Using Computer-Mediated Communication and Collaboration in Architectural Design Education:
Investigating the Virtual Classroom

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Keywords:

Abstract:

This paper argues that teaching and learning are seen as a collaborative social process in which two or more participants in the educational process work together towards a common educational goal. This is achieved through a Virtual Classroom which extends the technological tools involved in architectural authoring, by including communicational factors like discussion and negotiation in the design cycle through actively using Computer-Meditated Communication.

The paper describes experiences and results of utilizing Computer-Mediated Communication structured to create a virtual classroom that has been conducted in one of the postgraduate courses at the Department of Architecture, Ain Shams University, during the academic year 2002-2003. Emphasis is placed on potentials of the technology, problems encountered during implementation and guidelines for using the technology successfully and enriching the educational process.

ملخص البحث

تناقش هذه الورقة البحثية مسألة التعليم والتعلم وتعتبرهما عملية اجتماعية يتعاون من خلالها شخصان أو أكثر نحو تحقيق هدف مشترك. ويتم ذلك من خلال تقديم مفهوماً جديداً للفصل الدراسى ألا وهـــو الفصل الاعتبارى أو الافتراضي. ويقوِّى الفصل الافتراضـــي دور الأدوات التكنولوجيـــة بتـــضمينه لمفاهيم التواصل والتعاون المختلفة باستخدام الحاسب الآلى من خلال المحاورة والمناقشة والمجادلـــة فى عملية التصميم المعمارى. فتستعرض الورقة البحثية التجربة والنتائج الخاصة بفصل افتراضـــي تم إقامته لطلبة الدراسات العليا بقسم العمارة بهندسة عين شمس فى العام الجـــامعى ٢٠٠٢/٢٠٠٣ – ويتم التركيز على إمكانيات هذه التكنولوجيا الجديدة والمشكلات التى تم التعرض لها أثناء التطبيـــق، كما تقدم بعض التوجيهات من أجل استخدام أنجح لهذه التكنولوجيا بهدف إثراء العملية التعليمية.

Introduction:

It has been argued that the architectural design process is envisioned as a social process in which two or more participants communicate with each other to reach an agreement about an artifact [Wojtowicz, 1995].

Computer-Meditated Communication through high-speed networks, and advanced computational technologies represented in real-time animation software, has greatly affected this communication between the different participants in the architectural design process thus introducing a new term; the Virtual Classroom which extends the technological tools involved in architectural authoring, by including communicational factors like discussion and negotiation in the design cycle. These factors have always been a part of the design process, but by actively using telecommunication technology, these parts of the process could be much more exploited. This can assert that architectural design education in a Virtual Classroom is fundamentally a social process, in which discussion and negotiation is constantly possible.

Advancements in computational and telecommunication technology are affecting many business areas, including the architectural design profession.

In the early phases of CAD maturation starting from the 1960's, the design process was perceived as more or less an individual and technical process, in which a designer uses a computer for analysis, presentation and making construction documentation [Kvan, 1997]. Any cooperation between designers was accomplished by physical meetings, or by physical delivery of data or by using shared information databases.

Recently, more emphasis is placed on networked computing, with the fast growth of the World Wide Web (www), giving rise to more awareness for social and interpersonal aspects in design work.

The Virtual Classroom perfectly fits into this new wave of developments in the architectural design profession, in which networked CAD and virtual architecture are the keywords. The Virtual Classroom conceives the architectural design education process not only as a technical process, but also as a social-collaborative one. This is coherent to the actual design process; in which about 87.9 % of the total time is spend on communication [Broadbent, 1988]. The social-collaborative process can be seen as an addition to the technical process, in which communication, whether discussion or negotiation, can lead to clarity and a better insight when making any design decisions. Summarizing, the Virtual Classroom can be used in educational situations as a practical method to teach students CAD and imaging tools, and to get them more acquainted with the digital architectural design process.

