

## Distributed Medical Informatics Education Using Internet2

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*The curricula of most medical informatics training programs are incomplete. We used Internet2-based videoconferencing to expand the educational opportunities of medical informatics students at Oregon Health & Science University and the University of Pittsburgh. Students and faculty in both programs shared extra-curricular research conferences and journal club meetings. A course in Information Retrieval was made available to students in both programs. The conferences, meetings and class were well accepted by participants. A few problems were experienced with the technology, some of which were resolved, and some non-technical challenges to distributing academic conferences, meetings and coursework were also uncovered. We plan to continue our efforts with expanded course and extra-curricular offerings and a more comprehensive evaluation strategy.*

### Introduction

Medical informatics is a young, multi-disciplinary field. There are approximately two-dozen universities in the United States that offer degrees or fellowships in medical informatics and maintain externally funded institutional research programs. A recent analysis of twelve National Library of Medicine (NLM) funded medical informatics training programs found that none of the NLM funded programs offered courses in more than eight out of 12 topics identified by Corn as core topics [1]. Incomplete program curricula in turn limit the educational content and research opportunities available to medical informatics students.

The goal of this collaboration between the Oregon Health & Science University (OHSU) and the University of Pittsburgh (UP) was to provide students access to a broader range of faculty, topical experts and student collaborators through the use of high-speed networking, videoconferencing equipment and related distance learning tools (email, document exchange, etc.).

We undertook this project with the following goals:

1. Develop distributed educational content that takes advantage of expertise at both OHSU and UP;
2. Give UP and OHSU students access to this content, and the faculty who teach it, using Internet2 and the existing administrative framework (enrollment, tuition, etc.) of the students' home institutions;
3. Facilitate cross-institution student collaboration;
4. Evaluate the technology used; and
5. Evaluate the educational outcomes.

### Rationale

As already reported, most academic medical informatics programs offer an incomplete curriculum. The expertise of programs varies from university to university and many programs offer only a small number of medical informatics subjects. Further, there is no standard core medical informatics curriculum, and students' course requirements vary from institution to institution [2].

Inter-institutional research presents an opportunity to overcome the deficiencies in these educational programs; however, although cross-institutional medical informatics research occurs, there is little related cross-institutional educational collaboration. For example, two of the authors of this paper (WRH and CPF) have collaborated on information retrieval evaluation research [3, 4], yet few of their students have been able to directly participate in this inter-institutional research or benefit from the research expertise of the faculty member at the other institution.

After OHSU and UP connected to Internet2 and joined the University Consortium for Advanced Internet Development, mutual interest developed in using Internet2 to enhance medical informatics education. Both OHSU [4] and UP [5] have well developed NLM-funded informatics programs with both overlapping and unique areas of expertise. We undertook this project to determine if students and

faculty from both programs could benefit from joint conferences, meetings and classes offered via point-to-point Internet2-based videoconferencing.

## Implementation

The first six months of the project were spent acquiring, deploying and testing the videoconferencing hardware and Internet2 networking. The next six months were spent facilitating joint research conferences and journal club meetings, and offering a joint Information Retrieval class.

### *Technical Implementation*

Internet based videoconferencing requires sustained access to high bandwidth (384 – 768 kbps). The conventional Internet cannot provide the necessary bandwidth; however, Internet2 has the capacity to do so. Local high-speed network backbones at UP and OHSU were also essential to make TCP/IP videoconferencing a reality.

UP and OHSU used H.323 protocol, TCP/IP enabled Polycom ViewStations ([www.polycom.com](http://www.polycom.com)) for Internet2 videoconferencing. The hardware installations were fairly straightforward, although the lack of uniform network, especially at UP, caused some scheduling problems.

Because similar hardware and technology were already in use by the OHSU School of Nursing (interdepartmental expertise and support were readily available), the technical implementation at OHSU went quickly. Most of the implementation time was spent testing the Internet2 connection and tracking down associated network and firewall problems. Because OHSU resources could be devoted to expanding, rather than building, Internet2 OHSU videoconferencing facilities, three rooms in the OHSU Biomedical Information Communication Center (BICC) were capable of TCP/IP videoconferencing over Internet2 by the end of project. The largest of these, the BICC Theater, is where the majority of the videoconferencing took place. Table 1 lists the equipment used in the Theater during this project.

The UP installation went less smoothly, though not for technical reasons. The University of Pittsburgh and the University of Pittsburgh Medical Center (UPMC) Health System, which are collocated in a dense health sciences environment, have separate computer networks, and while UP is a member of the Internet2 consortium, the UPMC Health System is not. Since the Center for Biomedical Informatics' main

classroom is on the health system network, it was necessary to move UP-OHSU shared classes and conferences to a classroom located in the UP Falk Library. Because the UP installation was restricted to one classroom, scheduling became a minor barrier to this project. The UPMC Health System plans to join the Internet2 consortium in the near future, and this will help ease scheduling problems for future OHSU and UP collaborations. Table 2 lists the equipment used at UP.

