Internet Studios: Teaching Architectural Design Online in the United States and Latin America

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This project is one of the most extreme combinations of computer graphic technology and Internet communication in contemporary architectural education. The findings can be applied to any discipline that consists of a large number of participants within a design setting. Over the past two years, the experiments have allowed more than 130 students and 20 professors from seven schools of architecture, in Miami, Buenos Aires, Caracas, Santiago de Chile, Valparaiso, Mar del Plata, and Santa Fe de Argentina, to work concurrently in a semester-long design studio. Most of the collaboration has been accomplished by using low-bandwidth Internet communication such as Web publishing, Chat, Web3D, RealPlayer, IP videoconferencing, CAD software, and other technologies such as ISDN broadcasting. New grants from Global Crossing, Cisco Systems, and Lucent Technologies support future experimentation with high-bandwidth technologies on the Internet[2] Abilene Network.

Traditional Architectural Studios

Typically, design studios are at the core of the curriculum in architectural teaching. These studios are usually held in rooms with drafting tables, on which students develop models, sketches, architectural drawings, and perspectives of the projects assigned during the semester. Architectural studios not only simulate the real-time experience of working in an architectural office, but also provide a very intense interpersonal environment for students to learn from each other as they search for design solutions. Knowledge, solution strategies, and design culture are transmitted by what Donald Schon calls a process of "tacit learning."[3] "Tacit learning" cannot be fully explained or fully structured. It is transmitted by examples, gestures, and acts, and developed by investigation of problems as they arise.

Studio reviews, or design juries, are the traditional method of assessing student architectural work. Conventionally, students pin their drawings to a wall behind their physical models and explain their design concepts orally to professors, visiting critics, and students who gather around the pin-up space. After the oral presentation is completed, critics develop oral arguments for or against different aspects of the student's design. After the presentation and the critique are completed, the pin-up spaces are dismantled, and the jury moves on to review the next student.

The Objectives

The primary question of this study is: How can we use new-media technologies to enrich the learning environment offered in the traditional design studio? This is a very complex question, since most distance-education software design and online teaching experiences support a more structured mode of teaching and learning. Thus, the study's objectives are:

- Exploration of technologies and techniques that support rich interaction among a large number of international participants with methodologies that sustain a variety of learning styles and technological conditions.
- Development of pedagogical strategies for these technologies and techniques with the objective of increasing the "speed" of architectural progress in these design communities.
- To reposition the creative processes of architecture in a highly digital environment by increasing skills and, ultimately, altering the design methodologies, imagination, and ambition in improving urban life.

Low-Bandwidth Technology: Chat, Web Publishing, and IP Videoconferences

The initial experiments of the Internet Studios initiative explored synchronous and asynchronous collaboration with low-bandwidth technology. This was necessary due to technological conditions in the participating Latin American schools of architecture. The most popular technique for weekly synchronous reviews of student work was a combination of chat and Web publishing that we called Web-chat. Students posted their weekly work on individual Web pages, then professors and visiting critics from all over the world set a time to review the students' pages. Student Web pages contained CAD renderings, process drawings, photographs of physical models, video animations, and Flash animations. Students presented this work via Web pages and chat, and then received instant responses from reviewers.

Weekly synchronous communication was also supported by unstructured IP videoconferences through the low-bandwidth Internet (software: Netmeeting, Vocaltec, and CU-SeeMe). The IP videoconference technology worked well for one-to-one communication among students and/or for professor coordination. However, it was considered too disruptive for online reviews with a large number of participants. Initially, every effort was made to conduct reviews using an IP videoconference format and supported by students' Web-page publication. However, surprisingly, over time, the combination of chat and Web pages became the preferred method for reviews, and videoconferences became unnecessary. The Web-chat technology was universally available (it required only a Java-enabled browser), and it provided instantaneous feedback. IP videoconferencing proved to be useful for developing initial social contacts among the teams.

Evaluating Studio Reviews: Real Classrooms vs. Online Low-Bandwidth

Several experimental evaluations were conducted to compare real vs. virtual studio reviews. We conducted online and local reviews at the same time and began to compare results from evaluations, record anecdotal references, and document the behavioral differences of participants based on each of the environments. The most important conclusions:

Review Tolerance
Participants in online reviews via Web-chat mode tended to have lower levels of time tolerance. Typically, review teams using Web-chat would spend no more than five minutes with each student project. Teams in traditional real-time settings were willing to spend 15 to 20 minutes per student.

