Electronic Conferencing Tools for Student Apprenticeship and Perspective Taking

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Clearly, there is a philosophical shift to reform education spurred by theory and research on multiple fronts. Those leading this crusade attach various labels to it, including constructivism (Duffy & Cunningham, in press; Duffy & Jonassen, 1991; von Glasersfeld, 1995), social constructivism (Bonk, 1995), and construc***tionism*** (Harel & Papert, 1991), among other philosophical terms and learning viewpoints (see Confrey, 1995). One recent attempt to umbrella these terms within contemporary educational and psychological literature is found in the 12 learner-centered psychological principles drafted by the American Psychological Association (APA) (1993). In fact, in the March–April 1995 issue of this magazine, Wagner and McCombs (1995) pointed out that these 12 principles provide a foundation for educational reform and school restructuring. Furthermore, they contended that distance education provides an ideal forum for demonstrating these learner centered principles in action (see Alexander & Murphy, 1994; APA, 1993; or Wagner & McCombs, 1995, for an elaboration of these principles). Wagner and McCombs also argued that distance education attracts independent and highly self-efficacious learners, as well as instructors who experiment with their pedagogy to provide active learning experiences and accommodate individual learning styles. As such, instructional designers might find that videoconferencing environments are an exciting testbed for operationalizing learner-centered shifts in education.

Though distance education provides one format for educational reform, other recent educational technologies are beginning to emphasize a learner centered design pedagogy by placing tools in the hands of learners to build, browse, link, draw, juxtapose, represent, and summarize information (Kozma, 1987; Lajoie & Derry, 1993; Pea, 1987; Salomon, 1993). In contrast to the prescriptive and instructor centered practices of the past few decades, emerging conferencing, collaboration, and global networking technologies offer distinct possibilities for apprenticing student higher-order thinking in real-world contexts, while fostering student social interaction and perspective taking (Harasim, 1990; Riel, 1993).

In this paper, we point to a few electronic conferencing tools, *CU-SeeMe*, *PictureTel*, and *VAX Notes*,[1] that can support such student apprenticeship and interpersonal understanding. More importantly, we detail one unique way to integrate these technologies. In addition to documenting the technical specifications for joining two videoconferencing systems, we provide some anecdotal results of our first attempt to marry all three of these electronic conferencing technologies.

Apprenticeship

A multitude of technologies have arisen in the 1990s to foster student dialogue and collaboration (Lajoie & Derry, 1993; Soloway, 1993). Prominent technologies for computer conferencing and collaboration (see Bonk, Medury, & Reynolds, 1994; Schrage, 1990) bring students close to real-world environments and abundant apprenticeship opportunities. Cognitive apprenticeships (Collins, 1990; Collins, Brown, & Newman, 1989), often based on Vygotskian theory (see Vygotsky, 1978, 1986), focus on the authenticity in which knowledge is developed as well as the dialogue processes between students and adult guides or more experienced peers (Rogoff, 1990, 1995; Wells & Chang-Wells, 1992). By using this rationale, methods for situating student learning in an authentic, real-world community (Brown, Collins, & Duguid, 1989; Lave, 1988; McLellan, 1996) or sets of context-rich, generative problems (Cognition and Technology Group at Vanderbilt, 1990) are gaining acceptance with each advancement in technology.

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[1]In moving away from its reliance on mainframe computers for electronic mail and conferencing to more distributed systems, Indiana University recently has switched from *VAX Notes* software to *FirstClass* from SoftArc, Inc., for all electronic course conferencing and collaboration.

The increasing power of technology tools, the growing acceptance of a more learner-centered pedagogy (e.g., collaborative learning, facilitating critical and creative thought, etc.), and the development of the information superhighway coalesce to create new educational opportunities and communities. For instance, international weather-related projects such as the *Kids as Global Scientists* (KGS) project (Songer, in press), the Collaborative Visualization (CoVis) project (Pea, 1993), and the *Global Learning and Observations to Benefit the Environment* (GLOBE) Program (GLOBE Program, 1995) involve students in genuine scientific data collection and reporting, while peer and mentor collaborations in these projects further students' sense of participation in communities of practice (Lave & Wenger, 1991). Also endorsed as a way to raise global perspective-taking on environmental issues, the *World Forum,* coordinated by the University of Michigan, has supported both live and simulated student correspondence with explorers involved in polar expeditions.

