in the learning process. Their collaboration produces a sense of sharing and community as they create knowledge together rather than transferring it from one individual to another." [MANN93] In most classrooms several students are assigned to a single computer to complete a project. The children must learn to collaborate and work together to complete the project.

Collaboration not only takes place among students, but also between the students and the teacher. The teacher becomes a coach in the classroom rather than a lecturer. Collaboration also takes place among different classes and schools. Through the use of the World Wide Web, email, and video-conferencing, the children have the capability to author their work on the Internet and communicate with others all over the world. As

more schools become connected to the Internet, this type of collaboration will become more relevant. Interclass collaboration through the use of video-conferencing is the main focus of the second half of this paper.

5.3.3 Quality of Work

With applications such as word-processing, students learn to focus their thoughts, collaborate, revise, and produce quality work. Error-free work becomes less of a concern to the children since they have the capability to easily alter and append their work. The overall quality of work improves.

Computers allow the students to present their work in a more professional format and to a wider audience. Traditionally a student's work was only presented to the teacher, classmates, and possibly parents. With the World Wide Web and other Internet resources, a student's work can be presented to the world. Students can incorporate graphics, video, sound, and other multimedia sources into their work. Since the children's work is no longer a class assignment, but a real-world project that will be viewed by people all over the world, the time and attention given to the work increases.

5.4 Problems with Computer Technology in the Classroom

The ACOT project demonstrated how introducing computer technology into the classroom will change teaching methods and the learning process. However, the project was conducted in unrealistic circumstances, ignoring many of the problems that a traditional school faces. The Entry level of the ACOT project began with the arrival of "hundreds of boxes of computers, drives, and magnetic disks." [DWYE91] The ACOT

classrooms were equipped with "computers, printers, scanners, laserdisk and videotape players, modems, CD-ROM drives, and hundreds of software titles." [DWYE91] Most schools do not have the staff or budget to create this type of technology-rich classroom environment. A typical classroom is fortunate to have a single computer with a CD-ROM drive and an Internet connection.

In the last nine months, our project, funded by the National Science Foundation (NSF), provided several computers to the Montgomery County School District and provided technical assistance and training to the teachers and administrators. Each participating school was equipped with a T1 network line, and each classroom was wired with Ethernet giving teachers direct access to the Blacksburg Electronic Village (BEV) and the Internet. In addition to the computers that were already present in the schools, eight additional computers were donated. The computers were equipped with ethernet cards, CD-ROM drives, and Internet client software, allowing the teachers to begin using them in their classrooms immediately.

In addition to the hardware, training and technical assistance was provided to the teachers. The teachers were given access to a help email address in which they could ask questions of the technical support staff. World Wide Web pages were created for additional support. Theses pages included frequently asked questions with answers (FAQ's), tutorials on using the Internet software, and "how-to" and "new ideas" sections. The "how-to" section was designed to be used as both a source of help when teachers had questions and a way of learning new skills as well as ways to use software more

efficiently. The "new-ideas" section was a repository, provided by the teachers, of new ways to use the computers in their classrooms.

One goal of the project was to give the schools a presence on the World Wide Web. Teachers in each of the schools, on a volunteer basis, attended classes on authoring World Wide Web pages. By the end of the school year, every school had its own page on the web. In addition, many teachers and students posted pages on the web displaying artwork, poems, and classroom projects.

Overall, the project was a success. However, we encountered many problems which a typical school faces when introducing new technologies to the classroom.

5.4.1 Technology Not Being Used

Having received the computers in their classroom, several teachers never made the move from the Entry stage to the Adoption stage of integration. In these classrooms, the computer sat in the corner "collecting dust". Even though these teachers were not using the computers, they were unwilling to give them up to another classroom.

"Given that long-term school workers are well adapted to a particular ecosocial niche it is understandable that their first response to attempts at innovation would be one of resistance." [HODA93] Teachers with more seniority are often the first to receive new technologies. These teachers are usually more "set in their ways" and are the least likely candidates to use the new technology in their classrooms and change their teaching methods.

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The only solution to this problem is to require the teachers to use the computers in their curriculum or remove the hardware from the classrooms that are not using it. The teachers should be required to submit a progress report to the building administration stating how the computers were used to enhance both learning and teaching along with future goals of computer usage. The teachers who are not using the computers should be required to give them up to other classrooms. Since this project was funded by Virginia Tech, they retained the title to the equipment and could request changes in its allocation. In a traditional school, the building administration must take on the responsibility of making sure the equipment is placed into classrooms in which it will be used.

Along with this solution, the teachers must be given the opportunity to attend classes and educate themselves on the use of the computers. The teachers must be given the resources and support to take full advantage of the technology.

5.4.2 Technical Support

The unreliability of computer equipment and lack of training are the primary reasons teachers reject its use in the classroom. [COLL91] When a teacher plans a classroom lesson around the computer and the computer doesn't boot or the software doesn't run, the teacher must have someone to turn to for technical assistance. Teachers cannot wait several days for a computer to be fixed. Unfortunately, in most school districts, hiring additional personnel is not possible, and support must come from other teachers or outside sources such as the parents, community, and businesses.

There are three steps that should be followed when a school system introduces technology into the classroom. First, all teachers should be given basic training in troubleshooting common problems on the computer. Along with this training, the teachers should be supplied with information sheets giving the answers to frequently asked questions and phone numbers for support.

Second, two or three teachers per school should be given in-depth training on troubleshooting and daily maintenance of computer hardware. These teachers should be able to solve most common hardware and software problems. By training more than one teacher for this type of support, a single teacher isn't faced with solving all the computer problems in his school building.

Third, a full-time technician needs to be hired to solve more complicated hardware and software problems. This technician could either be a school district employee who supports several buildings or a local computer vendor.

To use the technology successfully in his classroom, a teacher must have someone available to solve technical problems quickly. According to Tamra Oliver, a second grade teacher, "This tech support was one of the best parts of this grant. I can't tell you how many times we get into projects without any of that kind of support. What a difference it makes."

5.4.3 Teacher Education

Most of the NSF grant money went to educating the teachers. This is a vital part of integration of computers into the classroom. "Resistance to change, lack of resources,

and lack of time are all problems which make the challenge daunting". [CAMP92] "Much of the question of teacher self-definition revolves around the anxiety generated by their unfamiliarity and incompetence with the new machines. The fear of being embarrassed is a major de-motivating factor in the acquisition of the skills required to use computer technology in the classroom." [HODA93] Teachers must first be trained on how to use the computer technology before they can apply it to their classroom curriculum.