Oral vs. Written Explanations
Surveys showed that student explanations via chat were more direct, articulate, and memorable to the reviewer than oral explanations.

Oral vs. Written Response
Reviewers also noted that online comments could be written simultaneously, and reviewers could quickly notice the similarity of their criticism without waiting for everybody to speak.

Electronic Anonymity
Another important observation refers to the lower level of diplomacy that is sometimes apparent in chat environments, where one can go directly to the point without reacting to a student's facial reaction.

Synchronous and Asynchronous Review Space
In traditional environments, reviewers can see the student work only during the pin-up time. In the online environment, reviewers usually become familiar with the student Web pages prior to the Web-chat review.

High-Bandwidth Technology: ISDN Videoconference and Internet 2 IP Multicasting

Only ISDN videoconference technology was tested in our Internet Studios during 1999 and 2000. Due to cost constraints, we maintain this technology for very structured sessions, which occur only two to three times per semester. During 2000, we obtained grants that provided 40 Gbps connections with major academic networks in the Americas through the Global Crossing inter-oceanic link. The grants support a DS3 connection in every country where the intercontinental network lands in Latin America and the Caribbean. The DS3 connection will link to our POP server in the US, which in turn will connect the universities to Internet 2. In testing this new bandwidth, we began to experiment with node-rooms with wide-IP multicasting technologies such as Access Grid on Internet 2. The Access Grid allows constant videoconference concurrency for a large number of participants. Each video and audio channel is connected at 800kbps, which allows for excellent-quality transmission. The experiment used a system that cost less than $15,000. It included three computers, three projectors, and a specially designed audio-video system.

Evaluating Studio Reviews in Real Classrooms vs. Online High-Bandwidth Environments

As stated above, our experience with high-bandwidth technology is very limited. However, our initial evaluation revealed the following:

Similar Review Culture
Design reviewers in both real-time proximity and high-bandwidth networks tend to follow the diplomacy, time tolerance, and review format of traditional studio jury processes.

Potential for Distraction
Although time tolerance and review formats are similar, spectators of the multicasting environment are more easily distracted than if they were in real review spaces. Techniques for moderating multicasting events have became elements of design. A very structured program is generally recommended. Our experience also suggests that, for online juries, tolerance lasts one to 1.5 hours, while in real environments they last approximately three hours.

Potential for Supporting A New Studio Culture Online
Our initial evaluations of IP multicasting technology, such as the Access Grid on Internet 2, have shown that this technology has more value in building social relationships than the more structured reviews. This is a very important factor in the studio experience, and one that needs to be maintained.

Lack of Spatial Orientation
Most high-bandwidth technologies still resemble human interaction at the level of a television monitor. The evaluators observed that more work remains to be done on physical design and layout to engage audiences with the actions and behaviors that transpire in traditional studios.

New Proposals

Our evaluations and observations will be translated into the following specific projects for the next academic year:

An improved low-bandwidth review space. Two schools of architecture that participate in the Internet Studio consortium are designing and testing a video-chat interface for design review. The video-chat combines three frames in a single web page. In the bottom-right frame, there is a chat area.The bottom-left frame is an embedded RealPlayer video window for live broadcast. And the top frame is a space where students can publish their work.

WebCam for Low-Bandwidth Social Space
During the Fall of 2001, two schools are incorporating Web cams in their studio spaces, with CU-SeeMe conferencing, to allow more social interaction among students in the studios.

Synthetic World: iStudio for Low-Bandwidth Interface
We are also beginning to develop 3D worlds that can structure "community behavior" in virtual systems. We have initiated this work based on critical observations of similar experiments, such as MUS, MOOS, DIVE,[1] MASSIVE,[2] and many other popular versions of virtual worlds. The virtual studio space prototype, iStudio, investigates the software design and human behavior of studio life in digital conditions. The design of the prototype does not attempt to recreate the space of the traditional studio. Instead, it supports community actions in design education. Three large box-rooms appear when one enters the iStudio:

1. The exhibit room, where students virtually pin-up their process during the semester.
2. The review rooms: Four virtual rooms where virtual reviews are held.
3. The forum: A space for building virtual community life. In this space, private meetings are held in secluded rooms, and public meetings, such as exhibitions and lectures, occur.

One of the most important aspects of a virtual world is the need to rebuild the human body. The body helps to develop a sense of scale and a feeling of community. When they enter a world, users can always see the red bodies of the all the avatars that are using the system; one red avatar represents each user.

