A blended training approach using videoconferencing for distance education

By Craig Locatis, PhD, locatis@nlm.nih.gov

Cynthia Gaines, gainesc@mail.nlm.nih.gov

Wei-Li Liu, MBA, wliu@mail.nih.gov

Michael Gill, mgill@mail.nih.gov
National Library of Medicine, 8600 Rockville Pike, Bethesda, Maryland 20894

John Carney, MLS, jocarney@cdrewu.edu

Jaimela Foster, PhD, jafoster@cdrewu.edu
King Drew Health Sciences Library, Charles R. Drew University of Medicine and Science, Los Angeles, California

Valerie McCall, MSLS

Michelle Woods, MEd
King Drew Medical Magnet High School, Los Angeles, California

INTRODUCTION

In 2004, the National Library of Medicine (NLM) recognized the need to expand its outreach activities to minority students. To meet this objective, NLM sponsored a program presenting information on varied health sciences topics to minority students interested in health sciences careers. An existing initiative, NLM's Adopt-A-School program, provided an initial foundation for this project. As part of the Adopt-A-School program, NLM staff provide training at a nearby school site, and students make field trips to the library. In addition, summer work opportunities are provided for some students. To explore the feasibility of providing a more flexible variant of this program that would extend the training component to more distant schools, NLM partnered with King Drew Medical Magnet High School in Los Angeles to deliver a distance learning program via synchronous videoconferencing and collaboration technologies. This brief describes approaches used in and preliminary evaluation of the training.

BACKGROUND

Selection of training methods

Several strategies for providing distance learning and outreach were initially considered, including training people to train others. The ''training trainers'' approach is very different from those where education is centrally provided. It can be less expensive and require less technology infrastructure, but any additional training or revisions and updates take time to propagate through the system. More centralized, online approaches, whether synchronous or asynchronous, allow more control and standardization and can be implemented immediately [1]. NLM had experimented with train-the-trainer and asynchronous Web-based distance learning before but had not used videoconferencing as part of an ongoing educational program [2, 3]. The library was interested in exploring how videoconferencing and synchronous collaboration technologies, especially those using Internet protocols (IPs), might be employed for distance education, either alone or in conjunction with other approaches. Given the ubiquity of the Internet, IP videoconferencing technologies have the potential to reach more locations at lower costs than alternatives requiring the lease of land lines or satellite time. In addition, creating real-time learning experiences can be less costly and time consuming than developing self-instructional tutorials.

Pilot site

The King Drew Medical Magnet High School in south Los Angeles was identified as a possible test bed for a pilot distance education program because it focused on minorities, had a health sciences curriculum, and was affiliated with the nearby Charles R. Drew University of Medicine and Science. NLM staff had conducted outreach activities with both the school and university before, and the university, one of four African American medical schools in the country, was connected to the Internet2 advanced research network, which allowed sufficient bandwidth to accommodate videoconferencing. Moreover, the university used the technology for telemedicine experiments previously funded by the library. Thus, the university had the infrastructure necessary to support the project and both the school and university had the interest. A health sciences class providing internship experiences in local hospitals and clinics for junior and senior high school students participated in the pilot program.

Distance education research

The choice of technology and the program's format were influenced by distance education research. Distance learning programs range from independent study to more formal coursework offered by various asynchronous (email, Web) and synchronous (videoconferencing) technologies [4, 5] and may include ''blended learning'' approaches combining distance education with face-to-face instruction [1]. Previous research indicates that students taught at a distance usually have no significant learning differences from face-to-face students, but that attrition can be higher and satisfaction lower when students are isolated from their peers or are learning in settings with distractions [4, 6]. Research also indicates students appreciate having more options in terms of the time and/or place learning occurs but prefer face-to-face instruction, which usually offers more opportunity to interact with classmates [4, 6].

Table 1
Program presentations, presenters, and origination points

Presentation topic	Presenter affiliations	Point of origin
1. Health sciences careers	Charles R. Drew University	Drew
2. Health sciences career information sources	National Library of Medicine (NLM)	NLM
3. Consumer health	NLM	NLM
4. Consumer health information sources	NLM	NLM
5. Disaster preparedness	Charles R. Drew University	Drew
6. Disaster preparedness information sources	Charles R. Drew University	Drew
7. Environmental health	Howard University	NLM
8. Environmental health information sources	NLM	NLM

Generally, students receiving distance instruction by television perform about the same as those in classrooms, but students in televised courses having two-way audio and video do better than those in courses where communication is only one-way [7]. Moreover, the ability of students and teachers to see and hear each other in real time may increase their sense of social presence and reduce transactional distance in communication, factors that are known to affect student satisfaction with distance learning [8–15]. The communication does not equal face-to-face, however, because of camera restrictions on the field of view, the need to use microphones, and other factors [14, 16–19].