In most school districts, teacher education is a problem because of budget restraints and lack of time. Teachers must be encouraged and given the time and funding to attend conferences, join peer support groups, and visit other classrooms to assist them in gaining insight on how other teachers are using the technology. They need to learn from the other teachers to keep moving ahead to more effective uses of the technology in their classroom. With the use of technologies such as email, the World Wide Web, and video-conferencing, teachers can directly communicate with other teachers all over the world to share ideas and information. Teachers should be encouraged to learn new technologies and teach it to others.

Teachers not only need to learn how to use the computers as a curriculum tool, but also how to use the computer to ease administrative tasks, such as grading, report cards, and attendance. Learning how to use computers for these tasks will further enhance the teacher's ability to use the computer as a teaching tool and, by reducing the time spent on administrative tasks, teachers will have more time to devote to applying the technology to the classroom.

Teachers must be given time and support to explore on their own. Teachers who now suffer from larger classes and more responsibility must be given time and space to take a break from teaching and start learning. Most importantly, teachers must be willing to progress into the world of technology and be willing to learn in order to teach. As with every new teaching method, there will be elements that will work and others that will need improvement. Teachers cannot allow themselves to be stymied by an unwillingness to reach out and try new ideas.

5.4.4 Administrative Support

The administration must be willing to give teachers time to educate themselves. Administrators must be willing to first provide training for the teachers, then encourage them to use computers in everyday tasks such as grading, attendance, and lunch count. If a principal sends memos through email, teachers will be required to learn how to use email and check it daily

A good administrator will constantly be seeking improved teaching methods to introduce to the professional staff, ways to fund the technology (through tax payer support, financial assistance from parent-teacher organizations, the community, and businesses), and technical assistance from community resources.

5.4.5 Community Support

"It is easy to convince a naive community that a school is making progress in implementing school reform and providing students with innovative teaching practices." [CAMP92] When parents tour a school they have the opportunity to visit the lab, see

computers in the classroom, and hear about all the innovative ways computers can be used to improve education. However, just because the technology is available in the schools doesn't mean it is being used into the curriculum.

The parents and community are the ones who will eventually force change in education. They must show support for additional funding to introduce technology into the classrooms, offer technical assistance, and encourage area businesses to participate actively (both financially and through human resources) in assisting teachers who are diligently attempting to introduce technology into their classroom.

Not only should the community support the schools, but the schools should support the community. By opening school computer labs one or two days a week, the community has an opportunity to see and use the equipment that tax dollars purchase. Both parents and children should be allowed to use the resources after school and in the evening to learn, play and experiment.

5.4.6 Budget Restraints

Most school districts are faced with diminishing funding in their budgets for new technology. As teachers move from the Adoption to the Adaptation stage and the computer becomes a resource and productivity tool, additional equipment such as printers, software, cameras, and modems are often needed. Since funding for this type of equipment is generally one of the first items to be cut from the school budget, school districts are unable to purchase additional equipment for the teachers or replace obsolete equipment. School districts must also be careful on what type of hardware and software

they purchase. They cannot simply purchase equipment because "it looks good." Each item must be carefully researched to make sure it meets all the objectives of the school district's curriculum and the teacher's needs.

By requiring teachers to submit periodic reports on how the equipment is being used and will be used, as well as moving the equipment from classrooms where it is just "collecting-dust" to classrooms where it will be an integral part of the curriculum, schools will be able to expend their resources more wisely. Money for technology is better spent in a classroom that will actually use it, than in one where the teacher displays no interest in innovative teaching methods using computer technology.

Again, community involvement is essential in solving budget problems. Schools must rely on donations of both time and money from local businesses, organizations, and parents. In return, the school must support the community by holding classes and making resources available for public use.

6. The Video-Conferencing Case Study

Video-conferencing can be used in the classroom to open up an additional channel to the outside world for elementary school students. Already, some students in the Montgomery County school system have had email or chat relationships with individuals and classes in other parts of the country and world. We hope that video-conferencing technology can further stimulate students to learn about life beyond their hometown. With the services available in our local area through the Blacksburg Electronic Village (BEV), we have an excellent opportunity to explore a wide range of uses for the Internet, including the use of video-conferencing in the classroom.

Our original goal was to measure the long-term retentivity of information learned through a video channel compared to traditional means. Unfortunately the project was plagued with problems from the beginning, and the actual video-conference was delayed until the end of the school year. The long-term effects could not be studied, but through observations of the video-conferencing sessions and short-term results, we have gained insight into the problems of introducing and using this new technology in the classroom. This section first discusses the goals and procedures used in the project and some of the observations made during the video-conferencing sessions. Then a summary is given of the problems we encountered using this new technology in the classroom and how some of these problems could be solved in the future.

6.1 Objective

We performed this study to observe the impact that video-conferencing has on the way children learn and participate in class. By comparing two classes using different levels of technology, we noted the differences in the learning process and the retentivity of information presented. We hypothesized that the results would show that retentivity of information gained in class would be higher for students using a video channel than students learning without one.

Two fifth grade classes in Montgomery County School District would learn about other regions of the United States which are geographically different from Southwest Virginia by using the Internet and related technologies. A class in Washington state was the other participant in the project.

Two fifth grade classes in Montgomery County School District and a class in Washington state participated in this study. The students in all three classes were given a list of questions (see Appendix C: Geography Session Forms, for a complete list of the questions) about the geography of their region to which they found answers by using resources on the Internet. One of the classes in Virginia exchanged the researched answers using email and the other class held video-conferencing sessions with the class in Washington. The students then presented their findings as a comparison of the geography of Southwest Virginia and Washington state. Following the project, the students were given a written and oral evaluation. These evaluations along with instructor's observations of the classes were used to formulate how the children's collaborative

activities over the network enhanced their learning. Since video-conferencing and access to the Internet is fairly new in the classroom, several problems were encountered during the project. These problems are discussed at the end of this section.

6.2 Equipment

One goal of the project was to use technology that would be available in a typical classroom environment. Through National Science Foundation (NSF) funding and the Blacksburg Electronic Village, our school was directly connected to the Internet through a T1 line and each classroom was wired with Ethernet. Although most schools are not yet equipped with a direct connection to the Internet, prices are beginning to drop and these types of connections are becoming more readily available.

For the video-conferencing software, we chose a product called CU-SeeMe created by Cornell University. CU-SeeMe is an integrated audio/video conferencing system with capability for multi-party and point-to-point conferencing, screen transmission through slide-show window, and text transmission though a chat box. The most important feature of CU-SeeMe is that it is available *free* over the Internet. Although there are other commercial video-conferencing software packages available that have better performance and more capabilities, we decided that the cost of the software was more important than the features and performance. If we had used a commercial application, each school that we communicated with would have had to purchase the same commercial application, causing more delays. Since CU-SeeMe is free and available over

the Internet, other schools can easily obtain a copy of the software. There is currently a Power Mac version, a Macintosh version, and a PC version of CU-SeeMe.