The Project:

Originally, postgraduate courses in architecture are conducted in classrooms. Starting on September 2002, 23 staff members and postgraduate students at the Department of Architecture, Ain Shams University, took the initiative to establish a Virtual Classroom Workshop, through the course offered by the title: "Advanced Computer Applications in Architecture".

This workshop entitled the Virtual Hatshepsut Temple, lasted for almost two months, it included collaboration and data sharing between all participants, students and staff members, over long distance, to construct a Virtual Temple that can be used in Courses of History and Theories of Architecture. The construction of this Virtual Temple went through all the well known phases of the design cycle; analysis, synthesis and evaluation. The Temple is to be navigated interactively by any user to reveal its history, concepts and beauty for students, researchers and history lovers.

Participating students were divided in four teams of fours and fives, with two objectives. The first was to test the conviction that design collaboration and communication over long distance could be possible. The second objective was to collaboratively construct the Virtual Hatshepsut Temple, located on the West Bank of the River Nile, and link it with available information related to it. The design task was not intended to construct a fully restored computer version of the Temple, but only to construct an abstraction of it as for the sake of simplicity. In favor of augmenting the Collaboration concept between the participating teams, each team was assigned a specific task in some sort of a building up process, so that each team's work builds up with or upon the work of another team, to fulfill the final picture. The different tasks were as follows:

- Team 1: Building the Hyper Data Base
- Team 2: Designing the User Interface
- Team 3: Building the 3D Computer Model and its Representation
- Team 4: Building the Virtual Reality Model

Collaboration Methods (The Process):

When considering how computers can support the communication of design ideas and information in collaborative work, [Maher, 1995a] and [Maher et al. 1995b, 1996] has identified two modes of online communication: asynchronous and synchronous.

- In the *asynchronous mode*, designers may work at different times, often on different parts of the design and do not require the simultaneous presence of all team members. Consequently, they do not need to be connected to the network simultaneously or continuously. Networked workstations and personal computers have a wide variety of functions and tools that support the work in a common electronic workspace, allowing designers to share and exchange information asynchronously, for example, E-mails and file transfer through file transfer protocols (FTP). This mode of collaboration has lower requirements towards designer communication and operation skills. Therefore this is a typical way of joint design activity among design professionals separated by long distances.

- The *synchronous mode* implies the simultaneous presence and participation of all designers involved in the collaboration. In this case the interactive design activity occurs in relation to a shared representation of the design that ideally incorporates designers' goals, descriptions,

reasoning paths in their design steps, partial solutions to the design task, design communications and information exchange. This mode is supported with telecommunication software, shared whiteboards and applications, and specialized groupware.

The Virtual Classroom workshop made use of the two modes of online communication, as different parts of the project were discussed using both modes, for different phases of *analysis* and *synthesis*. However, for *evaluation* purposes, the synchronous mode of communication has always been the case, in favor of getting instant feedback and making decisions. Because of technical limitations in bandwidths, the virtual classroom presented in this paper relied only on audio conferencing instead of video conferencing. For all participants to know who are they talking to and to get acquainted and to socialize with each other, all participants photos, including students and staff members, were posted in one file and sent to all participants at the beginning of the workshop. In addition when each team was presenting their work on the digital whiteboards, they were asked to make the opening screen a page showing their photos and names.

The Virtual Classroom workshop used a brain storming approach for the design task sharing in addition to a firsthand evaluation approach for the critique and evaluation task, to help in the evolution of ideas in which only the strongest survives. Regular online meetings were scheduled twice per week, on different times for different teams. In every phase of the design process, a participant had to finish a task and post it on the whiteboard. The submitted task, after discussion and evaluation was the starting point for the next phase.

If we consider the Virtual Classroom as an environment, we can describe it as a digital equivalent of the conventional classroom. Except that it is distributed in time and space and allows synchronous and asynchronous collaboration among different participants. All information is presented and communicated electronically. The software used for this communication was MSN Messenger 6.0, as it allows for audio conferencing, in addition to chatting and sharing whiteboards and applications. Communication between participants was achieved via e-mails for sharing ideas and solving problems, and e-mails with attachments for transferring files. MSN Messenger 6.0 was also used at the final discussion and review as the audio conferencing software.

