Desktop Videoconferencing Applications and Issues – Connecting the University and K-12

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Abstract

The College of Education at Kent State University started in 1998 to develop joint university and community projects that provide teacher staff development programming in educational applications of desktop videoconferencing and promote collaboration among teachers and students in pre-K-12 and higher education settings. The work, supported by funding from the Ohio Board of Regents, has gone through several stages. These stages, the research findings, examples of successful activities, and some of the technical issues involved will be addressed. . Instructors at KSU have been using these units as a tool to collaborate with faculty at other universities, conduct classes, supervise student teachers in the field, connect to students in other countries, and view professional conferences from a distance. The project continues to have positive outcomes for K-12 and higher education students and the activities continue to increase both in scope and numbers.

Introduction

With the support of funding from the Ohio Board of Regents, Kent State University, College of education has been working since 1998, to develop joint university and community projects that provide teacher instructional programming in educational applications of low-bandwidth and related technologies, and promote collaboration among teachers and students in pre-K-12 and higher education settings.

Early activity with desktop videoconferencing (DVC) focused on ways to replace face-to-face corporate meetings to reduce travel costs. [Fuller 1994] There was also evidence from the early work that video images, making eye contact and observing facial expressions, can help establish familiarity and is important in developing trust and confidence.[Ishii, Kobayashi, and Grudin 1992] Another successful use of desktop videoconferencing is to allow activities that are less easy to do in the conventional classroom. Teachers see the value of using the technology to bring experiences into their curriculum that could not be provided otherwise. [Thorpe, 1998]

University faculty were seeking ways to increase the amount of contact preservice students have with PK12 settings early in their educational programs. Scheduling, transportation, and access were all obstacles preventing implementation of increased access. At the same time, the University was investing heavily in interactive video conferencing. Dedicated rooms were created at each of the regional campuses requiring a huge capital investment. This system of dedicated equipment also required a system with a lot of bureaucracy to schedule, and maintain.

There was also no provision at the time to connect to K-12 schools so using this system was not an option for much of the work we wanted to do. Desktop videoconferencing technology had advanced sufficiently and the research supported it enough to make this technology a viable avenue to explore. DVC was a relatively low cost solution both in terms of hardware/software and bureaucracy.

Phase One (1998-2000)

The work started with a version of CU-SeeMe™. All eight of the Kent State campuses developed an action plan to work with a K-12 school in their area. Nine projects were developed, equipment was purchased, and training was provided for the initial participants. The grade level ranged from second grade through High School. The topics were just as varied including journalism, history, science, writing, vocational education, and technology skill building.

The projects that had total commitment from both the K-12 educator and the College instructor were the most successful. Technical issues with hardware and software resulted in several of the projects not accomplishing their goals. In cases where the teachers involved really saw the advantages as outweighing the technical issues were the ones that were able to complete their projects. It took a lot of support and communication between the grant staff, K-12 teachers and their technical support, and the university personnel to make the connections successful. The projects were supposed to start at the beginning of the fall semester but most were delayed well into the semester or didn't actually start the videoconferencing until the spring semester.

Research was conducted at the end of the first year to determine the viability of DCV for continued use. One hundred fifty-four students, sixteen teachers and four university faculty participated in the study. Overall, the experience was reported as successful. All three audiences felt that using DVC: 1) gave them better access to experiences outside of the school; 2) increased student motivation to learn; 3) provided an opportunity for student collaboration, group work and a real audience; and 4) improved student attitudes about school and school work. Disadvantages of DVC centered on the technology. Participants noted the need for more technical support, better network access, and more powerful computers. [Fitzgerald, 2000] Based on this evidence, the project continued to pursue its objectives.

Phase Two 2000-2001

We learned from the research and experience that technology support for the participants is paramount to success. Several new goals were added to the project. One was to eliminate any technological roadblocks by providing access to information through increased communication channels and a web site with information about technology upgrades, fixes, questions and problems that the participants might encounter. The second new objective was to add Ohio based resource sites to connect with other project participants. Sites like Sea World of Ohio, Nature Center at Shaker Lakes, the Rock-n-Roll Hall of Fame, and The Aviation Hall of Fame. The DVC project staff set up procedures to facilitate the communication process between the educational community and the resource site. They also helped to guide and arrange education opportunities for students that do more than "enhance" the curriculum, but actually address the curriculum through real world experiences.