For hardware we used a Power Mac equipped with a CD-ROM drive, external speakers, and a Connectix QuickCam Camera. The external speakers allowed us to control the volume level so that the entire classroom could hear the audio. The Connectix QuickCam was chosen because it is inexpensive and can be used on any Macintosh. The Quickcam has a video digitizer and microphone built into the camera so it does not require an AV Macintosh; it plugs directly into the Macintosh serial port.

In addition to the computer hardware, in the Virginia class we used a LCD overhead display and an overhead projector to display the video images onto a movie screen (we discovered this was necessary after the initial practice session). This allowed the class to stay at their desks and not have to crowd around the computer monitor. We also had a speakerphone available in the classroom as a backup to the CU-SeeMe audio. Since the CU-SeeMe audio and video are being transmitted over the Internet and at peak hours the audio may degrade to a point where it is not comprehensible. The speakerphone was available for use as an audio backup.

6.3 The Practice Session

Before the students in Virginia began doing research for the geography class, we wanted to give them a chance to use the CU-SeeMe program and learn about video-conferencing. This practice session allowed us to observe the children's initial reaction to video-conferencing and work out any problems with the procedures. It also allowed the

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students to get over the "rabbit ears", "waving", and "face-making" phase of seeing their picture on the computer screen.

6.3.1 Procedures

The practice session took place over three days. On the first day the children were given an overview of what video-conferencing is, how it works, and what it can be used for. We demonstrated the CU-SeeMe program by connecting to a reflector site (which is a central connection point for multi-party video-conferences) and allowing the students to talk to other people on the reflector. After demonstrating CU-SeeMe, the students were told about the practice session, in which they would hold a video-conferencing session with another class in Virginia. The students were given the following five questions to research and prepare presentations:

1. When was your school built?
2. Who is your principal?
3. How many students do you have in your school? In your class?
4. What is your weather like right now?
5. What kind of permanent equipment do you have on your playground?

On the second day, the children were divided into five groups and each group was given one question to research. Each group would present their answer over CU-SeeMe the following day. The groups were instructed to include, along with the answer to the question, visual items and supplemental information in their presentations. For example, instead of answering the first question directly, the students also included additional information such as who built the school and how many years old it is, and used a visual

item such as a picture of the school. Other visual items used during the presentations included pictures, drawings, and numerical answers written on paper with black marker.

On the third day, we conducted the CU-SeeMe session between the two classes. The classes alternated giving their presentations to each of the questions. After all the presentations were completed, the students were given the opportunity to communicate freely with each other. Following the CU-SeeMe session, the children were given a written and oral exam (see Appendix B: Practice Session Forms).

The practice session was designed to follow the same format as the geography class. The written exam results were not used for the evaluation of the practice session; only the instructor's observations of the procedures and the students' initial reaction to video-conferencing.

6.3.2 Evaluation and Observations

During the entire procedure we observed the session to analyze the students' first reaction to using CU-SeeMe, the procedure used for the project, technical issues such as how well the audio and video worked, and classroom issues such as how well the students worked in groups and conducted their presentations (see Appendix B: Practice Session Forms, for a complete list of the observation categories and questions).

Overall, the students' first experience with video-conferencing proceeded smoothly. The students were well behaved and were excited about the possibility of using CU-SeeMe again in their class. However, it was necessary to improve a few of the procedures used in this practice session.

Most of the students didn't speak directly into the camera, didn't speak loudly enough, and had difficulty presenting the visual elements. Some of the visual elements did not display well on the screen because of the glare from the window and the use of glossy photographs and coated paper. The students should practice their presentations in front of the camera before the actual on-line session. Preparation will allow the students to look directly at the camera when they are speaking and help them display the visual elements to the camera. By practicing displaying the visual elements to the camera, the students will be able to see what the items look like on the screen and eliminate those that won't display well.

The setup of the computer and room should be changed. Twenty-five students were huddled around one computer screen and many of the students in the back had trouble seeing what was on the screen and hearing what the other class was saying. Those students had a much shorter attention span. The computer and camera should be moved to the front of the room with an overhead projector displaying the images onto a movie screen. The computer should be set up so the students know where to stand so they can be seen as a group and where to stand to be seen as an individual. The students could start the presentation as a group by introducing themselves, then move to the "individual position" when a single person is talking or giving his part of the presentation. With this setup only the students who are giving the presentation need to be near the computer and camera; the remaining students can stay at their desks.

Another problem was that the students didn't speak loudly enough and that the microphone was poorly positioned. When the Apple microphone was passed around, often the students put the microphone too close to their mouths and the audio was garbled. What is needed is a "traditional" stage microphone that can be passed around to the person who is speaking. This type of microphone works better when an individual is speaking since the foam keeps the students mouths from getting too close to the microphone. Again, with practice, the students will know how to modulate their voices.

Finally, before the presentations begin, the students need some "free time" to ask questions and meet the other class. This helps alleviate some of the "embarrassment" of talking to someone they don't know. It also gives the supervisor a chance to test the audio levels and picture quality. The students should also be given a chance to ask questions between the presentations, while the questions are still "fresh" in their minds.

All of these changes were incorporated into the Geography Session except for the new type of microphone. The overhead projector made a huge difference in class organization during the CU-SeeMe sessions. Although these changes improved the procedures followed during the Geography Session, new problems were encountered.

6.4 The Geography Session

Two fifth grade classes in Southwest Virginia participated in the geography study. Both classes communicated with Sunset Elementary School in Bellevue Washington; the first class using email and the second class using video-conferencing. The class in Washington was sent a copy of the questions (see Appendix C: Geography Session

Forms, for a complete list of the questions) and followed the same procedures as our

second class, since both were participating the CU-SeeMe sessions.

The Geography Session took place over a two week period and had four phases:

1. Preliminary work, which included researching the answers to the list of geography questions and, for the CU-SeeMe participants, gathering visual materials to display over the video channel.

2. Email exchanges with the peer sites.

3. CU-SeeMe collaboration, consisting of two 1-hour sessions, followed by free conversation between the students and their remote peers.

4. Review of the material presented over CU-SeeMe and gathered through email followed by a written and oral evaluation.

The procedures used by the Email class and the CU-SeeMe class for the

geography lesson are given below, followed by the observations and evaluations made in

both classes.