While students interact with peers over the Internet about sensitive environmental issues, World Forum mentors and explorers question and guide their understanding of key environmental issues (Sugar & Bonk, 1995). Similarly, Ruopp, Gal, Drayton, and Pfisters (1993) have used the Internet to build communities of physics teachers who then apprentice less skilled learners through a mix of e-mail social interaction and dialogue. This latter project is an illustrative example of the two-tiered scaffolding potential of distance technologies, wherein consultants and experts scaffold teachers who in turn scaffold students (Gaffney & Anderson, 1991; Tharp & Gallimore, 1988). In addition, all of these electronic collaborations exemplify how innovative learning communities can be created when students from diverse backgrounds and locations share in the common exploration of a topic or question (Riel, 1985, 1990; Songer, in press). As technology provides increasing opportunities for online communities or "networlds" (Harasim, 1993), the pedagogic potential of every connected classroom multiples.

From a Vygotskian perspective, education-related networlds bring new collaborative partners and resources into a student's learning environment and additional chances for his or her learning to be elevated to new heights. Computer supported collaborative learning (CSCL) studies indicate that peer feedback, for instance, might motivate student discussion, debate, and internal reflection, thereby scaffolding student learning to new heights (Daiute & Dalton, 1988; Koschmann, 1994). Experts and learning guides, too, might arrive on the network to participate in a learning activity and provide information or demonstrations regarding the current discussion topic (Sugar & Bonk, 1995). According to assisted learning theory (see Tharp & Gallimore, 1988), these mentors might lend various forms of learning guidance, including feedback, questioning, task structuring, modeling, direct instruction, and instructional aids or hints. During a computer conference, teachers and mentors might mediate between expert and learner roles by stating the purposes and goals of the learning activity, asking and modeling questions, providing explanations, offering insights into their own new understandings, supporting student inquiry, redirecting attention when it sways significantly off course, and offering generic procedural assistance and prompts. Of course, the learners themselves might add to the learning activity by asking questions, seeking additional information, and offering tentative conclusions or recommendations.

Computer conferencing systems might further encourage reflection and dialogue through scheduled as well as impromptu moments in the conference wherein students self-reflect on particular learning events and activities. Computer conferencing tools also might be embedded with guidance questions or aids, task support, peer commenting notes, and private reflection journals (Bonk & Reynolds, 1992; Kozma, 1991; Salomon, 1988, 1993; Woodruff, Bereiter, & Scardamalia, 1981; Zellermayer, Salomon, Globerson, & Givon, 1991). From a social constructivist viewpoint, therefore, the above peer, expert, teacher, learner, and tool resources jointly create an instructional environment for apprenticing learners into a community of discourse (Bonk, 1995; Bonk, Hay, & Fischler, 1995).

Perspective Taking

Besides apprenticing learners, electronic conferences offer unique opportunities to enhance student ability to take the position of another person or "infer another's capabilities, attributes, expectations, feelings, and potential reactions" (Selman, 1971). Long before the current global educational opportunities of the information age, many psychologists and educators held that putting oneself in another's position was at the heart of human intelligence (e.g., Bonk, 1990; Mead, 1934). Though the term varies, developmental psychologists typically refer to this skill as social cognition or perspective taking (Muuss, 1988; Selman, 1976). As a stage-like, developmental skill, similar to cognitive and moral reasoning, social cognition moves through a distinct developmental sequence from egocentric stages wherein the learner can only see his or her point of view, to realizing that others have different views from one's own, to knowing that others can also take your position, to being able to take a neutral, third party point of view, and finally to being able to assume a societal or generalized other perspective (see Selman, 1980).

As indicated, the ability to take the perspective of someone else when learning is becoming increasingly critical as the channels of communication multiply (Sugar & Bonk, 1995). Instructional designers, therefore, might want to focus their pedagogical strategies on encouraging episodes or moments of perspective taking. For instance, computer-mediated environments such as networks, e-mail, bulletin boards, and computer conferencing might offer a chance for sharing, idea exchange and feedback, peer modeling, and joint database exploration. As technology increases the range of audiences and viewpoints available, students' ideas should be extended beyond personal views, while their faulty preconceptions and biases are coincidingly reduced. Only when this occurs, can significant common ground and intersubjectivity among participants occur.

Many questions arise here, however. For instance, what sorts of tools are available for electronic conferencing that might support cognitive apprenticeships and enhance student perspective taking? Exactly how might these conferencing tools encourage learners to explore and accommodate alternative viewpoints? And how does one obtain a greater sense of intersubjectivity and common ground through computer technologies? Perhaps computer conferencing designers should focus on supporting shared meaning or momentary common ground between learners during these electronic conferences. When designing instructional environments, therefore, one might want to insert or alter the visible windows or collaborative tool opportunities with the outside world based on the social cognitive abilities of potential user(s). More specifically, technology tools might embed possibilities for the display of multiple opinions and alternative answers, diverse forms of representing data, interactive debate forums, options for participation, student role taking opportunities, peer commenting windows, mentor reaction transcripts, and peer knowledge bases. Already a number of collaborative writing and computer conferencing tools provide one or more of the following options within one's text-generation activities: teacher guidance windows, peer chat boxes, expert feedback windows, scrollable dialogue tracking devices, private self-reflection notes, public text pointing tools, organizational and planning aids, peer knowledge base browsing devices, and metacognitive reflection prompts available on demand (Bonk *et al.*, 1994; Bonk & Reynolds, 1992; Salomon, 1993; Zellermayer *et al.*, 1991). Few tools, however, contain a sufficient mix of these perspective taking properties.