METHODOLOGY AND APPROACH

The overall approach in the pilot project was to provide distant instruction approximating the face-to-face approach through videoconferencing and to offer the convenience and flexibility of asynchronous communication by recording and archiving all presentations and creating an online resources guide that could be used for review by participating students or by other students, teachers, and schools. Archiving live presentations about frequently changing online sources also meant training might be updated more rapidly than reengineering self-instructional tutorials. Moreover, instructors did not have to make appreciable changes in the way they teach.

Investigators at the school, university, and NLM identified a series of health sciences topics of interest to the students and developed a program format. Each topic had two learning sessions; one involving a presentation by a subject matter expert covering content and a follow-up involving discussion and demonstration of online information sources related to the topic. An attempt was made to recruit presenters representing the ethnicities of the students, and half the presentations were made by professionals with minority backgrounds. Presentations were given locally when subject experts and librarians at the university were available and at a distance, from NLM, when they were not. The distant presentations were made by NLM staff and faculty at Howard University. Session topics, their point of origin, and the affiliations of topic presenters appear in Table 1.

The venue for the program was an auditorium at the university due to concerns about available bandwidth at the high school and restrictive firewall policies that could block communication. Connectivity tests and a single presentation were conducted before launching the formal program. Dates and times accommodating time zone differences, the students' schedules, and the auditorium's availability were established for the formal program. Videoconferencing was employed for all sessions because presentation recording and archiving was done at NLM and it gave NLM staff an opportunity to preview subject matter presentations given at the school site on occasions when staff were to follow up.

When distant presentations were made to the Drew site, presenters were projected on one screen and the slide or browser applications they used were projected on another. When presentations originated in the auditorium, applications were projected on both screens, and the NLM staff monitoring the presentation appeared in a small window (picture-in-picture) in the corner of one screen. Presentations initially were recorded off computer screens with a video camera, and the video was later encoded for streaming on demand. Recording quality was later improved by using a third computer to capture the computer screens that presenters used to show slides or Web pages along with the audio and video from the computers in the videoconference. The software encoded the screens, audio, and video directly into the streaming format employed at NLM with little degradation.

The project's blending of face-to-face and distance education provided an opportunity to compare the two types of sessions. Students completed a short Likert scale rating teaching effectiveness of each presenter.* The scale (Figure 1) used a subset of questions related to making formal presentations from a longer instrument developed at Stanford Medical School [20]. An interview protocol (Figure 2) was used to collect additional data from six students during a follow-up site visit, but the questions guided discussions with teachers, administrators, and support staff at the school and university as well. The interviewed students were a convenience sample who did not have class or internship assignments at the time of the site visit. Three students participated in a focus group interview, and three were interviewed individually. The

* Ratings were not collected for one session because the evaluator was called away.

Figure 1
Likert rating scale of teaching effectiveness

Please indicate your level of agreement with each of the following statements. During this class session, the presenters generally . . .

	Strongly disagree				Strongly agree
1. Stated presentation goals clearly and concisely	1	2	3	4	5
2. Stated relevance of presentation content to learners	1	2	3	4	5
3. Presented well-organized material	1	2	3	4	5
4. Explained relationships in material	1	2	3	4	5
5. Avoided digressions	1	2	3	4	5
6. Used appropriate visual aids	1	2	3	4	5
7. Expressed respect for learners	1	2	3	4	5
8. Encouraged learners to participate in discussion	1	2	3	4	5
9. Explicitly encouraged further learning	1	2	3	4	5
10. Motivated learners to follow up on their own	1	2	3	4	5
	Very poor				Excellent
11. Overall teaching effectiveness	1	2	3	4	5

interviews were open ended, and the order in which questions were addressed varied. Additional information was collected that helped explain quantitative ratings and identify problems and opportunities that might be addressed in future programs.

After the site visit, the high school and university library directors came to NLM for three days to produce an annotated list of online health sciences information sources of interest to high school students, drawing on material presented in the program and other sources. They were brought to NLM because this was the first time the two library directors had worked together and the task required a coordinated effort in a distraction-free environment where the expectations of NLM staff could be addressed quickly. Moreover, the librarians' physical presence at NLM added to their understanding of the library and its programs.

OUTCOMES

The pilot project provided NLM with valuable experience in using IP collaboration technology for outreach, especially for distance learning. The evaluation and other collected data fell into the following categories: (1) overall value, (2) teaching methodology, (3) distance learning technology, and (4) logistics and costs.