6.4.1 Procedures for the Email Class

During the first week, the students in the Email Class were divided into five groups

and each group was given three or four questions to research. The groups used

encyclopedias, text-books, maps and the Internet as research material. Each of the five

groups found the answers to their set of questions and shared the answers with the

remainder of the class. At the end of the first week, all the answers were sent via email to

the class in Washington.

The class received a response during the middle of the second week and the

students were given a printout of the answers from Washington. The teacher presented

answers to the class as a comparison of the geography of Southwest Virginia and the state of Washington. By using charts and graphs, the students were asked to compare and contrast the answers to the questions about the two geographic regions.

On the last day of the project, the class was given a written and oral evaluation (see Appendix C: Geography Session Forms, for a list of the evaluation questions). The written exam was used to collect data on how much information the students in each class retained. The oral evaluation was used to collect data on how well the classes enjoyed doing the project and communicating with a class in Washington using email.

6.4.2 Procedures for the CU-SeeMe Class

The CU-SeeMe classes in Washington and Virginia began in much the same way as the Email class. The students were divided into five groups and each group used encyclopedias, text-books, maps and the Internet to research the answers to its set of questions. These classes used video-conferencing to exchange their answers.

During the first week, each group prepared a 30 to 60 second presentation for the answer to each of their questions. To help alleviate the problem of incomprehensible audio which was discovered during the practice session, the students were instructed to write each of the answers on a piece of paper with a black marker. These answers would be held up to the camera when the students gave their presentation. In addition, the students used other visual item such as maps, pictures, drawings and actual products to assist in their presentation. At the beginning of the second week the CU-SeeMe class practiced their presentations in front of the camera. This gave them the opportunity to

familiarize themselves with what they were going to say and test the visual items to be used.

Two one-hour CU-SeeMe sessions were held. The first was a "student introduction" session in which the students in Virginia and Washington introduced themselves. This session also gave the students a chance to practice using CU-SeeMe. The students gave a one line introduction, which included their name and a sport or hobby in which they participate. At the end the session the students were given a few minutes of free time to ask questions.

The following day the "student presentation" session took place in which the students in each class shared their answers to the questions. The classes alternated their presentations. After all the presentations were completed, the students were allowed 10 minutes of free conversation with the other class. Following the CU-SeeMe session, the teacher reviewed the answers from Washington. During the review, the class was asked to do a comparison of the geography of Virginia and Washington.

On the last day of the project, the CU-SeeMe class was also given a written and oral evaluation. The written exam was used to collect data on how much information the students in each class retained. The oral evaluation was used to collect data on the students' comments and opinions of the project and how they felt about communicating with the Washington class using video-conferencing.

6.4.3 Observations and Results

The Email class encountered very few problems. At the end of the project the students were asked how they felt about the project and what they would have liked to have done differently. The biggest objection was that there wasn't enough time to get to know the students in Washington. The students would prefer to have had several email exchanges and a more personal relationship with the other class.

The CU-SeeMe class encountered many problems with the use of the video-conferencing technology. During the initial "student introduction" session between the two classes, two major technical problems occurred. The first problem was incomprehensible audio received by CU-SeeMe at the Washington site. The class in Washington was using an older Macintosh with build-in speakers in which the volume could not be adjusted to a volume audible to the entire class. As a temporary solution for this session, we used the speaker phone for audio communication. The Washington class was able to get a set of external speakers so the CU-SeeMe audio could be used during the "student presentations" session the next day.

The second problem was that the connection between Virginia and Washington was lost several times. This was most likely due to extensive traffic on the Washington server. The only solution was to wait a few minutes and try to reconnect the CU-SeeMe session. Despite these two problems, the initial "student introduction" session went well.

The following day we conducted the "student presentation" session. Again the connection between Washington and Virginia was lost several times during the

presentations. After a few minutes we were able to reconnect, but several of the presentations had to be eliminated because of the time lost while we were disconnected. We only had time for half the presentations.

Another problem that occurred the second day was that many of the visual items used by Washington were hard to see over the video channel. Because of this, the students had to rely on the audio, which wasn't always comprehensible.

The students were given about ten minutes at the end of the session to ask the other class additional questions. Although we were hoping that the questions would have been geography based, most of them were more personal. The students mainly talked about school policies such as when is your last day of school, are you allowed to wear hats in class, what time does your school day start and end, and do you have any pets in your classroom.

At the end of the project, the CU-SeeMe class was also asked how they felt about the project and what they would liked to have done differently. Again, the students wished that they had more time to get to know their peers in Washington. They would have liked to have had more CU-SeeMe sessions so that they could form a more personal relationship with the other class.

6.5 Problems Encountered During the Study

Although this study was plagued with problems from the beginning, the study demonstrates common problems faced by teachers when trying to integrate and use technology in their classrooms.

6.5.1 Planning and Approval

Before beginning the project we had to receive approval from both Montgomery County School District and Virginia Tech. The school district required only a written letter of approval from the school superintendent and a signed permission letter from the parent of each student participating in the project. The Virginia Tech IRB (Internal Review Board), which must approve all projects involving human subjects, required that the project protocol, including a detailed explanation and justification of the project, consent forms, questionnaires, quizzes, oral discussion questions, and standard IRB documents be submitted and approved before the study could begin. This requirement creates several problems when performing a study in an educational environment.

Usually teachers design a test or quiz after the lesson has taken place so that any variations in the lesson plan can be taken into account in the exam questions. Because the quizzes and oral discussion questions had be submitted to the IRB before the study took place, they could not be changed to reflect the actual lesson. This is especially difficult in an "active" learning environment where the children ask questions and maneuver the lesson to areas in which they are interested.

Additionally, the Virginia Tech IRB required formal consent forms be signed by all participants and their parents. The official consent forms are long and complicated. The Montgomery County School District wanted an uncomplicated one-page permission letter. After several trials and appeals, the IRB approved a one page consent form.

The most difficult situation caused by the Virginia Tech IRB's requirement that the entire project must be submitted and approved prior to the start of the project was that the procedures had to be determined in detail before the study took place. Unfortunately, because of all the problems that we encountered during the project, we had to diverge from the original procedures. In an educational environment, it is nearly impossible to predict beforehand what will take place during an experiment.

6.5.2 Initial Delays

This project was scheduled to begin in January, but delays in the installation of the network lines delayed the project. The T1 and Ethernet lines were not installed in the schools until April which delayed the project to the point where long-term results could no longer be studied. The actual CU-SeeMe sessions didn't take place until the last weeks of the school year.

6.5.3 Scheduling Sessions

After the network was installed, we had to find another school in the United States to cooperate with us on the project. In January, we sent email to several list servers looking for other classes which would be willing to participate in the project. We required these classes to have a direct connection to the Internet (not a modem) and a Macintosh computer. We would supply the camera. We had many initial responses from other classes interested in participating. However, by the time we were ready to begin the project, several of these classes did not have time or had reconsidered their decision to do the project. We finally decided on a class in Washington that met the minimum criteria.