Given the increasing pathways to an information superhighway, the flow of new ideas and corresponding feedback is more spontaneous and instructionally exploitable. Such idea exchanges may push one to decenter from egocentric viewpoints toward the incorporation of many potential perspectives. With increasing possibilities for global networking and computer conferencing in an electronic world, notions of audience will be forever altered. Social cognitive skills of young learners will be pushed to new heights as exposure to a diverse array of online pals becomes more commonplace (Sugar & Bonk, 1995). Instructional designers, aware of these electronic opportunities to address multiple audiences and human diversity, may discover both a moral and professional goldmine here. Instead of discrete factual knowledge and declarative skills, it appears that instructional designers of the twenty-first century will be paving the roads to collaboration, interpersonal understanding, conflict resolution, information sharing, and perspective taking that few have driven in the past. And since most school restructuring and educational reform seems to be stuck in second gear (Papert, 1993; Tharp, 1993), instructional designers might want to build new showrooms for perspective taking as well as test drive new models of apprenticeship before issuing any more licenses for the global information highway.

Three Electronic Conferencing Tools

As witnessed within a distance education course team taught by the first and third authors during the spring of 1995, there are plenty of electronic conferencing models to test drive. In just one 24-hour period, we examined three distinct conferencing tools: (1) the asynchronous, electronic classroom of *VAX Notes* as well as the compressed videoconferencing capabilities of (2) *PictureTel* and (3) *CU-SeeMe* technologies. These three conferencing tools each offer unique ways to apprentice novice learners as well as encourage them to grapple with alternative perspectives. In the sections that follow, we first define and describe these three electronic conferencing tools. Next, we detail the some of technical aspects of these tools so that others may replicate or extend our efforts.[2] Afterwards, we describe one instance wherein these three conferencing technologies were united.

First of all, the more expensive and higher quality of the two audio/video technologies employed here, *PictureTel,* from PictureTel Corporation, used telephone lines to carry compressed audio and video between Indiana University's Bloomington and Indianapolis campuses. At these locations, *PictureTel* suites or Instructional Classroom Studios (ICS) are equipped with customized lighting, air-handlers for quiet room operation, two CameraMan auto focus remote control cameras, specially designed ceiling microphones sensitive to general audio pick-up, large

[2] Those requiring more specific technical information should contact the second author.

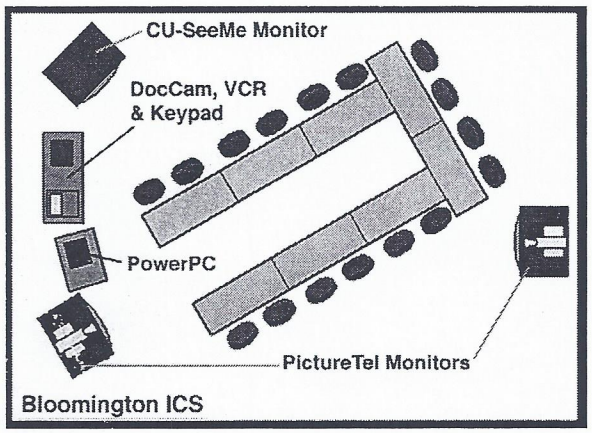

Figure 1. Bloomington Instructional Classroom Studio (ICS).

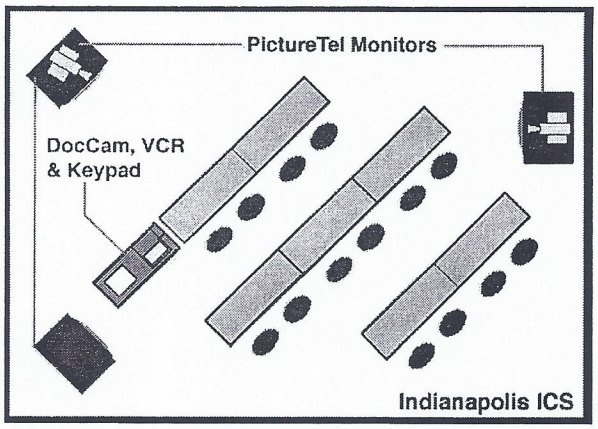

Figure 2. Indianapolis Instructional Classroom Studio (ICS).