Participants in a Virtual Classroom can communicate their ideas via electronic communication tools like email or chatting, but the attention is mainly focused on the Digital White Board (DWB), where concepts, plans, geometric 3D models and rendered representations are placed to share with other designers and participants. The DWB, a combination of a website and a database, can be seen as the replacement of the traditional pinup board, which is still found in almost every class or design studio [Field, 1998]. The different media which has been used in the Virtual Hatshepsut Temple workshop can be categorized as follows:

Text
- Introduction to the workshop
- Project description
- Project planning / timetables
- Annotation of drawings
- Describing design ideas

Images
- Scans of sketches, or screen captures to communicate early design ideas
- Plans and elevations, for describing functionality and structure
- Renderings (images and walkthroughs)

CAD
- DWG files
- DXF files
- VRML files

Email / Chatting
- Communicating ideas
- Transferring files
- Solving technical problems

Tele-Conferencing
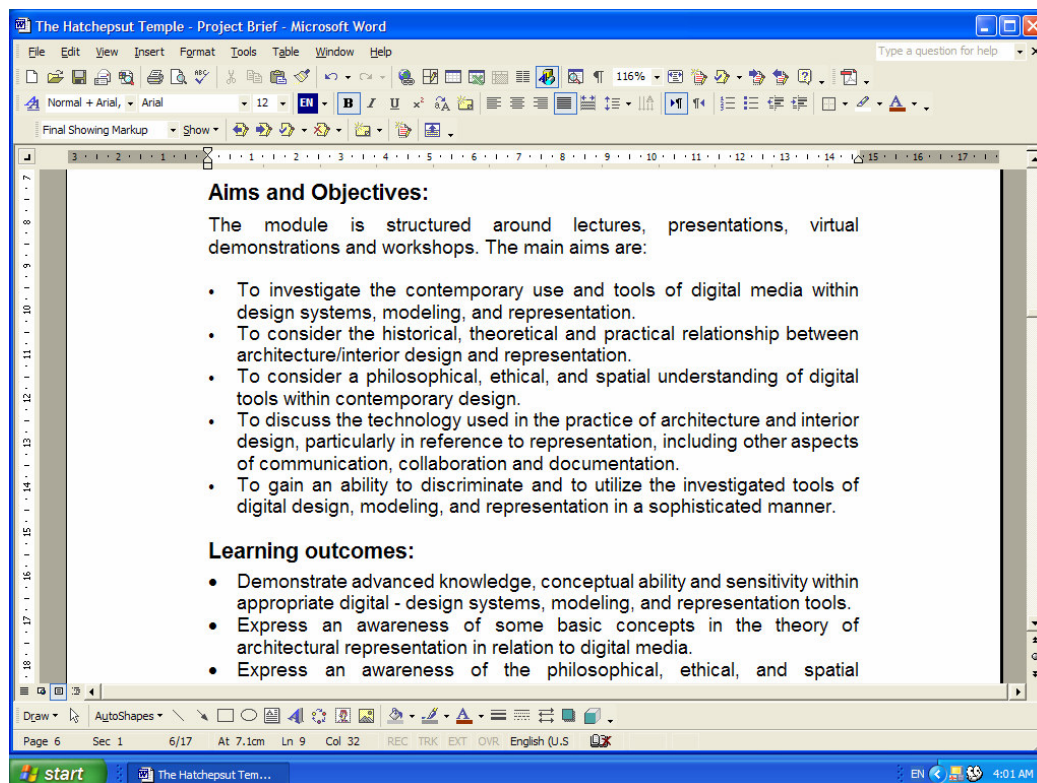- Communicating ideas
- Solving technical problems