It took several weeks to schedule a time and date for the CU-SeeMe sessions in order to accommodate both classes. Because of the three hour time difference between Washington and Virginia and the fact that they started their school day an hour later than we, there was only a one hour period at the end of our school day that was compatible to both schools.

At the end of the project many of the students expressed an interest in talking to students in other countries. The time difference between Virginia and other countries would be an even greater obstacle. Earlier in the school year another teacher planned a video-conference with a class in Russia. This conference was accomplished only because the class in Russia volunteered to come in at night. Although synchronous communication between two classes has advantages, it is not always possible.

6.5.4 Technical Support

Before the sessions took place, the site in Washington had to install the CU-SeeMe software and the camera. As with most schools, there was no technical assistance available and the teacher in Washington was faced with the problem of installing the software and hardware herself. After several failed attempts and numerous phone calls between Washington and Virginia, the teacher finally sought help from a local college student and we were able to get CU-SeeMe running on her machine.

The CU-SeeMe software has not yet matured to the point in which setup and installation is easy for a new user. "If the computer system does not have all the required hardware and extensions installed for CU-SeeMe to work properly, it is not always clear

why the program is not working properly. If the user does not know what the system looks like or how it works when it is installed properly, they may not realize that it is missing a component and will wonder why it is not working." [BIBE95] Often CU-SeeMe displays a cryptic error message such as "System Error -277" and refuses to run. A novice user will have no idea what this error means or how to fix the problem.

6.5.5 Technology Issues

After CU-SeeMe was installed and running at both sites and we were able to conduct the sessions, we discovered several problems with the current video-conferencing technology. The biggest problem was with the CU-SeeMe audio. Many times during the sessions the audio degraded to a point where it was incomprehensible. Along with the audio, the video needed improvement. Many of the visual items that were used during the presentations did not display well over CU-SeeMe.

Another problem with the technology was that the interface of CU-SeeMe is not intuitive. Since the Washington site had never used CU-SeeMe before, some initial training was needed before the sessions took place. Even after several days of experimentation, the they had trouble using the audio dialog box and reading system status indicators during the during the initial CU-SeeMe session with Virginia. Although first time users have trouble using the software, there is usually a small learning curve before the they becomes familiar with the program. "Video-conferencing with CU-SeeMe is as conceptually simple as making a phone call and should be so in practice, even to someone who has never done it before." [BIBE95]

6.5.6 Other Issues

Because of the initial delays, the students only had time for two CU-SeeMe sessions. If the students had been given more time to become acquainted with the class in Washington and had not felt pressured to complete their presentations, the project would have had better results and the students would have felt more comfortable talking to the other class.

The presentations were a good idea, but the students preferred the personal question and answer period. The questions that the presentations were answering were too specific. Rather than doing a short presentation on a limited question, do a longer presentation on an expanded topic, then allowing the students time to ask questions after the presentation.

6.6 Potential for the Future

All the teachers involved in the project agreed that although there are still many problems with video-conferencing technology, it definitely has potential for future classroom use. There currently are several commercial packages available that may have prevented many of our problems while doing this study, but these packages are outside the price range of a typical school budget. In the future, as prices drop and the technology improves, video-conferencing will play an important role in the classroom.

Even though this project endured many problems, several incidents occurred which demonstrated why video-conferencing will be useful in the future. One highlight occurred during the practice session in which the class used CU-SeeMe to connect to a reflector

site. One person on the reflector from Finland began talking to the students. The students went to a wall map to see where Finland was located, then began asking several questions. One of those questions was "what is the weather like in Finland right now." Because Finland is farther north than Virginia the students expected the temperature to be colder, but they didn't expect the answer to be given in Celsius. Immediately the students ran to a thermometer that had both Fahrenheit and Celsius scales and did the conversion.

Another interesting incident was when students in Virginia saw students in Washington wearing hats in class. The students in Virginia have been arguing with their teachers and principal for several months to allow them to wear hats in class. It turned out that the class in Washington also had to convince their administrators to allow them to wear hats, and they were successful. Unfortunately there was not enough time to further discuss the topic, but it would have been interesting for the students to hear the arguments that the Washington class made to convince the school to let them wear hats.

At the end of the project the students were asked in what ways they could envision video-conferencing technology being used in the future. One answer was that in a foreign-language class the students could connect to another country and practice speaking the foreign language. Another was to talk to scientists and ask them questions pertaining to current lesson from the students' science classes. Most of the students wanted to talk to classes in other countries to learn what school was like there. All the students agreed that they would like to use video-conferencing more often in their classes.

7. Summary

Even without the introduction of technology into the classroom, teachers have been moving toward a more constructivist approach to teaching in which children become "active" members in the classroom. Computer technology serves as a catalyst to this change in teaching and learning.

As part of a NSF grant, Virginia Tech was given funding to connect local schools to BEV and the worldwide Internet, and provide teachers with computers and related technology in their classrooms. In the process of introducing this technology to the schools we encountered many common problems that school districts face when placing computers in classrooms.

These problems were clearly demonstrated during a project involving video-conferencing in a fifth grade classroom. The original project was designed to study the effects that a video channel has on the retentivity of information presented in class. Unfortunately the project was plagued with problems, including:

- Obtaining approval from the school district to conduct the study
- Delays with the installation of network lines in the school buildings
- Finding another school in the United States to participate in the study
- Technical support problems in setting up hardware and software
- Audio and Video problems caused by immature technology

These problems are not specific to this project; they are typical problems that occur when technology is used in the classroom. Some general solutions and guidelines to solving these problems include:

- Educating the teachers on use of technology

- Providing technical support to the teachers so that problems are quickly solved
- Forcing teachers to use computer technology in everyday administrative tasks
- Giving teachers time to explore and learn on their own
- Getting the community involved in the schools
- Using thoroughly tested technology

Educational administrators, under pressure from the community, often try to push the "latest and greatest" technology on teachers without providing them with the proper training. We cannot expect teachers to know how to use new and unfamiliar technology. Teachers must be prepared in the use of classroom technology while still in college and continue their education and training throughout their teaching careers.

With support from administrators and the community, teachers will be able to gradually integrate computer technology into all aspects of the classroom and will be able to assist students in using technology for research and the exchange of information and ideas. Technology education for students must be included in curriculum planning and students must be encouraged to use technology throughout their education.

Although computer technology alone will not revolutionize our educational system, the introduction of the technology into the classroom will encourage change in teaching methods and open up new horizons for teaching and learning. Thus, computer technology must become an integral component of the classroom.