In December 2000, we began using the technology for our project meetings. We tested and debugged the technology as part of these meeting, and used videoconferencing for our project meetings continued until the end of the project. During these meetings the project team learned by doing, and we benefited from this experience as we designed and implemented a graduated program of educational events.

### *Educational Implementation*

Our first cross-institutional educational offerings were chosen from already scheduled events at either UP or OHSU. Because of the three-hour time difference between Pittsburgh and Portland, we looked for events scheduled for the middle of the day. The weekly OHSU research conferences and UP journal club meetings satisfied these requirements. By using preexisting educational forums, students and faculty from both institutions could immediately benefit from cross-institutional expertise.

The following research conference and journal clubs events were carried out starting in January 2001:

- 1/19/01 - OHSU Research Conference - *Systematic Review of Telemedicine*, William Hersh, MD.
- 2/15/01 - UP Journal Club - "Causal Discovery in Medicine Using Observational Data" by Subramani Mani, MBBS., MS, and "Introducing Handheld Computing into a Family Practice Residency Program: Patterns of Change in Computer Usage and Attitudes" by Brenda Manning, PhD, MS.
- 2/16/01 - OHSU Research Conference - *Update on SNOMED*, Kent Spackman, MD, PhD.
- 4/20/01 - OHSU Research Conference - *Bundles in the Wild*, Paul Gorman, MD.
- 5/25/01 – First Annual Informatics Bowl – A real-time "Synchronous Jeopardy" over the Internet.

The second step for cross-institutional distribution of medical informatics education was development and

offering of an inter-institutional class, i.e., a credited class that was available to students at both campuses. Not surprisingly, scheduling was a major factor in the decision of which class to offer. OHSU academic calendar is divided into quarters and its academic year runs from September to June. The University of Pittsburgh has semester-based calendar that runs from August to April calendar. After careful consideration of time-zones, room availability, academic calendars and other scheduling issues, OHSU's *MINF 514 - Information Retrieval* course was opened to UP students. The class met weekly from May 6, 2001 to June 8, 2001. Dr. William Hersh was the primary instructor, and one class session included a lecture, from Pittsburgh, by Dr. Charles Friedman.

The final project event, the Medical Informatics Bowl, pushed synchronous delivery of audio and video toward its limits during an inter-institutional student competition. The Informatics Bowl consisted of two three-student teams (one at UP and one at OHSU) who took turns answering questions prepared by both faculties.

#### **Assessment**

We did not have a large enough sample of participants or events to carry out a formal, quantitative evaluation. Instead, assessment methods measured student and faculty acceptance of the technology and distributed educational offerings as evidenced by continuing and expanding student participation in the cross-institutional events, and positive participant (faculty and student) feedback.

#### *Educational Assessment*

The Information Retrieval course was the most structured and intensive use of the technology; it was also the best test of our ability to expand informatics curriculum beyond institutional boundaries. The success of this phase of the project was shown by the successful completion of this OHSU course by the two UP students who enrolled in it. Using Internet2 videoconferencing and email, the UP students were readily able to participate in all course activities, which included instructor-led lectures and discussion, student-led presentations of research articles, weekly reading and homework assignments, a term paper, and a final exam. Student-to-student and student-to-instructor discussion may have been slightly constrained by requiring students at both locations to use microphones; however, this constraint did not prevent dynamic classroom discourse.

Both UP students satisfactorily completed the course and one of them received the second-highest grade in the class; this result leads us to conclude that the technology did not significantly impair student learning.

The other distributed educational activities were also successful. All of the research conference and journal club presentations had cross-institutional attendance and dialogue. The Informatics Bowl was attended by a capacity crowd at both locations. University of Pittsburgh students won the event, claiming the "Milton Corn Traveling Trophy," which will stay in Pittsburgh until OHSU successfully challenges the reigning champions of this now-annual event.