screen monitors, a fax machine, a document camera, and comfortable seating capacity for 15–30 students (see Figures 1 and 2). The video images and sound from this room are sent to a CODEC (*Coder-Decoder*) where signal compression chips digitize and compress information-dense analog signals for delivery across two switched 56 kilobyte per second ISDN phone lines via dual modems. As the compressed signals are received back from the remote site by the CODEC, the audio signal is passed through an echo-canceler (i.e, a device for keeping the remote site sound from being transmitted back in a recursive fashion). Once through the echo-canceler, these signals are delivered to the three 37" monitors and corresponding ceiling speakers in the ICS. A control keypad for camera selection, motion, and zooms, as well as volume control, is located at the instructor station in both sites.

The second compressed two-way audio/video technology employed here, called *CU-SeeMe* (first developed at Cornell University), was added to one of our class sessions to provide live connections to prominent researchers at other campuses (i.e., the community of practice). Even though a remote access, semi-private reflector site was selected to handle this particular conference, *CU-SeeMe* supports both public and private reflector sites as well as individual point-to-point connections. As a less expensive videoconferencing option, *CU-SeeMe* technology uses either a Macintosh or PC Windows-based computer platform to digitize and compress audio and video signals transmitted over the Internet. While this type of technology requires a video-capture board capable of digitizing a video signal, it uses less sophisticated video transmission algorithms than are used by *PictureTel* technologies to transmit video signals. Nevertheless, when using *CU-SeeMe* software, images, text, and sound from multiple sites can appear simultaneously on a computer screen. But with low transmission rates (i.e., 2 to 12 frames per second) and grayscale images in a 120 X 80 pixel window, the video image typically lacks some clarity. In addressing some of these issues, White Pine Software recently announced a relatively inexpensive version of *CU-SeeMe* with color support, interactive whiteboard capabilities, audio improvements, and application sharing, which may make the less stable public domain versions of *CU-SeeMe* obsolete.

The third electronic conferencing technology employed here, *VAX Notes* from Digital Equipment Corporation, is a text-based, asynchronous (i.e., delayed) conferencing tool. It is a fairly basic conferencing program that features private bulletin board capabilities through Indiana University's central computing system. College instructors primarily use the electronic classroom (EC) features of *VAX Notes* to manage class tasks, provide student feedback, extend classroom dialogue, share ideas and information, post potential exam questions, and foster small group work (Chong, 1994). In this particular class, we chose to use the EC to discuss and debate assigned readings and reflect on class discussions and demonstrations. Important to the creation of an electronic community, the time and geographic independence of *VAX Notes* system empowered students, whether on campus or at home, to enter and exit the EC anytime.

Clearly, each of the three electronic conferencing tools detailed above offers opportunities for perspective taking and cognitive apprenticeship. By using these

three conferencing tools during one 24-hour span in our class, students shared and debated views with each other electronically, interacted after class with students and instructors more than 50 miles apart, and engaged in a live discussion with researchers whose articles they were currently reading and debating.

Linking Videoconferencing Systems: *PictureTel* and *CU-SeeMe*

A desire to extend these technologies and foster collaboration and debate had us thinking of ways to temporarily marry these three conferencing systems. Because we were using *PictureTel* technology to teach a graduate seminar on *Interactive Technologies for Learning*, we wanted to find interactive ways to illustrate learner-centered technology tools and apprenticing situations. During a week on the cognitive benefits of computer programming, we thought it would be valuable for the students to speak directly with one or more of the authors from that week's course readings. As a result, we contacted the two main authors for the week, Dr. Elliot Soloway at the University of Michigan, and Dr. David Palumbo at the University of Houston-Clear Lake (UHCL), and asked whether they would participate in this class using *CU-SeeMe* technology. Upon agreement, Palumbo offered to use the UHCL reflector site to host the *CU-SeeMe* teleconference. Through electronic mail correspondence, plans were then made to connect Soloway in Michigan and Palumbo in Texas with the classes in Indianapolis and Bloomington. But since a marriage of *PictureTel* and *CU-SeeMe* technologies had yet to be conducted, our focus shifted from apprenticeship and perspective taking possibilities to the technical barriers in our path.

Technical Specifications and Hurdles

A series of audio and visual tactical strategies lead to our final *PictureTel/CU-SeeMe* connection. The first problem we considered was how to send *CU-SeeMe* images of Drs. Soloway and Palumbo from the PowerPC Macintosh to the remote *PictureTel* site in Indianapolis as well as to the large monitors in the Bloomington ICS. Fortunately, *PictureTel* keypads at our two classroom sites were each capable of selecting video sources from two different cameras as well as from a document camera and VCR, thereby enabling the instructor at the Bloomington ICS to send the present *CU-SeeMe* image to the local monitors as well as to the remote site in Indianapolis.