Introducing innovation, particularly in the field of IT, is recognized as a particularly difficult change to implement. [Casey, 1996] Thus the implementation phase of technological innovations is much slower than the innovation itself. The DVC project reached the implementation phase. This phase includes helping people connect and communicate, while designing, and carrying-out meaningful learning experiences for all involved. The nature and structure of the DVC project had attracted the attention of a large contingent of Summit County school districts who had recently acquired videoconferencing technology through a telecommunity grant from Ohio SchoolNet. They were looking for guidance and structure to utilize the technology in meaningful ways. The third new goal was to partner with school districts to use desktop video conferencing as a lever to create web-based learning and communication environments which foster intellectually engaging, highly interactive learning.

Much of the activity in this phase of the project was developing relationships with resource sites and schools, dispersing equipment, and providing training. Support was also provided for the original participants who continued their projects. Eleven K-12 schools were involved including 70 teachers and 1200 students.

Phase Three (2001-2003) the Present

In 2001 we began another phase of the DVC Project. New project leadership, new College initiatives, and new technology caused a shift in focus for the project in this third phase although the major goals remain the same. Two Preparing Tomorrow's Teachers to use Technology (PT3) grants were received by the College and each had a videoconferencing component. We are now using Polycom® ViaVideo™ and ViewStation™ IP (H.323) videoconferencing systems. We have assisted over 80 schools and universities in 21 states, and two countries with the installation, operation and use of desktop videoconferencing. Instructors at Kent State University have been using these units as a tool to collaborate with faculty at other universities and to instruct students at a distance. We have also used the systems to supervise student teachers in the field, connect to students in other countries, and view professional conferences from a distance. Several of these projects are described here briefly. You can find more information on the DVC website. http://dvcproject.org

National Project - Dr. Harold Johnson is using desktop videoconferencing to connect to and sign with over 35 sites in 13 states which includes 10 universities and 5 K-12 Schools for the Deaf. The major problem of deafness is not too little hearing, but too much interpersonal and informational isolation. The major problem of teacher preparation is not too little innovation, but too much of a "gap" or difference in the day-to-day instructional realities of college professors and their K-12 colleagues. Desktop video conferencing is one way to bridge the gap between professors and K-12 colleagues. The video conferencing project is one part of the "Crossing the Realities Divide" PT3 Grant.

Preservice students, Instructors and mentors use desktop video conferencing equipment to communicate in real-time over the Internet. Deaf and hearing participants use this equipment to create a virtual meeting place where deaf education students, instructors and mentors can share information, questions and concerns. The system is also used to allow preservice students access to K-12 sites for a virtual field experience. Students in Kent, Ohio connect to a classroom in another state to observe a deaf education teacher in action with her class. After the observation,

students contact the teacher for a discussion of what they observed. Prior to this project, it was very difficult to provide field experiences for the students because of the lack of excellent programs within driving distance.

Internet 2 plays a large part in this project. When using sign language to communicate, it is essential that the video connection be as good as possible. Many of the universities participating in this project have Internet 2. One of the future goals is to sponsor the K-12 partners to provide them access to Internet 2. For more information about this project, their web site is http://www.deafed.net

International connections - We have several projects connecting to students at Thomas Jefferson School in Mexico. Prof. Seeberg's students at KSU and the students in Mexico connected during fall 2002 to discuss the differences between the U.S and Mexican perspective views of the Battle of the Alamo. The project will be repeated and expanded during spring 2003. We have also connected elementary students in the SBC Ameritech Classroom to elementary students at Thomas Jefferson for a variety of discussion topics.

Dr. Marty Jencius of KSU and Dr. Richard Hayes at the University of Georgia have been using desktop video to have the students of a graduate level course discuss the differences between cultures in different parts of the country and world. They have had five successful conferences with each other in this way. During a trip to Tokyo, Richard Hayes connected with Dr. Jencius' graduate class on Human Development, and conducted a discussion with his Japanese host and KSU students about the differences and similarities of our two cultures. This led to a multipoint with UGA, KSU, University of South Carolina, and the University of Tokyo.

Classroom connections - Dr. Douglas Kline, KSU faculty, has been working with high school classes in Kent and Streetsboro. With the help of the classroom teachers, Dr. Kline has designed a course around cell biology and the use of a microscope. He is able to share information to their classroom where they have a ViaVideo™ unit. In addition, he is able to connect the lab microscopes to the ViewStation™ and project the video to the classrooms.