The eye and the body are attached-but-separate concepts in the iStudio. The body of the avatar only moves horizontally in the planes that users visit. But users can move freely in 3D. The hand and the body are also attached-but-separate concepts in the iStudio. Whenever users touch one of the elements in the 3D space, user movement is triggered. In this way, users can travel quickly among student files, rooms, and boxes.

Communication among users is chat-based. Via local software, the text in the chat is transformed into voice. Icons in the world can also trigger other communication applications to open, such as IP videoconferences, Web-page browsing, etc. Students are required to design their own exhibit spaces and review rooms. Files such as JPEGS, CAD, videos, and audio files are uploaded into the iStudio via a simple Web interface. Each of the virtual walls can be edited remotely by using Java applets in the student Web pages. The iStudio is designed to render different spaces in stages, so users never see the complete world at one time. The goal is to keep the world accessible to users with low-bandwidth technology (less than 1,000 polygons) and a reduced number of texture maps at all times.

Grants for "Last-Mile" High-Bandwidth Projects
Although Latin America is currently connecting to the first 40 Gbps inter-oceanic and terrestrial network, additional work is required to connect each university and architectural school to the national nodes of high-speed networks and Internet 2. At the Summit of the American Presidents held in Santiago de Chile in 1998, the "last mile," between the universities and the national nodes, was recognized as the most difficult aspect of networking in Latin America. The Internet Studio experience demonstrates the usability of the technology. Members of the Internet Studio consortium are working closely with national institutions such as Educ.ar (Argentina) and Reuna (Chile) to develop and promote "last-mile" grants that will support high-bandwidth projects.

Space Design for High-Bandwidth Video Spaces
One frequently observed situation when high-bandwidth videoconferences are conducted, is that they engage the participants at the level of a television screen. As architects, some participants are taking the initiative to design new video spaces, that can absorb other senses of the human body. For example one group is working on developing a prototype of an Internet Studio room in which video projectors enlarge human figures to 1:1 scale. The walls on which the images are projected are no longer video walls. They are areas of social interaction in which ad hoc events can occur. Another technique is to project horizontally by using blue-screened table surfaces, where physical models and drawings can be placed, viewed, touched, and acted on remotely.

Conclusion
Our experiences with several low-bandwidth Internet technologies indicate that the preferred method for virtual design reviews is the combination of student Web-page publishing and chat. Technologies that we favored initially, such as IP videoconferencing, were found to be useful in one-to-one conversations but did not support large design review sessions. Several differences were found between traditional review procedures and online session. Among online reviewers, time tolerance tends to be smaller, and student explanations and commentaries tend to be more direct, precise, and shielded by electronic anonymity. This is a product of the ability to edit information online and the constant accessibility reviewers have to student material during the semester.

This experience has triggered a set of observations and conclusions for conducting Internet studios in low-bandwidth conditions, and translated into a series of follow-on projects. We are working to develop a better Web-page interface with Web publishing, chat, and IP video broadcasting. We are testing Web-cam technology to support spontaneous multimedia collaboration. And we are developing virtual reality prototypes that support creation of virtual communities.

We have more limited experience with high-bandwidth technology and expect to work with it more in 2001, due to a series of grants that allow us to experiment with Internet 2 in Latin America. In our initial observations, we found that there is no significant difference between in studio design reviews and reviews that use high-bandwidth technologies. Similar cultural and behavioral codes are observed on both sides of the virtual experience. Among the slight differences we found were a higher potential for distraction in online audiences and a need to develop better spaces for interaction. These conclusions have prompted a number of initiatives for improving the physical design of interactive spaces. In the future, designs will attempt to enhance engagement of the body and senses of the participants in their meetings.

In the past two years, we have proven that the online design studio experience can be accomplished, and all of the participants acquired an increased appreciation of their ability to communicate, teach, and learn remotely. As we continue to experiment with the technology, we are starting to develop academic agreements and curricula to offer post-graduate degrees in conjunction with the participating US and Latin American universities.

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miami00.tripod.com

Figure 1.
Weekly synchronous communication was supported by unstructured IP-video-conferences over regular Internet connections (top). However, the most popular method for weekly synchronous reviews and communication was Web-chat (bottom).

Figure 2.
The virtual studio space prototype, iStudio, investigates the software design and human behavior of studio life in digital conditions. Students and professors interact in the prototype with avatars in two VRML review rooms that are supported with chat and Web page links.

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