It must be pointed out that the *PictureTel* keypads and monitors were designed for a picture-in-a-picture (PIP) capability, which allowed the Bloomington and Indianapolis students to view at least two video sources. Though all the monitors in a particular ICS typically would display the same image(s), we modified the standard ICS monitor configuration in order to access one additional video source during the upcoming *Picture-Tel/CU-SeeMe* videoconference. To obtain this third video source in the Bloomington ICS, we dedicated one of the three available monitors for the *CU-SeeMe* image, while the other two would simultaneously display both the remote Indianapolis site and the local Bloomington site. Hence, in the Bloomington ICS there would be three video sources displayed: (1) the *CU-SeeMe* conference guest speakers, Palumbo and Soloway, on the dedicated monitor, (2) students from the remote Indianapolis *PictureTel* site in the large window of the remaining two monitors, and (3) a smaller shot of the local Bloomington class in the embedded PIP window of these two monitors. Figure 3 displays these unique videoconferencing connections.

The first attempt to connect two relatively new videoconferencing tools, naturally, required some trial and error testing. For instance, to establish this situation, we first had to repatch our monitor connections in the control room adjacent to the Bloomington ICS. Next, we decided to send the video output of the dedicated *CU-SeeMe* monitor in the Bloomington ICS to the video input of a PowerPC Macintosh in the room, thereby enabling whatever source was displayed on the *Picture-Tel* monitor in Bloomington to be sent to the *CU-SeeMe* conference. By doing this, the instructor could still use the *PictureTel* keypad to display the local site, the remote site, or, more typically, a combination of the two (one full screen shot and another embedded in a smaller window) to the *CU-SeeMe* conference. In addition to being able to send the dual PIP signal of Bloomington and Indianapolis students to the *CU-SeeMe* videoconference, this signal also could be sent to the remote *PictureTel* site in Indianapolis which would not dial into the *CU-SeeMe* conference. In summary, then, at the same time that the collective Bloomington-Indianapolis video signal could be sent to the reflector site and received by both Palumbo and Soloway, both of their respective *CU-SeeMe* images could be routed through the reflector site in Houston and then received on the Power Macintosh in Bloomington for immediate display on the TV monitors in the two *Picture-Tel* ICS's. Thus, at least in terms of a video signal, we determined that two distinct videoconferencing systems could be joined.

Once the video configuration dilemmas were solved, we devoted our attention to a myriad of audio issues related to the upcoming *Picture-Tel/CU-SeeMe* videoconference. Though *CU-SeeMe* has built-in microphone capabilities for individual speakers, we wanted all our students to freely make comments and ask questions during the conference. Additionally, we hoped that the students at the remote *PictureTel* site in Indianapolis, who were indirectly connected to *CU-SeeMe*, would be more than video voyeurs. In terms of