Elizabeth Crawford, a graduate student and teacher in Nordonia Hills Schools, is working with Dr. Albert Ingram to familiarize her students with the culture and art of Paris, France before their trip next winter. The students in her classes will be working with an art graduate student, Lilianne Luneau, who is from France, via the video system. Lilianne will be sharing information about Paris and art and the students will ask her questions about her homeland.

Graduate Course using DVC - Supported by a grant, a course on disability issues was conducted during fall 2002 with a group of students in White Hall and a second group at the University of Louisville. The class was held once per week for 15 weeks using DVC. Because both sites are Internet2 and the class was held in the evening, the connection was adequate for their needs. Each site did have a facilitator in case the technology failed, and to assist students with questions and support outside of class. There were no major problems with the technology. They plan to repeat the course with a connection to a university in Pennsylvania next fall.

Student Supervision - Vocational Educational preservice students working in school districts and their instructors at KSU are using desktop videoconferencing to create virtual conferences to meet over the Internet. The preservice students and vocational education instructors are not able to meet face-to-face as often as they would like because of distance. A camera is set-up in the classroom so that the instructor can observe the progress of the student teacher in their working environment. The camera and computer can be moved from room to room during the day of the observation. The student and instructor then discuss the student's performance using DVC. They have successfully used the system with several students and are continuing to expand this activity to additional K-12 sites.

Virtual Field Experience - The Inquiry I course taken by all teacher education students is piloting a virtual field experience during spring 2003. Using videoconferencing equipment already in the schools and Polycom™ equipment in the College of Education, several schools will provide access for classes to "look in" on their daily activities with discussion conducted with the teacher afterwards. Depending on the success of the pilot project, it will be expanded to all 12 sections of the Inquiry course and increase the number of K-12 schools involved for fall 2003.

Technical Issues

There are a variety of technical issues that must be addressed when endeavoring to use desktop videoconferencing. The technology has advanced significantly and access to Internet 2 has made a significant difference in the success of DVC activities. However, there are still issues. Some have relatively simple answers, others require persistence and in some cases, funding.

Equipment

The ViaVideo™ and ViewStation™ both function successfully with as little as 128k of bandwidth. Many K-12 schools have at least a T1 line which offers 1.5M bit/sec in each direction. This seems like enough bandwidth for videoconferencing however the bandwidth available for the videoconference is determined by the other traffic on the network in the school and on the Internet. A network administrator can determine the network traffic for your system. Or, the bandwidth for your site or station can be checked by using a bandwidth meter. [See Resource list]

In order to have the best possible signal, make sure you are connected to switches and not hubs all the way to the server. Switches give you full bandwidth to each of the devices using it; while a hub must share (divide) the bandwidth between the devices. Make sure the network connections are 10/100mb and full duplex. Full duplex can transmit in both directions at the same time, while half duplex can only transmit in one direction at a time.

The time of day can also make a difference with bandwidth. It might be a good idea to test different times during the day for videoconferencing in your area to determine if there is any effect. At our University, the network is most busy between 12 and 4pm.This is typically a high peak use time for the Internet also. You can improve the quality of your videoconferences by conducting them during times in the day when the network is less busy. Even though poor bandwidth causes problems with the video signal, the audio is usually less affected. If high quality video isn't critical, the conference can still be successful.

Firewalls
All K-12 school systems have some form of security, and no two systems are configured in the same way. This makes it very difficult for many of the technical people in the schools to configure the firewall for H.323 conferencing. In order to use the video units the firewall must be configured to allow the video and audio signals to pass through. A number of ports must be opened for H.323 traffic. If a school is reluctant to open ports for videoconferencing, there are some options that may work.

If the router's firewall software provides a Demilitarized Zone or DMZ, the network administrator can assign the internal IP address of the PC running ViaVideo™ to the DMZ. This allows full (unrestricted) external access for the PC running ViaVideo, while the other devices in the internal network are protected by the firewall. This solution does not provide protection for the PC running ViaVideo™ in the DMZ, but it does keep the rest of the network safe.

When a school is using a ViewStation™, the problem of hackers getting into their system is also reduced because it is an appliance-based codec; not PC based. If someone breaks into the camera, they cannot use it to get to the server. They can only go back out the same way they came in. ViewStations™ are more expensive then a ViaVideo™, but they offer many more features besides added security. Among other things, the ViewStation™ allows multipoint conferencing and doesn't require a dedicated computer. The Via Video™ must be connected to a computer with Windows™ and a USB connection.