8. Bibliography

[BAGL92]   C. Bagley and B. Hunter, "Restructuring, Constructivism, and Technology: Forging a New Relationship," *Educational Technology*, pp22-27, July, 1992.

[BARR90]   D. Barr, "A Solution in Search of a Problem: The Role of Technology in Educational Reform," *Journal for the Education of the Gifted*, v14, n1, pp79-75, 1990.

[BEAR93]   H. Beare and R. Slaughter, *Education for the Twenty-First Century*, Routledge, London, 1993.

[BIBE94]   M. Bibeau, "A Formative Evaluation of CU-SeeMe", MS Thesis, Virginia Polytechnic and State University, 1995.

[CAMP92]   R. Campoy, "The Role of Technology in the School Reform Movement," *Educational Technology*, pp17-22, August, 1992.

[COLL91]   A. Collins, "The Role of Computer Technology in Restructuring Schools," Phi Delta Kappan, pp28-36, September, 1991.

[DOCK91]   D. Dockterman, *Great Teaching in the One Computer Classroom*, Tom Snyder Productions Inc, 1991.

[DWYE91]   D. Dwyer, C. Ringstaff, & J Sandholtz, "Changes in teachers' beliefs and practices in technology-rich classrooms.", *Educational Leadership*, v48, pp45-52, May, 1991.

[GLOW84]   D. Glowinski, "Computer as an Aide, Not a Classroom Teacher," *Capitolizing on Computers in Education*, 1984.

[GOOD86]   K. Goodman, *What's Whole in Whole Language?*, Heinemann Educational Books Inc, 1986.

[HODA93]   S. Hodas, "Technology Refusal and the Organizational Culture of Schools," *Education Policy Analysis Archives*, v1, n10, September, 1993.

[HOLL95]   H. Holland, "Needles in a Haystack: The real have-nots in technology are rural schools," *Electronic Learning*, pp26-29, April 1995.

[JONA91]   D. Jonassen, "Evaluating Constructivistic Learning", *Educational Technology*, v31, pp28-33, September, 1991.

[MANN94]   C. Mann, "New Technologies and Gifted Education," *Roeper Review*, v16, pp172-176, February, 1994.

[MATU95]   M. Matusevich, "School Reform: What Role can Technology Play in a Constructivist Setting," Virginia Tech, School Leaders Program, 1995.

[MURP93]   J. Murphy, "What's In? What's Out? American Education in the Nineties," *Phi Delta Kappan*, pp641-646, April, 1993.

[PELG93]   W. Pelgrum, T. Plomp, *The IEA Study of Computers in Education: Implementation of an Innovation in 21 Education Systems*, Pergamon Press, 1993.

[STRA89]   A. Straker, *Children Using Computers*, Basil Blackwell Ltd, 1989.

[STRO92]   E. Strommen, B. Lincoln, "Constructivism, Technology, and the Future of Classroom Learning," *Education and Urban Society*, v24.4, pp466-476, August, 1992.

[WOOD86]   D. Woodhouse, A. McDougall, *Computers: Promise and Challenge in Education*, Blackwell Scientific Publications, 1986.

9. Appendix A: IRB Forms

These are the forms needed to get approval from the Virginia Polytechnic and State University's IRB. The actual forms submitted to and returned by the IRB can be obtained by contacting the IRB or one of the committee members. The following forms were submitted to the IRB:

- Statement of Protocol
- Consent Form for Jim Sellers
- Consent Form for Parents
- Consent Form for Students
- Standard IRB Form

9.1 *Statement of Protocol*

Justification

We are performing this study to determine the long term educational impact of video-conferencing in an educational environment. The hypothesis to be tested is that long term retentivity of information learned in class is better for those students learning with a video channel than students learning without one.

Overview

Fifth grade students in Montgomery County School District will learn more about other regions of the United States which are geographically different from Southwest Virginia. Students will be given a list of questions to which they will find the answers by using resources on the Internet and email exchanges with similar classes in other states. A list of the questions to be researched by the students is enclosed.

The students will use Virginia's Public Education Network and BEVNet during their research. In addition, the fifth graders at Riner Elementary will utilize a program called CU-SeeMe which will give them live audio and video interactive sessions with the partner sites. The students will then present their findings as a comparison of the geography of Southwest Virginia and the other state.

We wish to determine how the children's collaborative activities over the network have enhanced their learning.

Procedure

There will be three fifth grade classes participating in the study. One of the classes will be used as a control group. That class will study the geographic regions of Southwestern Virginia and other areas of the United States using traditional methods such as the library, research books, and traditional classroom lectures. This class will be taught using the traditional lesson plan.

The other two fifth grade classes will use Internet resources to locate information about Southwestern Virginia. Another site in the United States will do the same type of research on their geographic region. The information gathered by the two sites (us and the remote site) will then be exchanged over the Internet so each site can learn more about the others geographical regions.

Students will be placed into small groups of three to five students. Each group will be given four or five generic questions to research. [See attached.] The results will be compiled and emailed to the chosen partner sites, which will probably be Alaska and Hawaii. The same questions will be emailed to students in these other locations who will answer them and email back their findings. When the information is returned, the fifth graders at Riner and Bethel will prepare charts or posters comparing the information received with the information they have researched about Southwestern Virginia.

At Riner Elementary School, following the activities above, the students will use the classroom computer and CU-SeeMe to connect with the other sites in live audio and visual interactive sessions to discuss the exchanged information. Using this technology will afford the students with opportunities to directly question the students at the other sites about the geography of the region. The students will also gather objects and prepare a 30 to 60 second presentation of how the object relates to the geography of their region.

We envision a program with four phases:

1. Preliminary work at our own sight, which includes researching information about Virginia and for the CU-SeeMe participants, gathering visual materials to display over the video channel. We wish to give each students 30 seconds to show something relevant to their counterparts over the remote channel.

2. Email exchanges with the peer sites.

3. CU-SeeMe collaboration, consisting of several 1-hour sessions, using a telephone/speakerphone to ensure a reliable audio channel.

4. Free conversation between the students and their remote peers over CU-SeeMe.

The actual test session will be preceded with practice sessions, each followed by a debriefing. One intent is to make the procedure seem routine by the time the actual experimental session is run, and another is simply to attempt to anticipate any technical problems that might arise.

Evaluation

Each of the three fifth grade classes will be evaluated to see how much of the exchanged information has been retained. The exam questionnaire is enclosed. A comparison of the findings will be made to see if the CU-SeeMe technology impacted the amount of information the students retained.