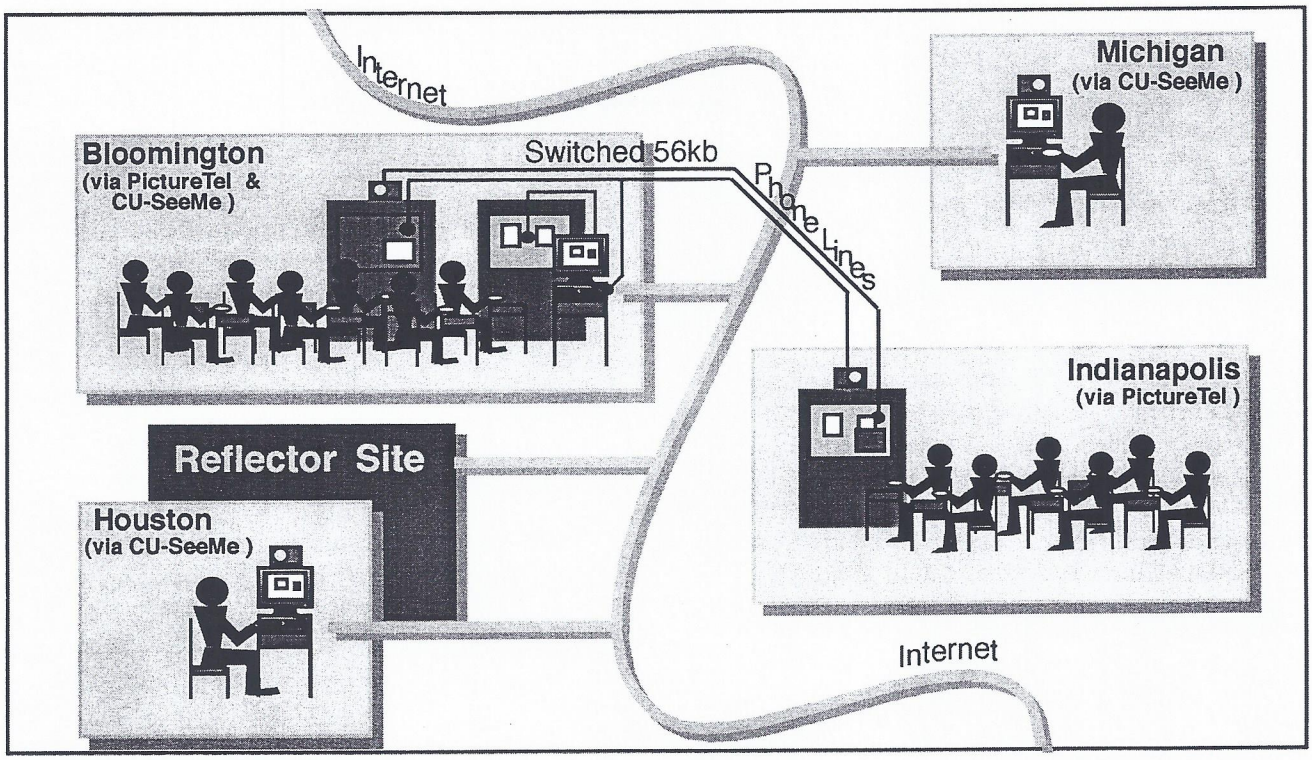

Figure 3. Diagram of *PictureTel* and *CU-SeeMe* videoconferencing site connectivity.

our *CU-SeeMe* audio output, therefore, we would send the "record" output from the echo-canceler which effectively "mixed" both the local and remote ICS room audio signals so that either could be heard by the *CU-SeeMe* conference participants. Since this signal was fed to the PowerPC Macintosh microphone input, any audio generated at the local or remote site would now be heard by Drs. Soloway and Palumbo and vice-versa. It is important to point out that our audio quality was not significantly affected when we switched to different video sources. Using this particular configuration, anyone could be heard at any time.

What Happened?

Once conference connectivity was tested, the switching of the monitors and the hook-up to *CU-SeeMe* became relatively easy (and it was now replicable!). Nevertheless, with all the novelty and wiring involved here, we prepared ourselves for problems. A few hours before the class was to start, therefore, we attempted to set up the *CU-SeeMe* conference link to the reflector at UHCL over the Internet (Palumbo in Texas, Soloway in Michigan, and the class in Bloomington). Once established, this three-way conversation was then added to the weekly *PictureTel* telephone line connection between the Bloomington and Indianapolis ICSs (and, of course, all fingers and toes were crossed). Fortunately, within seconds, the two videoconferences were fused!

Even though the *PictureTel/CU-SeeMe* connection was successful, there remained one additional dilemma to overcome. Because of a minor but unforseen technical difficulty with *CU-SeeMe* at the Michigan site, the audio connection to Ann Arbor was not functional in this configuration. Once again, the equipment in Bloomington's ICS suite came to the rescue. After a few moments of wondering who was going to read Prof. Soloway's lips and translate, we decided to try a telephone conference call between Bloomington and Ann Arbor. Once a phone conference was established (i.e., the fourth distance education conference of the week), the audio volume was adjusted until both the *PictureTel* and *CU-SeeMe* conferences could carry the sound back to Indianapolis and Houston, respectively. This complex configuration of equipment highlighted the capabilities of *PictureTel* studios to effectively control sound from multiple sources.

Figure 4. Sample *PictureTel* video image from the Bloomington ICS.

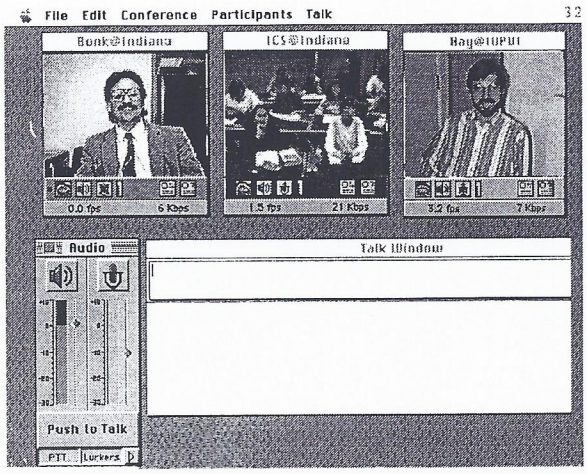

Figure 5. Sample *CU-SeeMe* video image of course instructors during pilot testing.