Figure 2
Student interview protocol

1. What are your reactions to the "Presentations in Medicine" overall? Were they interesting? Were they useful? Were they relevant to either your personal needs or college or career decisions?
2. Did you use any of the content presented or information resources presented personally or in your school work? If so, how did you use them?
3. What do you like most about the programs? What did you like the least?
4. What changes in content or format would you suggest? Are there topics that were not covered that you would like to see added? A lecture format with questions (usually at the end) was used. Was this format appropriate to you? How would it compare with a less formal discussion session for presenting information?
5. How did the distance sessions compare to the ones on site? Did you feel more disconnected from or less rapport with the distant presenters or did you feel that the experience was about the same as if they were physically present in the room? Were you any less reluctant to ask questions when the presenters were distant than when they were in the same room with you?
6. What if we could bring in students from another distant school to participate in addition to just having distant presenters? Do you think it would be useful or worthwhile? Would you interact with them? Would you have a preference for how you would like to see such sessions conducted?

Overall value

Student feedback indicated that the project and program were highly valued and perceived as relevant and worthwhile. The scale used to measure participants' reactions to the training was shown to be highly reliable: inter-item correlations for individual sessions ranged from 0.865 to 0.969 and the correlation for the combined sessions was 0.94. One hundred and ninety-three forms were returned for the 8 evaluated sessions. Session ratings (Table 2) were consistently high for all presentations, and the interviewed students indicated that they liked the content and learning experiences. The teacher, school librarian, and principal as well as faculty presenters at the university were also enthusiastic. They all indicated interest in continuing the program and including other classes at the school. *T* tests showed no significant differences in ratings of face-to-face or distance instruction for individual items on the rating scale, but there were significant differences favoring the distant sessions when the ratings for all items were combined, reflecting the slight, but consistently higher ratings for the distant sessions ($t(690) = -2.995$, $P < 0.003$).

This unexpected outcome was probably not due to the distant teachers being better or to the technology's novelty, because teachers at both sites were very experienced and the novelty of the technology would likely have worn off with eight sessions spread over the academic year. The most plausible explanation for the difference would have been due to the absence of students at NLM, which encouraged the distant presenters to attend more to the remote site. While the video from NLM, usually close ups of the presenter, was projected on a large screen at the university, the return video was usually a long shot of the audience in the auditorium displayed on a plasma monitor at

Table 2
Presentation ratings by students

	Presentation session number or origin															
	1 (DREW)		2 (NLM)*		3 (NLM)		4 (NLM)		5 (DREW)		6 (DREW)		7 (NLM)		8 (NLM)	
	Mean	STDEV	Mean	STDEV	Mean	STDEV	Mean	STDEV	Mean	STDEV	Mean	STDEV	Mean	STDEV	Mean	STDEV
Goals	4.14	0.83			4.27	0.83	4.56	0.70	4.76	0.44	4.45	0.51	4.78	0.42	4.68	0.65
Relevance	4.14	0.83			4.41	0.80	4.67	0.69	4.67	0.58	4.50	0.61	4.83	0.39	4.59	0.73
Organization	4.23	0.87			4.41	0.85	4.78	0.65	4.86	0.36	4.35	0.67	4.78	0.42	4.77	0.53
Relationship	4.09	0.75			4.27	0.83	4.56	0.78	4.81	0.40	4.55	0.60	4.78	0.42	4.41	1.05
Focus	4.23	0.92			4.18	0.85	4.39	0.70	4.76	0.44	4.20	0.70	4.70	0.47	4.59	0.67
Visual aids	4.14	1.06			4.27	0.94	4.67	0.69	4.90	0.30	4.30	0.98	4.48	0.95	4.71	0.64
Respect	4.32	0.89			4.36	0.85	4.78	0.65	4.86	0.36	4.35	0.59	4.78	0.42	4.59	0.73
Discussion	4.09	0.92			4.23	0.81	4.22	0.88	4.29	1.06	4.20	0.95	4.74	0.54	4.18	1.05
Further learning	4.23	1.15			4.27	0.83	4.50	0.79	4.62	0.74	4.35	0.81	4.65	0.49	4.38	0.86
Motivation	4.27	1.08			4.14	0.89	4.56	0.70	4.43	0.87	4.45	0.89	4.65	0.65	4.45	0.80
Overall	4.33	0.80			4.36	0.73	4.56	0.70	4.71	0.56	4.50	0.69	4.78	0.42	4.55	0.80

* Ratings were not collected for session 2 because the evaluator was called away.