Fig. (1): A screen capture of one of the text documents stating
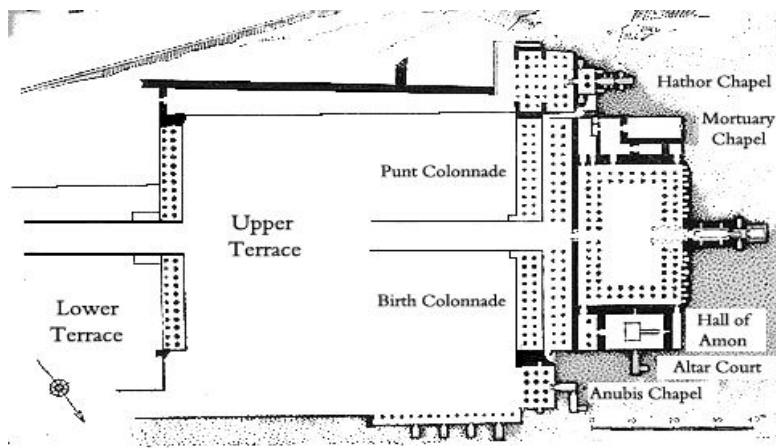the objectives of the project

Fig. (2): One of the scanned images of the Temple's Plan

Fig. (3): Two screen captures of a drawing file from AutoCAD
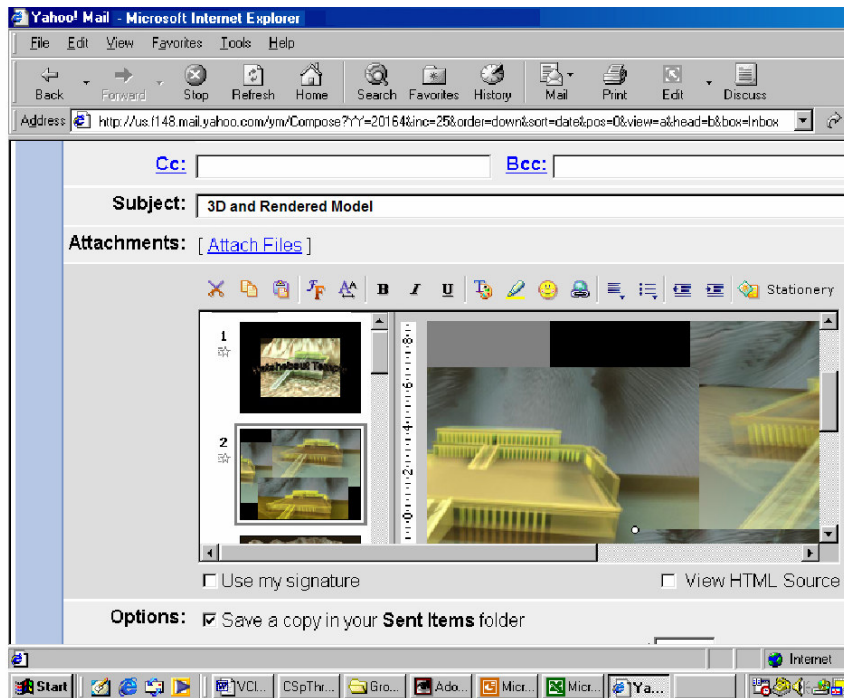and rendered images from 3D Max

Fig. (4): An e-mail showing a screen capture of a rendered 3D Model
from a Power Point presentation

Workshop Themes:

Team 1: Building the Hyper Data Base

Team 1 was mainly responsible for the research work and the data collection from different references and sources, all data collected was stored digitally to be used directly in the Virtual Hatshepsut Temple project. The research work comprised data gathering regarding the history of the Temple, its architectural concept, the building technology used to construct it and other related subjects.
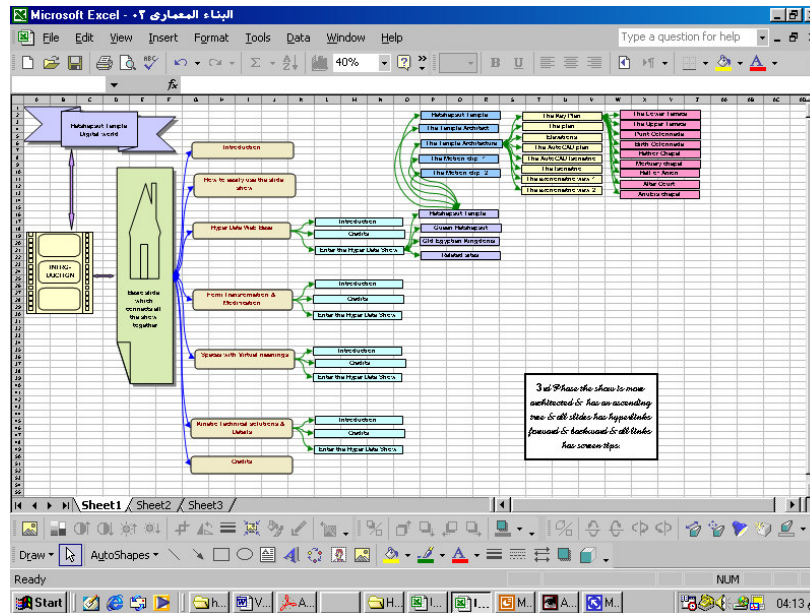

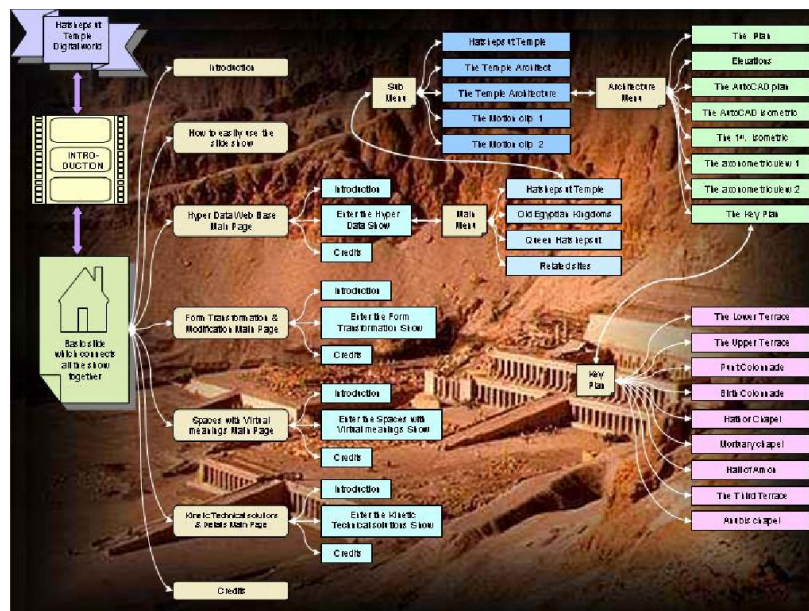Fig. (5): The structure of the Hyper Data Base designed on the EXCEL spread sheet program

Fig. (6): The user interface with hotlinks to different nodes of information in the program

Team 2: Designing the User Interface

This team was responsible for the design of the user interface. The interface was designed using "FLASH" and "Adobe PhotoShop" programs, with hyperlinks to all titles in the Main Menu. All screens had a "Go Back" hot link button to revert to a previous screen when browsing through the different links. In addition, there are hotlinks to the main menu screen.