Participant Consent and Confidentiality

The participants and their parents will be required to sign a consent form before participating in the study. A copy of both consent forms is enclosed. In addition, we will have a letter of consent from Jim Sellers of Montgomery County School District giving us his permission to perform the study in the schools.

In the letters of consent, the participants are notified that any information obtained during the study will not contain the child's name, or any other information which could link the results back to an individual student. Only a subject number will be used to identify the students during analysis and in any written reports of the study.

List of Principle Investigators

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9.2 Consent form for Jim Sellers

Dear Dr. Sellers:

As part of our NSF planning grant, we would like to study the educational gains from live interactive video-conferencing on the learning process. We would like to perform these studies in Susan Hood's and Cheryl Robert's fifth grade classes at Riner Elementary School and Susan Frye's fifth grade class at Bethel Elementary School. The three classes will conduct a geography lesson over the Internet, according to the attached lesson plan. Melissa Matusevich will be the Instructional Coordinator of the study.

The students will communicate over the Internet with other students within the United States, allowing each class to learn more about the other's geographical region. Students will be given a list of questions to which they will find the answers by using resources on the Internet and email exchanges with similar classes in other states. In addition, students at Riner will utilize a program called CU-SeeMe which will give them live audio and video interactive sessions with the partner site.

The questions the students must research will be similar to the following:

- What is the name of your location and how many hours difference is there between you and the Eastern Time Zone?
- What are the latitude and longitude of your location?
- Describe the climate of your area.
- Name any volcanoes or fault lines found in your location.
- How did your state get its name?
- Is there anything particularly interesting or unusual about where your live?
- Please list for your state -- capital, song, bird, tree, and flower.

Not only will students be expected to find the answers to these questions, they will also have to provide answers to similar questions asked by the Alaskan site. The students will then present their findings as a comparison of the geography of Southwest Virginia and Alaska.

As educators, we wish to determine how the children's collaborative activities over the network have enhanced their learning. We are asking the parents permission for their children to participate in this study. We explained to them that the children will be observed and evaluated on what they have learned. A copy of the parent's and student's permission letter are attached.

We hope this project will spark an interest in the Internet and Video-Conferencing, and can be used as a stepping stone for future projects.

We would appreciate a letter giving us your permission to proceed with this project. In addition, we are seeking permission from the IRB (Internal Review Board) of Virginia Tech to conduct this study. You will be continuously updated on the status of the project as it progresses and apprised of the final results. If you have any questions please feel free to contact Dr. Ehrich, Melissa Matusevich, or me; our numbers are listed below.

Robert Mohn, Principal Investigator
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703-951-4975

Dr. Ehrich, Computer Science Department, Advisor
ehrich@cs.vt.edu
703-231-5420

Melissa N. Matusevich, Instructional Coordinator
mmatusev@pen.k12.va.us
703-381-6180

Thank you for your prompt consideration of this request.

Sincerely,

Robert C. Mohn
CS Department
Virginia Tech

9.3 Consent Form for Parents

Dear Parents:

Fifth Grade students in Susan Hood's and Cheryl Robert's classes at Riner Elementary School and Susan Frye's class at Bethel Elementary School have the opportunity to participate in a geography project which involves the use of computers and the Internet. We would like your permission for your child to participate in this innovative project.

The students will communicate over the Internet with other students within the United States, allowing each class to learn more about the other's geographical region. Students will be given a list of questions to which they will find the answers by using resources on the Internet and email exchanges with similar classes in the other states. In addition, students in Susan Hood's class at Riner will utilize a program called CU-SeeMe which will give them live audio and video interactive sessions with the partner site. The students will then present their findings as a comparison of the geography of Southwest Virginia and Alaska.

As educators, we wish to determine how the children's collaborative activities over the network have enhanced their learning. To do that we would like your permission to have your child participate in a small study in which they will be observed and asked questions about what they have learned.

The results of this study will be kept strictly confidential. The information that we obtain will not contain your child's name and only a subject number will identify your child during analysis and in any written reports of the study.

This research project has been approved, as required, by the Institutional Review Board of Virginia Tech and Montgomery County School District.

Please fill out the form below and return it to the school by April 10, 1995. If you have any questions, please contact the principal at your school.

-- cut here --

My son or daughter, _____ (please print)

students name

has permission to participate in our innovative geography program and learning evaluation study.

_____   _____

parents signature   date

9.4 Consent Form for Students

Dear Students:

You have the opportunity to participate in a geography project which involves the use of computers and the Internet. You will correspond with other classes in the United-States to teach them more about the geography of south-west Virginia and to learn about the geography in their states. The correspondence will take place using email and live-video conferencing.

We wish to determine if working with other classes over the Internet helps you learn more in class. We would like you to participate in a small study in which you will be observed and asked questions about what you have learned.

The results of this study will be kept strictly confidential. The information that we obtain will not contain your name and only a subject number will identify you child during analysis and in any written reports of the study.

This research project has been approved, as required, by the Institutional Review Board of Virginia Tech and Montgomery County School District.

To participate in this class, please sign the form below.

I give my permission to participate in this geography class and learning evaluation study.

_____   _____
students signature   date

10. Appendix B: Practice Session Forms

These are the forms used during the practice CU-SeeMe session between the two classes. The written exam and discussion questions were used only to follow the same protocol that would be used in the geography session. The observation questions were used to gain insight to the students first reaction to CU-SeeMe and to evaluate procedural and technical issues in the process. The following forms are included in this appendix:

- Written Exam Questions
- Oral Class Discussion Questions
- Observation Questions

10.1 Written Exam Questions

1. Which school was built first, ours or theirs?

2. What is the name of their principal?

3. From the picture you saw of the other school, do you think their school is bigger? Why?

4. Which school has more students?

5. Whose class has more students, yours or theirs? How many more?

6. Name something that they have on their playground that you wish you had at your school.

7. Was the weather at the other school the same as yours?

8. Name something you learned about their school that is different than your school. Be specific.

9. What did you like best about talking to the other school?

10. Name two other uses for video-conferencing either inside or outside school.

10.2 Oral Class Discussion Questions

1. What did you like or dislike about talking to the other school?

2. If you could talk to the other school again, what would you ask them?

3. Did you like using the computer to talk to other people?

4. Who else would you like to talk to on the computer?

5. Could you use video-conferencing in other classes? How?

6. Where else (outside school) could video-conferencing be used? Be specific.

7. Would you like to use the computer more in your classes?

10.3 Observation Questions

First Reaction
1. How the kids react the first time they saw and used CUSM?
2. How did the kids react to seeing their picture on the computer?
3. How did the kids react the first time they did a live CUSM video session?