NLM. This restricted view caused distant presenters to lean forward and frequently ask questions about how well they were understood. This explanation of the ratings, that a limitation of the technology might have caused distant presenters to be more animated and interactive, was supported in part by student interview data.

Teaching methods

All the interviewed students indicated presenter personality, interactivity, and teaching style were more important than point of origin. They singled out the distant session on environmental health because the presenter frequently asked questions and specifically used the neighborhood near the school as a context for discussing the subject. Several students reported consulting the information sources the presenter used to identify pollution sites near their homes and school.

All the students felt the presentations could be made more engaging and interactive and that having hands-on experience was needed in sessions related to using information sources. Although half said that they consulted the presented information sources, they did not always view them in the same way that the presenters or program organizers did. For example, MedlinePlus was presented as a consumer health information resource, but the students appreciated it just as much for its dictionary of medical and health sciences terminology. Students indicated that they would like information about health topics that were timely and ''in the news'' and felt that the content could be covered in greater depth, an indication of the advanced curriculum at the school.

Distance technology

Distance did not make a large difference, but it had some effect, given the slight but consistently higher ratings for the distant presentations. The fact that most students reported that it was the lecture style of the presenter and the amount of interactivity and engagement with the students that mattered more than location suggested that the conferencing technology was not obtrusive. Only three incidents of technical problems occurred: one in which the connection broke but was quickly restored, one in which a videoconferencing unit malfunctioned just prior to a session and was quickly replaced, and one in which communication could not be established because Internet2 traffic to Charles R. Drew University was inadvertently cut off at the University of Southern California, the point at which it accesses the Internet2 Abilene backbone. All presentations except two were recorded, one because of an equipment failure and another because only one of the two applications the presenter used was shared with the recording computer, causing blank screens to be captured.

Logistics and costs

One of the biggest reported problems with videoconferencing technology, blockage by firewalls, was not a factor in the project because the university network administrators were willing to relax their firewall rules. Scheduling became a primary problem, given the school's schedule, the different time zones, and the university auditorium's general lack of availability. Moving students from the school to the university took valuable time, despite proximity, because the sessions only lasted an hour. The program was very cost effective, given the connectivity in place. The primary expenses were stipends for presenters, a videoconferencing system, and the costs of bringing the librarians to NLM to create the resource guide. The up-front design and development costs of fielding standalone tutorials was avoided, and more personal interaction took place between the students and staff at NLM.

DISCUSSION

This pilot project has established the feasibility of providing distance learning using real-time videoconferencing via IP and shown that the target population valued the program. The best indicator of success, perhaps, is that the high school, university, and NLM

have committed to continuing the program another year and that the teachers of other classes at the high school have asked to be included. To enable greater interactivity, hands-on learning experiences, and more flexible scheduling, the NLM, university, and high school have worked together to reactivate the network link between the university and the high school that was used in earlier telemedicine experiments, effectively projecting the university network and Internet2 into the school. The school's network switches can be set to direct this access to any room, and its wireless network and large collection of laptop computers add even greater flexibility in providing the hands-on training the students requested.

The blended approach to instruction and the fact that the students were colocated eliminated the attrition and isolation problems affecting other types of distance education. It is uncertain whether the program would be as acceptable, or even feasible, if students were not colocated. Moreover, the pilot project involved a single class and school specifically focused on the health sciences that also had access to Internet2 and other technologies needed to field the program.

Because the program's next iteration will involve more classes and students, a better appraisal can be made of the overall approach, but the limitations of the current assessment will not be eliminated. Ultimately, the program should be tested with other students and schools in contexts where less network infrastructure is available. The videoconferencing technology employed has been designed to work with the regular Internet, but performance is affected by available bandwidth. Commercial messaging and voice over IP services offer real time video to the desktop that can work at lower bandwidths, but how well the technologies can function in classroom and large group settings is uncertain.

Most distance education offered on the Internet uses asynchronous communication via Web pages, email, and message boards that are inherently low bandwidth. Experience with the pilot program suggests that it is possible for librarians and other instructors to consider higher bandwidth applications employing Internet protocols to offer interactive learning experiences approximating those of face-to-face instruction. The evaluation results provide librarians contemplating these approaches with some evidence that synchronous learning by videoconference does not adversely affect students' attitudes toward their learning experience. The results also suggest that librarians and educators should identify ways of integrating hands-on learning experiences at distant training sites into the educational program, given the highly interactive, computer-based nature of most library training. Additional research is necessary to determine what alternatives are available to provide hands-on training at a distance, how well different videoconferencing technologies work in contexts where there is less available bandwidth, and how the distant training affects students' attitudes *and* knowledge.

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