Team 3: Building the 3D Computer Model and its Representation

Team 3 was responsible for the building and the representation of the 3D computer model and its rendering. This was done using "AutoCAD" and "3D Studio Max 5.0". In addition "Bryce 4.0" was used to model the Mountain background of the Temple. Once the 3D model is built on the computer, different views of the Temple can easily be constructed for further study or investigation.
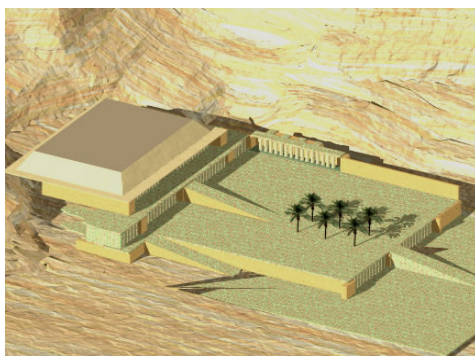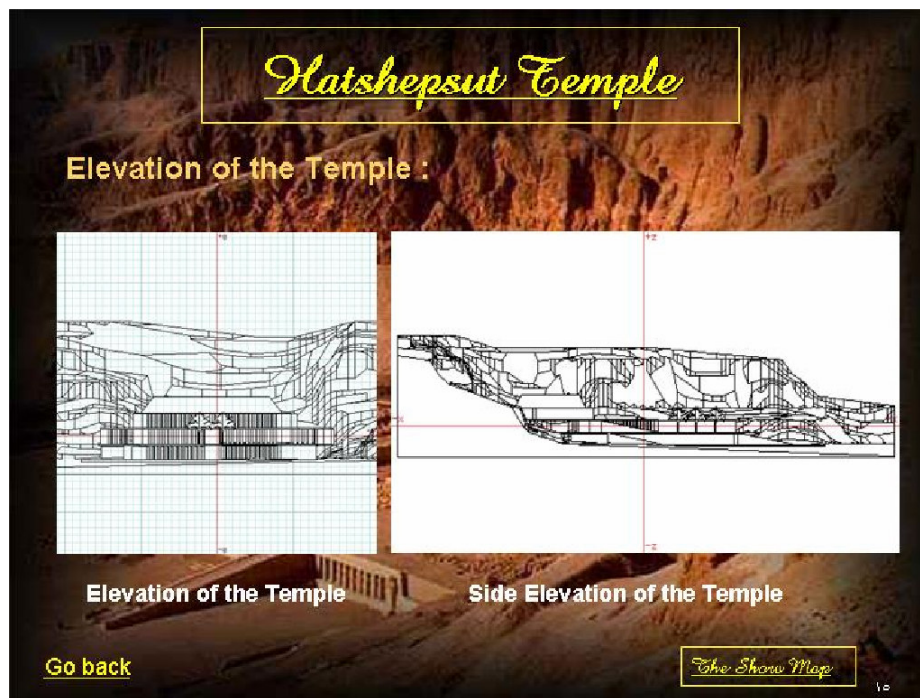

Fig. (7): Different views can be constructed from the 3D Model

Team 4: Building the Virtual Reality Model

This team was responsible for writing the final program in VRML (Virtual Reality Modeling Language). This was achieved because one of the students in this team had a good experience in using VRML.
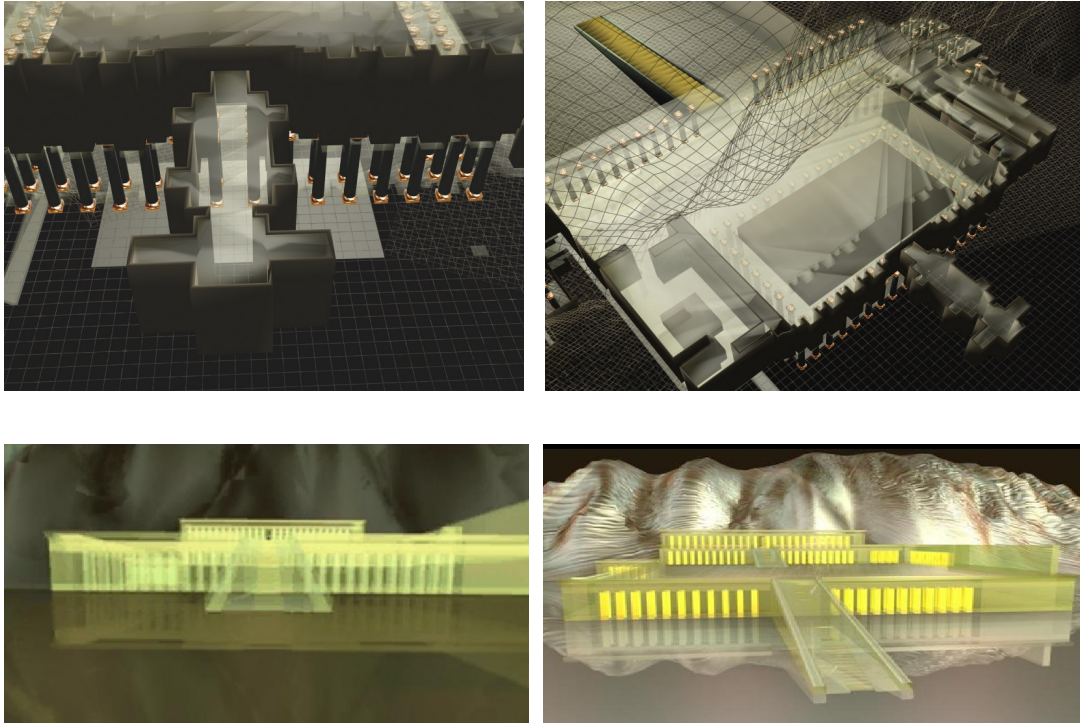