#### *Technical Assessment*

The following technical problems were discovered during the various videoconferencing sessions:

- Microphones set up for student and audience questions created audio echoes. For example, if the lecture site was at UP the OHSU microphones, which were set up to be able to transmit OHSU student questions back to UP, would pick up the UP lecturer's voice and send it back to UP, creating an audio echo. The OHSU solution was to keep the audience microphones off until someone wanted to speak. This was best accomplished by using push-and-talk microphones because they turned off when the speaker released the button.
- There were audio feedback problems with the mixer and portable wireless microphone in the University of Pittsburgh Conference Room. The Polycom ViewStation has a proprietary microphone that is designed for a conference table instead of a traditional classroom. The microphone was not sensitive enough to pick up both the sound of a speaker in the front of the room, and a student with a question seated in the back of the room. Although the ViewStation allows the connection of a standard distribution amplifier and additional microphones, we received audio feedback when trying to do this. This problem was improved by the careful adjustment of the mixer and the position of all of the microphones in the room.
- For reasons unclear to the institutions' technical staffs, the connection between the Polycom units occasionally dropped during sessions. The connections were easily re-established by re-dialing.

- Poor video resolution occurred when the Polycom camera was used to show the visual portion of a lecture, e.g., when the camera was focused on screens projections of computer screen images. Upgrading the existing Polycom units to ones that can directly receive video feed from a computer, document camera, or other device will solve this problem.

## Conclusions

The project demonstrated that Internet2-based videoconferencing could be used between OHSU and UP to deliver educational content on a variety of topics and in a variety of formats. These programs included research conferences, a three-credit graduate course in Information Retrieval, and an interschool student competition. Technology problems were encountered and they accentuated the challenges of using this technology for didactic communication. Students from UP and OHSU did interact with each other, and the achievements of UP students taking an OHSU graduate course, demonstrated that the technology can be used to create a distributed learning environment.

This project set the stage for further research on the value of high-speed Internet technology for medical informatics education. In particular, we need to investigate its benefits and drawbacks from different perspectives:

- Student perspective. Do aspects of the technology help or hinder learning? Do the advantages (e.g., access to a wider variety of courses, faculty, and student colleagues) outweigh the annoyances (e.g., video image quality, latency, and need to use microphones)?
- Faculty perspective. Do aspects of the technology help or hinder teaching? Is the time required to teach distant students more or less than the time required to teach local students? How effective are email and video mediated student interactions? Are these remote communication methods more or less effective than the face-to-face communication available to local students?
- Program perspective. How can course requirements, institutional rules, and time zone differences be overcome most effectively? Does the investment of time and money provide a pay-off and, if so, how?

We hope to address these questions during our current and future collaborations.

## Continuing Collaboration

During the current academic year (2001-2002), we are continuing to share weekly conferences and journal clubs meetings using Internet2 videoconferencing. This year, both programs were able to schedule these extra-curricular sessions for the same day and time. As a result, about one-third of each program's weekly conferences are shared. The inter-institutional Information Retrieval course was offered again in the spring of 2002.

We have also begun sharing faculty expertise by having faculty from one institution serve as guest speakers in classes at the other location, and the Informatics Bowl is now an annual tradition between these programs.

## Acknowledgements

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## References

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Table 1 - Equipment in the BICC Theater at OHSU

Equipment	Quantity	Location
Polycom PVS 1419-Q	1	Front of Theater
61" Sony monitor	2	Front of Theater
Panasonic 5100 Cameras	2	Front of Theater
Gateway Pentium III computer	1	Front of Theater
Sony VID-P100 document camera	1	Front of Theater
JVC monitor	1	Front of Theater
FOR.A pointer	1	Front of Theater
ELMO TRV -3JH (slide to video selection)	1	Front of Theater
Remote multiple channel lapel microphone	2	Front of Theater
Push and Talk microphone	24	Auditorium
Sanyo video projector	1	Auditorium
35" Mitsubishi monitors used for lecturer to view other site and see what they are seeing	2	Auditorium
Panasonic 300 CLE studio cameras	2	Projection Room
JVC monitors	8	Projection Room
Sony monitors	3	Projection Room
Videonics video switcher	1	Projection Room
Koved 8 input passage switcher (picture in pictures and switch output)	1	Projection Room
Mixmax RM81 audio mixers	4	Projection Room

Table 2 - Equipment in the Faulk Library at UP

Equipment	Quantity
Polycom ViewStation 512 MP	1
Polycom Visual Concert PC	1
Phillips 32"TV # PPC932C	1
Bretford Wide Body Cabinet TV Cart	1
Bretford Wide Body Cabinet TV Cart	1
JVC AV-P750U Document Camera	1
Bretford Cart for Document Camera	1
Dell Latitude C600, 750 MHz, Pentium III, 512 MB RAM	1
Toshiba TLP-710 LCD Projector	1
50 ft High Resolution Video Cables	2
50 ft Audio Cables	2
50 ft Composite video and audio cables	1
Extron P2DA2 Distribution Amplifier	1
Schure Omnidirectional Condenser Microphone	2
TOA Wireless Microphone	1
Sony Digital Handicam DCR TRV17	1
Dell PowerEdge 6300 (Media Archive Server)	1
50' S Video Cable	2