Procedures
1. Could the kids be kept under control? Were the groups small enough to work in front of the camera? Was there enough going on to keep them busy and/or interested?
2. Did each child have a role in the group and did they work cooperatively to put the presentation together?
3. Were the kids able to work without a lot of supervision? Could they figure out how to work out questions or problems among themselves without asking for help?
4. Were all the students able to participate?
5. How did the visual items work during the session?

Technical
1. How did the audio work? Did the microphone work or was the speakerphone needed?
2. If typing was used - how well did it work?
3. Did the kids have problems using the CUSM program?

Educational Value
1. Where can it go from here - what else can you do with this to make it fun as well as educational?
2. How can this be incorporated into other curriculum areas?

11. Appendix C: Geography Session Forms

These are the forms used during the actual geography CU-SeeMe session with the class in Washington. The following forms are included in this appendix:

- Research Questions
- Written Evaluation
- Oral Evaluation

11.1 Research Questions

1. What is the name of your location and how many hours difference is there between you and the Eastern Time Zone?

2. What are the latitude and longitude of your location?
   How many miles are you from the North Pole? From the Equator?

3. Describe the climate of your area.
   What is your average temperature in January? July?
   What is your weather like today [today's date]?

4. What natural resources are located in your area?

5. Name any volcanoes or fault lines found in your location.

6. What is your distance from Riner/Radford, Virginia?

7. What are your main land forms?

8. What are your main water forms including rivers, major lakes, and bodies of salt water?

9. What, if any, crops are grown in your area?

10. What products are you known for?

11. What is the population of your state?
    What is the size, in square miles, of your state?
    What is your population density?

12. How did your state get its name?

13. What bodies of water or land masses border your state?

14. Please list for your state:
    a. capital
    b. song
    c. bird
    d. tree
    e. flower

15. Find the prices of the following consumer goods:

a. gallon of 87 octane gasoline
b. gallon of milk
c. a can of Coke in a machine
d. a dozen eggs

16. In which of these regions is your state located?
    a. The Coastal Plain
    b. The Appalachian Region
    c. The Central Plains
    d. The Mountain West
    e. The Pacific Region

17. Is there anything particularly interesting or unusual about where you live?

11.2 Written Evaluation

1. Who is closer to the equator, Washington or Virginia?

2. In what month is the weather the warmest in Washington?

3. What oceans or seas does Washington touch? Can you name any other bodies of water or rivers in Washington?

4. Are there any fault lines or volcanoes in Washington? If so, can you name them?

5. Does Washington grow the same farm crops as we? Which ones are the same and which ones are different?

6. Name something that Washington is famous for.

7. Where does gas cost more, in Washington or Virginia? How about eggs?

8. List the following for Washington:
   capital:
   song:
   bird:
   tree:
   flower:

9. How many hours difference is there between Washington and Virginia? What time zone is Washington in?

10. What other states' borders touch Washington? Other countries?

11. If you were going to visit Washington, where would you want to go? Why?

12. If you were going to visit Washington, what would you wear?

13. Did you enjoy learning about Washington? Why?

11.3 Oral Evaluation

1. What did you like or dislike about talking to the other school?

2. If you could talk to the other school again, what would you ask them?

3. Did you like using the computer to talk to other people?

4. Who else would you like to talk to on the computer?

5. Could you use video-conferencing in other classes? How?

6. Where else (outside school) could video-conferencing be used? Be specific.

7. Would you like to use the computer more in your classes?

12. Appendix D: Teachers' Comments

12.1 Melissa Matusevich, Riner Elementary School, Virginia

I greatly enjoyed working with Rob Mohn on the CU-SeeMe project
at Riner Elementary School. While there were technical
difficulties due to the technology being in its infancy, I can
envision many, many positive uses in classrooms of the future.

-Foreign language students will be able to converse with native
speakers in other countries.
-Students will be able to participate in comparative studies
with other locations about historical topics such as "civil
war."
-Various cultural differences can be discussed through foreign
exchanges.
-Students will be afforded opportunities to debate political
issues.

The students at Riner greatly enjoyed the exchange with
Washington state. The concept of time zones became meaningful
as we planned the time of our connection. An interesting
social issue was brought up as the Riner students wanted to
know why the fifth graders in Washington were allowed to wear
hats in the classroom. I'm sure the students in Washington noticed
the Southern drawl when one of the Riner students spoke. Our
study of comparative geography really came to life using
CU-SeeMe.

I hope to continue working with CU-SeeMe and to plan further
exchanges, testing it's effectiveness with many different grade
levels and in many different subject areas.

12.2 Terrye Latting, Sunset Elementary School, Washington

Dear Rob,

The kids were simply enchanted with the technology of CU-SeeMe and the Quick Cam. After we finished they kept wanting to reconnect and ask more questions. I realized that building more rapport with your class was an important ingredient that would have added interest and perhaps increased learning of all kinds. I have to admit I was pretty amazed, too.

It was incredible to me how much the interest went up when the ordinary questions unrelated to the content were exchanged and they began to hear that their issues and problems were not all that different than another fifth grade class across the country. This technology is fascinating to me because of the possibility of creating community and enhancing understanding and tolerance all over the globe, kid to kid.

The "state history" content we chose was little "dry" but I think it was a safe choice for a start. If learning is to be enhanced by this technology I believe the global aspects need to be investigated more fully.

Can you imagine directing kids to become "experts" or actors on a chosen topic or person, then having them field questions from other classrooms to demonstrate expertise? For example, dramatizing and acting the roles people out of history (say the founding fathers of the constitution) who are asked questions by a class who has just finished studying the bill of rights, preamble to the constitution, and the declaration of independence. Perhaps they would appear in costume of period design. Can you imagine how a group of kids in Williamsburg might dramatize and re-enact the colonial period? The possibilities are endless and exciting about the ways to enhance and actually increase learning!

If learning is to be *enhanced* by this technology it will not be with emphasis on content rather by process such as described above, in my opinion. The possibilities for integrating or combining content areas are endless. Students engaged in this type of learning are fully engaged in the creative process. Learning by doing and then sharing or exchanging these kinds of experience and discovery is ,in my opinion, the most effective way to enhance or increase learning.

Rob, thanks for giving our class an opportunity to experience the CU-SeeMe technology and to create a memorable fifth grade experience. I was so delighted that we were able to get the audio to work today. That reminds

me that I need to thank you for all your kind and *patient* help. That
made all the difference in my really wanting to make this work and
feeling encouraged to keep trying.

I'm sure you will be successful with your new job in D.C. because you have
already demonstrated the most important characteristics to do a good job:
enthusiasm, expertise, patience, flexibility and persistence. With those
qualities you are already well on your way. Good Luck!

If you ever make it to the area give us a call and I'll treat you to dinner!

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