Fig. (8): Screen captures from a virtual tour in the program

Potentials and Problems:

The **potential** of the virtual classroom as a model for e-learning is that it is not just a collection of facilities, but it serves well-defined educational functions, emulating the components of a real-world class and studio environment: workspace, design tools, information access and communication channels. Its educational model joins all participants in an active learning process that overrides one of the problems confronting distance education - the passive participation [Kaye, 1992], which keeps the learner isolated. The presented post graduate virtual classroom workshop at Ain Shams University, department of architecture, has proved to be an information rich learning environment that allows remote students to:

- Take part in educational projects with different mentors and evaluators involved,
- Keep contacts with tutors, teachers and colleagues by means of computer mediated communication while working in a decentralized way,
- Learn the electronic communication and collaboration techniques through actual hands-on in addition to design technology,

- Create and handle electronic design documents, experiencing the potential uses of advanced information processing technologies they will apply later,
- Cultivate a basis for understanding and implementing advanced innovations in design technology,
- Collaborating with other participants in the design process without geographically having to move from the convenience of their homes,
- Speed up the design process by assigning tasks, in a 24 hour time slot, as much more work can be done when different people from the same team work on the design task. The virtual classroom has shown that at every moment in the 24 time slot people were working on the design task.

Quotations from the students during and after the workshop:

"I feel that I can get assistance and help from my colleagues 24 hours a day, this makes me feel very comfortable"

"I felt very comfortable when I was chatting with other participants from other teams, some times when I was bored with my work I felt like talking and chatting with them, just to socialize more"

"During experiencing the Virtual Classroom with my design partners I was so excited and loved the process itself, I don't feel I like working in a traditional classroom again"

"Good thing I didn't have to leave home with my terrible flu when my team was going to deliver our presentation"

The virtual classroom workshop has a high educational value. Students gained experience in an artificial design process and showed great advancements in using design software, both CAD and imaging tools. In addition, students through this experience have gained the required technological knowledge to participate internationally with students or professionals from different parts of the world to enrich their design experience.

The virtual classroom workshop has benefited from the new advancements introduced by computational technology, and one has already identified its potentials. However, the reality is that many **problems** still need to be solved.

- The various software packages used during the project are not always compatible. Exchanging files between participants is thus not always possible, making it more difficult to communicate design information. As not all students have the same software, nor even the same software versions, and not all of them have the same experience with the different software that may be used in the workshop.

- Structuring design information on the WWW is complex - the data repositories are easy to access, but the structure is hard to follow [Maher et al., 1996]. User friendly interfaces need to be further developed.

- Audio conference tools are not specifically designed for distributed discussion and negotiation in the architectural design process, which leads to misunderstandings during the communication between multiple participants [Mitchell, 1997]. The combination of face-to-face communication and digital model viewing should be provided by some kind of application.