Of course, after the above technical problems and requirements were handled, we remained curious as to how this system worked in terms of student learning. The results of these efforts extended far beyond our original goals as students and guest speakers engaged in a highly interactive conversation shared by over 30 people at four different locations. Though *CU-SeeMe* conferences default to relatively small windows, the students watched and listened to enlarged TV monitor images of Soloway and Palumbo as each spoke and asked or answered questions (see Figures 4 and 5 for sample *Picture-Tel* and *CU-SeeMe* images). Equally important, both scholars could view and hear each other as well as the Bloomington or Indianapolis representative(s) involved in the current conversation. Full classroom shots and pans of these classrooms also were available and frequently used.

During this remarkable session, a wide range of topics were covered. Among the issues and questions discussed were: (1) computer programming as a basic skill, (2) essential cognitive skills of the information age, (3) recent computer tools addressing higher-order thinking skills, (4) the importance of multimedia tools in K–12 schools, (5) effective preservice and in-service teacher technology training, (6) the promise and initial results of problem-based learning, and (7) key variables impacting school change. Additionally, each guest speaker briefly summarized his current research efforts in light of these issues, trends, and concerns.

After the conference, it was noted that selecting both Palumbo and Soloway was extremely fortunate, since they were unique, animated individuals who seemed to pop right into our classroom with this technology. Though this level of inspiration and sense of physical presence might not be attained with other *CU-SeeMe* guest selections, these two electrifying personalities really charged up the students, who previously only knew the authors by their published articles and professional reputations.

Later Discussion in the VAX Notes Electronic Community

This inspiring discussion carried over into students' *VAX Notes* conference postings later that night and the following few days. Before providing examples of this conversation, however, our scheme for transforming *VAX Notes* into an electronic learning community (Lin *et al.*, 1996) must be explained.

Utilizing a delayed electronic collaboration tool was a deliberate pedagogical strategy to create a shared space (Schrage, 1990) for student-student and student-teacher interaction and meaning making dialogue. One of the key goals of this electronic learning community was for the 22 students in the class to engage in weekly reflections of the readings on a mix of practical and theoretical issues. Instead of the instructor as the primary source of information, students were encouraged to reflect, discuss, question, comment, and provide peer feedback as they wandered through the course readings and topics. To accomplish these goals, the two instructors provided article scaffolding and insight to the weekly readings, especially at the beginning of the semester. For this graded assignment, students signed up for either a "starter" or "wrapper"

role in order to initiate or conclude one of the week's discussions, respectively. Besides assuming a starter or wrapper role during one of the weeks, students needed to participate each week in the *VAX Notes* discourse. At the end of the semester, they turned in portfolios of their *VAX Notes'* contributions as well as a reflection paper regarding the utility of this task.

In apprenticing student learning, students were all given some preliminary role guidance. For instance, students leading the electronic conversation each week were asked to state reactions, questions, and suggestions for the upcoming readings as well as point to linkages between these readings and past assignments. In contrast, students summarizing the weekly electronic conversation were to reflect on the starter's initial points for that week, summarize the resulting participant discussion, and point out questions and concerns yet to be answered. Whereas starters read and reviewed the week's readings at least four days prior to the "live" class discussion of those articles, wrappers waited until after class to summarize what transpired in this shared social space. To add apprenticing possibilities and outside perspectives, the remaining 20 participants, over a third of whom were foreign students, joined in the dialogue by asking and responding to posted questions, relating the readings to current issues in the news, and adding personal spins on the articles or class discussion.

When finished with the *CU-SeeMe/PictureTel* teleconference, the students and professors engaged in a lively conversation about the experience that extended into their *VAX Notes'* discussions later that night and during the next few days. One common theme of this discussion was the amazement that "everything worked." In fact, one of the instructors' *VAX Notes'* comments from that evening acknowledged that this was an "interactive and enlightening session" that ranked as one of his top two or three teaching experiences ever. In retrospect, both instructors realized that this combination of three electronic conferencing devices actually was a demonstration of many of the 12 learner-centered principles of the APA. More specifically, it was fruitful marriage of technologies in terms of both student apprenticeship and perspective taking.

Students, too, indicated that they gained from the *PictureTel/CU-SeeMe* linkage. One foreign student offered this assessment during her *VAX Notes* commenting:

> Tonight was a unique and interesting class meeting. The majority thought that CUCEEMe [*sic*] was a wonderful thing and I agree. I always get excited when there's something new going on and I'm experiencing it myself instead of just hearing from someone else. It makes a difference hearing and seeing the authors of the papers themselves and see how enthusiastic they are about their work.

Though she and other students mentioned concerns about time and money, they also appreciated the opportunity to "visualize" researchers when reading their works. Other *VAX Notes'* comments like the following from another foreign student also revealed the importance of having a face to match to the research articles they were reading:

> A good picture is worth thousands of words. This old saying comes to mind when I read the word "visualization" from some of the articles. Especially after last night's *CU-You See Me* [*sic*] in the class, most of us agree the impact we had [*sic*] after seeing the authors visually. I start to think how many visual [*sic*] we use in our everyday life?