Ridgeway Systems™ have developed software that allows the user to transverse any firewall without compromising the network security. The software is free, but the licenses for the program are expensive. With the educational discounts, the cost for 20 licenses is almost $12,000. If you have an IP video project and are working with many different organizations with different brands of firewalls, then you might consider this type of software to eliminate multiple firewall issues.

DSL and Cable Connections
The IP video units can also be connected and used over DSL or Cable Modem. You cannot however, have a successful connection with a traditional phone modem. The connection speed is just not sufficient to allow for videoconferencing. We have had several instructors successfully set-up a ViaVideo from home over DSL or cable.

DSL (Digital Subscriber Line) is not available in all areas, and it is a service only provided to home users. This technology can supply the necessary bandwidth for numerous applications, including high-speed access to the Internet, dedicated Internet connectivity and videoconferencing. DSL directly connects your home system to the Internet, via the existing copper telephone lines. The telephone company provides this service. With a DSL line the signal is smooth and steady most of the time.

The term "cable modem" is relatively new and refers to a modem that operates over cable TV network cables. You connect the cable modem provided by the cable company to the TV outlet for your cable TV, and the cable TV operator connects a Cable Modem Termination System

(CMTS) in his end (the Head-End). This system also provides adequate connectivity for desktop videoconferencing.

Internet2

Internet2 is a consortium being led by over 190 universities working in partnership with industry and government to develop and deploy advanced network applications and technologies, accelerating the creation of tomorrow's Internet. Internet 2 is recreating the partnership among academia, industry and government that fostered today's Internet in its infancy. At this time, 190 universities are members of Internet2. More universities are not involved because of the expense and time needed to hook up to Internet2. We hope that it will soon be possible to bring K-12 schools to the Internet2 through a K-20 initiative that will allow member universities to sponsor a school to get connected to I2. This will make many of the projects we are planning more feasible.

Conclusion

While there are still some obstacles to overcome such as speed and firewalls, most of the projects have been successful. Advances in hardware and software and access to Internet2 eliminated many of the technical problems that were barriers in the first year of the project. More importantly, the feedback and the research we have done indicate that it is a medium worth continuing to explore and to use. Access to experiences outside of the school and the opportunity for collaboration with peer and professionals remain very positive outcomes of desktop videoconferencing. Our list of activities grows each year and we anticipate that this growth will continue.

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Czeck, Rita L.H. 1995. Desktop Videoconferencing: The Benefits and Disadvantages to Communication. University of North Carolina at Chapel Hill.

Thorpe R. (1998). The use of personal video conferencing with special needs pupils from three schools serving rural areas: A case of successful adoption of new technology. *Journal of Information Technology*, 7(3), 395-408

Resources

Bandwidth Meters

Polycom Bandwidth Meter:
http://www.polycom.com/clubPolycom/members/bandwidth.html

Bandwidth Place:
http://www.bandwidthplace.com/

Firewall Ports to Open for Polycom Equipment

ViaVideo ports are TCP 1503, 1720, 3230 – 3235 and UDP 3230 – 3235.
ViewStation ports are TCP/UDP 389, 1503, 1720 and TCP 3230, 3231 and UDP 3230 – 3235.

Videoconferencing Sites

Ridgeway System has a free trial version
http://www.ridgewaysystems.com/

Video Conferencing at UVA
http://www.itc.virginia.edu/netsys/videoconf/midlevel.html

Review Video
http://www.reviewvideo.com/

Videoconferencing at Warwick University
http://www.warwick.ac.uk/ETS/Resources/video.htm

Network Fusion News –Videoconferencing
http://www.nwfusion.com/news/1999/0712video.html

Video Conferencing FAQ
http://www.ucl.ac.uk/mediares/vconf/vcfaq.html#anchor40853

Internet2 & K-20 Initiative

- Internet2
  - http://www.internet2.edu/
- K20 Initiative
  - http://k20.internet2.edu/about/index.html
- FAQ about internet2
  - http://www.internet2.edu/html/faqs.html#
- Membership
  - http://www.internet2.edu/html/join_i2.html
- Internet Universities
  - http://www.internet2.edu/html/universities.html#
- ITEC Ohio
  - http://www.itecohio.org/