Multimodal Technologies for Interschool Collaboration

ANTHONY COATES WEBSTER
Columbia University
JOHN MORRIS
Drexel University
WILLIAM SPILLERS
New Jersey Institute of Technology
JANE MURPHY
Ohio State University

INTRODUCTION

The "Multimodal Technologies for Interschool Collaboration"[1] (MMT) projects discussed in this paper are part of the Gateway Engineering Education Coalition[2], and are supported in part by the Engineering Education and Centers Division of the National Science Foundation. The Coalition is best described by quoting the text found at its website:

> The "Gateway" Engineering Education Coalition is a collaborative program of 10 institutions, supported by the Engineering Directorate of the National Science Foundation. Headquartered at Drexel University and representing a diversity of institutional cultures imbedded in regions of significantly underrepresented minority populations, the Coalition expects to open new "gateways" for learning by altering engineering education from a focus on course content to a focus on the development of human resources and the broader experience in which individual curriculum parts are connected and integrated.
>
> The intellectual threads weave together the introduction of engineering and its functional core "up-front," unified and connected supportive knowledge "concurrently," the integrative aspects of the engineering process, multidisciplinary emphasis, and instructional technologies. To the greatest extent possible these are achieved through cross-institutional programs which lead to lowering barriers among institutions as well as within institutions.[3]

PROJECT DESCRIPTION

The Multimodal project is a part of the Educational Technology and Methodology focus area of the Gateway Coalition. Building on work done in previous Gateway projects four co-principal investigators representing architecture and engineering disciplines have worked separately and together to develop and use curricular materials across university and disciplinary boundaries. The primary tasks of the Multimodal Technologies for Interschool Collaboration project included:

1. Building a multimodal (ISDN and Internet based) electronic infrastructure for the collaborative development and instructional use of educational engineering materials.
   The infrastructure includes ISDN and Internet-based Desktop Video Conferencing (DTVC) systems, as well as World Wide Web (WWW)-based multimedia systems for remote document editing, document sharing, and newsgroups. Some of the educational materials had been in development prior to this program year (Gateway Year Four, 1995-96)
2. Using the infrastructure to jointly develop distance learning curriculum materials for undergraduate engineering and architectural education.
3. Using the electronic infrastructure, curriculum materials, and individual researchers' special expertise in networked, interschool classes. This includes in-class use of all facets of the infrastructure, which are supplemented with existing computer laboratories and computer-projection equipped classrooms.
4. Evaluating: the performance of the multimodal digital infrastructure as a toolset for collaborative curriculum development; the curriculum materials developed by the four-school faculty team; and the infrastructure's ability to broaden the offerings at each of the four institutions.
5. Disseminating the results of the project, in a paper and WWW-based report.

TASK DESCRIPTIONS

Task 1 (Infrastructure Development)

Each of the four schools is now equipped with ISDN and Internet based desktop video conferencing (DTVC) facilities. Some systems reside in faculty offices, some in student labs, and some in seminar or conference rooms. Columbia University maintains the project web site and an ftp site used for some of the projects. Ethernet infrastructures support the work as well. Drexel University has helped set up an ISDN DTVC system in a structural engineering office that allows interaction between students and professionals.

Task 2: (Curriculum and Content Development)

Distance learning materials, primarily Web based instructional units have been developed and are being used across curricula at several schools, in both architectural and engineering programs, allowing curriculum development at various institutions to share resources and ideas. The materials are varied, and meant to be used at different levels in architecture and engineering curricula.

Drexel has put a variety of educational engineering topics on the WWW, including: fire protection,[4] building systems analysis,[5] and architectural engineering design.[6] These projects are intended for use by and with other schools. Drexel has also developed spreadsheets HVAC system selection, and preliminary analysis.

Prior to the Multimodal project, Columbia University had begun a library called "Engineering for Architectural Projects"[7] of case studies of significant buildings including history and various aspects of technical development and analysis. The spreadsheets developed at Drexel for thermal analysis are being used for analyses of the Farnsworth House and the PATCenter case studies; at Columbia as part of the Multimodal project, the case studies have been supplemented by an atmospheric model of the Farnsworth House prepared using the "Phoenics" flow modeling software. Mechanical engineering documents for the PATCenter have been obtained and scanned. as additions to the PATCenter volume.

NJIT has prepared an extensive set of curriculum materials and analysis tools for "Paperless Design of Fabric Structures."[8]

Task 3: (Use the infrastructure, curriculum materials, and individual researchers' special expertise in networked, interschool classes.)

Using the internetworked infrastructure described in Task 1 and the curriculum content described in Task 2, the principal investigators developed a variety of approaches to interschool classroom collaboration:

Links to practice: Drexel/Practitioners:

Project participants have used the electronic infrastructure to introduce "remote expertise" into the curriculum. Drexel University has established a video conferencing link between their design classrooms and local engineering firms. Currently on-line is PWI Engineering, a firm specializing in the design of HVAC systems. Drexel's agreement with PWI allows students to "call" their firm via DTVC during a set of pre-established hours (up to eight hours per week).