Course evaluations indicated that many students found these three conferences extremely valuable, even though no specific course evaluation questions addressed the joint *Picture-Tel/CU-SeeMe* videoconference. In fact, over half of the students mentioned something valuable about it in their course assessments, many arguing that this was the best activity of the semester. Ironically, two students, who were critical of Soloway's and Palumbo's ideas in their weekly *VAX Notes'* comments prior to the conference, acknowledged that they were enlightened by the ideas of these two scholars after interacting with them on *CU-SeeMe*. In effect, these students found out that reading one or two articles from a researcher or theorist gives an incomplete picture of his or her key ideas and educational philosophy. Stated another way, as a result of this electronic conferencing activity, they were better able to grasp alternative perspectives and, at least temporarily, stand in someone else's shoes. Just like attending a conference presentation or invited colloquium, *CU-SeeMe* brought students into the current research agenda of a scholar and updated them on unanswered questions and concerns mentioned in his or her previous work. And such insight and apprenticeship, of course, was the original goal of this particular conferencing idea.

Conclusions and Future Directions

PictureTel, *CU-SeeMe*, and *VAX Notes* conferencing technologies offer unique opportunities for graduate students to be apprenticed into a community of practice. They highlight the importance of learner-centered instruction in the information age. Perhaps most importantly, perspective taking skills might now be targeted and enhanced with each of these conferencing tools. It is conceivable that in the near future, instructional designers and teachers will be able to vary the type of perspectives or audiences offered in electronic conferencing situations as a means to move students through developmental stages of social cognition as well as apprentice them into a community of practice.

The pedagogical possibilities of merging technologies, such as *PictureTel*, *CU-SeeMe*, and *VAX Notes* conferencing tools, are endless. As indicated above, keynote speakers and guest hosts can now be brought into a distance education classroom from other sites. Not surprisingly, some of our colleagues at Indiana University envision coordinating "Great Researcher" seminars wherein distinguished scholars within a particular field appear at preselected times over distance education with the help of *CU-SeeMe* or similar technologies. Others of us have more modest goals. For instance, team teaching opportunities should abound with *CU-SeeMe*, especially for those having close collaborative relationships with scholars at other campuses. In terms of perspective taking, graduate students in schools of education in the United States might use *CU-SeeMe* to find out what topics and ideas are considered important in such places as Europe, the Middle East, or South America. In turn, prospective graduate students from other countries might use *CU-SeeMe* to glance at the courses they might later take, interact with potential future faculty and graduate student colleagues, or interview for job openings before they actually arrive on campus.

Apprenticeship and perspective taking opportunities extend well beyond the classroom with these technologies to research projects, grant proposals, and dissertations defenses. In effect, with conferencing tools like *CU-SeeMe*, universities reliant on *PictureTel* or similar distance education technologies, now have a means to inexpensively bring experts from outside the university network into multiple classrooms and meetings. With all these new conferencing systems, teachers certainly will have an assortment of apprenticeship, perspective taking, and other pedagogical possibilities to consider during the next few years. And though this merging of conferencing technologies here was just "a day in the life" of the graduate student apprenticeship process, it was, nevertheless, a thrilling means to further transport our two distance education classes into the workshop of the master. With days such as these, students may better appreciate the labor of the expert, while beginning to envision some of the key battles yet to be won, as well as their own potential roles in this crusade. □

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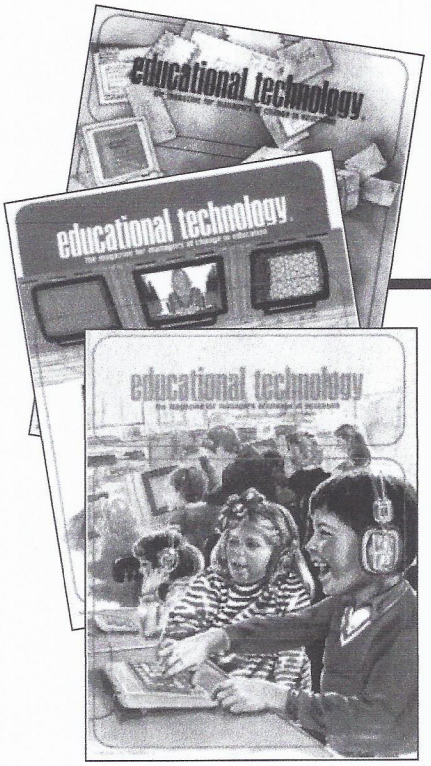

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