Other quotations from the students during and after the workshop:

"I felt very bad when I received a file from one of my colleagues in another team attached to an e-mail in which he had sketched a small detail using a special software that I didn't have"

"My team and I faced several technological problems at the beginning of the workshop while trying to establish our telecommunication facility; it is strange that MSN messenger 6.1 did not provide white board sharing, while MSN messenger 6.0 did"

"It would have been much better if all teams in addition to the instructors were able to communicate at the same time, I don't know of any software that facilitates this feature?"

Guidelines for Using the Technology Successfully:

After experiencing this virtual classroom, several lessons may be learned in order to make future virtual classrooms more successful, among which the following are recommended:

- Expand the project duration, as new technologies consume more time among students who are not familiar with it, in favor of giving more time to real collaboration, evaluation and feedback.
- Instructors need to sign in daily and respond to the students' e-mails as frequently as possible, so that students get daily feedback on their work.
- When dealing with large numbers of students, organizing material will be more problematic, instructors must divide the course into modules and establish regular schedules, so that all participants can plan ahead, and teams move through the topics and tasks in an orderly manner.
- Experimenting with other software is encouraged especially software that allows more participation from more than two participants, and gives the chance for a moderator to lead the discussion digitally.
- All participants have to provide their personal photos in favor of giving the chance to all participants to virtually "see each other".

Future Research Work:

In International Virtual Classrooms, when students from different parts of the world with different cultural and social backgrounds communicate or collaborate with each other digitally, cultural differences can create

unsuspected situations and misinterpretations. It is seen that cultural differences may lead to different view points on the common design problem, resulting in interesting and resourceful building designs. Still this issue needs to be investigated in another future research.

Another very important issue is that technology may change and enhance the context in which learning and teaching are taking place, but without pedagogical principles and design models that underlie technology, e-learning will not be effective in design teaching. It is important to emphasize the role of a pedagogical and theoretical model of design [Oxman, 2003].

Conclusions:

Current architectural design education does not emphasize technological issues properly, it does not prepare graduates to meet the challenge of the new COMers of technology; COMputers and COMmunication, and it neglects the rich potential of the new technology. Computers and communication through the INTERNET should be used to connect architectural students and graduates to a different world of viewpoints. Thus introducing change in the architectural education process that we should be aware of and ready for.

With continual advancements in computational technologies, virtual classrooms seem to have a long and prosperous life ahead. The current state of virtual classrooms is still in its infancy. Virtual classrooms therefore are in a crucial but exciting phase of development. However, even with technological advances, we must remember that all classrooms, virtual or actual, are based on people, and people are social creatures. The classrooms people form in cyberspace need to be nurtured and given social support. They must be given room to grow and expand, and find their own footing.

It has become obvious that the greatest determinant of the extent to which students feel that the online mode of delivery is better or worse than traditional modes is the amount and quality of interaction between the instructor and the students, and/or among the students. When students were urged into this collaborative approach to learning, they shared ideas with each other in a way that was seldom or never seen in a traditional classroom. Herein lies both the key and the challenge for being an effective teacher in the Virtual Classroom environment.

In many ways, teaching a course online is merely a variation of moderating any computer conference. As in any computerized conference, the outcomes are dependent upon both the skills and hard work of the moderator, and the skills and level of motivation of the members of the conference.

As [Oxman, 2003] has pointed out, Studio based learning is the most accepted traditional framework in most architectural schools in the world. E-learning environments, employing the web, computer applications and other multimedia should provide new modes for the representation of curriculum material and course structuring in order to support an electronic analogy to

the problem-based learning of the design studio as well as providing for the delivery of related theoretical and scientific course materials.

We have seen that a Virtual Classroom is a teaching and learning environment located within a computer-mediated communication system. As a teaching environment, it provides a set of tools, strengths, and limitations which are available to an instructor for delivering course materials and structuring learning experiences. Its characteristics are merely potentials, just as the empty classroom with its chalkboards and desks awaits the efforts and creativity of the instructor and the students to make it come alive.

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