Manufacturing technologies: OSU/Columbia[9]:

Participants in the multimodal technology project have also used the electronic infrastructure to enable collaborative work between students at distant schools. Columbia and OSU ran a testbed class featuring remote design collaboration and component prototyping. Students and faculty from both schools worked together to design, analyze and fabricate a mockup of selected architectural and structural building components. OSU students met with Columbia students via DTVC to discuss the subject matter and techniques for CNC manufacturing, and they communicated via e-mail. Three dimensional Form-z component models were shipped between schools using Columbia's project-specific ftp site. Prototype structural components were fabricated on Columbia's CNC (computer numerically controlled) milling machine.

Building Systems: OSU/NJIT/Columbia/Drexel

By way of desktop video-conferencing, Professor Webster taught a seminar-style class on structural typology in cooperation with Drexel faculty in a Drexel class. This session has been recorded on videotape. Professor Murphy appeared in Prof. Spillers' Matrix Analysis class at NJIT, providing an architect's view on the process of engineering analysis and design. Professor Spillers appeared in OSU's "Structural Systems in Architecture"[10] course as a guest lecturer, to present the work he has prepared and posted on the web. His visit provided an opportunity, in a course taught by an architect, for students to discuss issues of structure and form with an engineer. The expectation is that such "consultations" will be ongoing.

In addition to using Professor Spillers and his web-based materials, OSU students have used Drexel's web-based "Structural choices" page in a structural system selection exercise. Existing case studies produced by Columbia University are being integrated into the OSU curriculum. The case studies of significant works of architecture serve as examples of structural typologies, as well as demonstrations of issues of coordination of structural systems with other building components and architectural issues.

One OSU student conducted an independent study to develop a web-based environmental controls exercise for use in OSU's Environment Control Systems (ECS) sequence of courses. The exercise is broadly defined to fit within an existing course, and to use the Farnsworth house model developed at Columbia.

Task 4: Evaluation

Evaluation has been conducted by Columbia University's Institute for Learning Technologies (ILT). Evaluators monitored e-mail correspondence between the researchers, interviewed researchers and student assistants, and queried students in relevant courses by e-mail.

Task 5: Project Dissemination

By making material available on the web to other Gateway Schools or to the public, the individual materials have been disseminated. In the coming year, curriculum development will continue, with course notes being posted on the web as demonstrations of the use of the materials produced. The web report of the Manufacturing technologies portion of the

project will be expanded to include video of meetings between Columbia and OSU students, e-mail tracking process of the project, and VRML models of the details studied. It is hoped that discussion among the researchers at Gateway schools will be expanded to include interested parties in other locations.

CONCLUSION

While the development of the infrastructure has taken more time and energy than predicted to put in place, its promise for the future is clear in the initial results. By sharing faculty resources as well as infrastructure, all schools have an opportunity to benefit.

As many programs feel the crunch of downsizing, the potential benefits of these collaborations seem self evident. Sharing expertise across departmental boundaries as well as across college and university boundaries becomes feasible when travel time and cost is eliminated and guest lecturers can appear from their own offices, using their own software and visual resources through desk top video. Schools with different sorts of equipment, such as that shared in the CAD/CAM project, can share their tools among themselves, and give students as well as faculty the opportunity to investigate beyond their own boundaries.

The work in curriculum development and implementation will continue during this Program Year Five of the Gateway project. Investigators will continue to post materials on the web for the use and evaluation of others. The real test of the material is in its applicability and effectiveness in a variety of pedagogical situations. The fundamental Gateway goal of "connecting and integrating individual curriculum parts" is surely being met in the project.

NOTES AND REFERENCES

[1] Multimodal Technologies for Interschool Collaboration website: http://www.columbia.edu/~archpub/BT/GATEWAY/multimodal.html

[2] Gateway Engineering Education Coalition website: http://www-gateway.vpr.drexel.edu/; NSF Award EEC-9444246

[3] Text quoted was taken on January 16, 1997 from: http://www-gateway.vpr.drexel.edu/#about

[4] Drexel Fire Protection: HTTP://www.coe.drexel.edu/CAE/Fire!/main.HTML

[5] Drexel Building Systems Design: http://www.coe.drexel.edu/CAE/AED1_951/*Templates+/structure.choice.html. The site is based on information from Edward Allen and Joseph Iano, *The Architect's Studio Companion*, New York, 1995 John Wiley &Sons, Inc.

[6] Drexel Architectural Engineering Design: HTTP://www.coe.drexel.edu/CAE/AED1_951/AED1.HTML HTTP://www.coe.drexel.edu/CAE/AED2_952/AED2.HTML HTTP://www.coe.drexel.edu/CAE/AED2_954/AED2.HTML

[7] Columbia University: Engineering for Architectural Projects: http://www.columbia.edu/~archpub/BT/GATEWAY/efa.html

[8] NJIT: Paperless Design of Fabric Structures: HTTP://www-ec.njit.edu/civil/gateway.HTML

[9] Columbia/OSU: Remote Component Prototyping: HTTP://www.columbia.edu/~archpub/BT/GATEWAY/remote.HTML

[10] OSU Structural Systems in Architecture: HTTP://web1.eng.ohio-state.edu/sar/arch/faculty/murphy/arch7 24.HTML