Media Space for Architecture Studio Courses

Interactive project analysis and discussion in Architecture Studio

Rafael Villazón¹, William A. Romero R.², José Tiberio Hernández³
Universidad de los Andes, Colombia
¹http://arquitectura.uniandes.edu.co,²http://imagine.uniandes.edu.co ³http://imagine.uniandes.edu.co
¹rvillazo@uniandes.edu.co, ²wil-rome@uniandes.edu.co, ³jhernand@uniandes.edu.co

Abstract. This paper presents a Media Space designed to reinforce the learning experience in the context of Architecture Studio courses by supporting interactive analysis and discussion of architectural projects. Based on the utilisation of information technologies, this initiative attempts to interpret the meaning of the traditional master/apprentice relationship and the project-based learning model. This paper summarizes the course methodology and outlines the aspects of interest in order to improve the learning experience. Also presents the main concepts behind the users’ interaction process in a session such as Catalogue, Stage, Mosaic and Sketch-Based Annotations. The result is a suite of modular applications and hardware engineered to provide interactive visualisation, collaborative tools and teleconferencing.

Keywords. architecture studio courses; computer aided instruction; computer mediated communication.

INTRODUCTION
Traditionally, the educational approach in architecture has been based on the discipline training and the master/apprentice relationship through a project-based learning model. A lesson is presented in the context of the practise, and therefore, brings into the student experience work-habits which help in the development of analysis and design skills. Often, such experience is built in courses of Architecture Studio where students work in the development of an architectural project. The project evolves during an academic term based on the teacher critiques or lessons in different development stages. Subsequently, students must gradually make slight changes until the end of the course in order to integrate the teacher’s lessons.

In Architecture Studio courses, a session is characterised by a close interaction between participants (teachers and students) through architectural documentation (plans, illustrations, photographs, etc.) and sketches. Architectural documentation describes a project and establishes the context in which activities of analysis and discussion will be performed with sketches as communication language. This is the ground where the learning experience is built and where the traditional master/apprentice relationship is located.

Bearing in mind this background, the foundation of this work is the idea that an education “of, by and for” the experience, requires building several supporting elements. In other words, it is necessary
to define procedures, propose techniques, design activities and make support material; in order to reinforce the learning experience (Dewey 1916). In this direction and as a result of a previous research, this paper describes a methodology and a well-defined technological infrastructure for strengthening the learning experience in courses of Architecture Studio. Accordingly, a Media Space has been engineered for exposition of projects, presentation and analysis of lessons and session recording, among others.

The next section gives an overview about the methodology for courses of architecture studio, as well as some aspects that can be improved with a media space. Subsequent sections describe in detail system design; functional evaluation and future insights.

INSIGHTS INTO THE LEARNING EXPERIENCE IN ARCHITECTURE STUDIO COURSES

Generally, a course of Architecture Studio is developed through a project-based learning model. During an academic term, students work in the development of an architectural project (each project may involves one or more students). A project is presented through the architectural documentation (plans, illustrations, photographs, etc.) which includes documents of analysis and design; architectural documentation allows to establish the context in which a project is developed. Students must present their projects in a session where the teacher and course mates analyse and discuss the proposed solutions, approach, design, etc. Therefore, the learning sources of the course are the process developed by students in a project, and the experience of analysis and discussion within sessions.

A previous research (Villazón et al 2009), highlights some problems (not favourable habits for the learning experience) in the methodology presented above. Teacher and students have to deal with the management of the architectural documentation volume in a session. Students do not pay attention when a lesson or a project is presented because there is a subject repetition from a project to another. Finally, teacher has lack of knowledge about the project’s development during the academic term. It is difficult to remember information about previous sessions; it is not easy to state achievements, changes or improvements in a project’s development.

As far as these problems are concerned, it is important to analyse how Information Technologies (IT) would support a project-based learning methodology. Besides, that research presents alternatives to the traditionally educational scheme within an innovation strategy to incorporate IT in the relationships between students, staff and curriculum content. An experimental workshop was engineered with a basic presentation set-up: laptop, video beam, MS PowerPoint and DyKnow [1]. Concluding remarks are:

- The software must be aligned with the methodology and activities. Usually, in class activities, the teacher and his students attempt to adapt to the IT constraints; therefore, the session focuses on how to deal with these tools.
- The need of a space where IT infrastructure is tuned and ready to work.

Incorporate IT tools to improve learning experience present a critical challenge, due such legacy tools are varied and generic, making them difficult to adapt to needs of the teaching and learning activities, especially for activities in architectural education. Consequently, the right approach will depend on the definition of a methodology based on technology, and the meaning of the traditional master/apprentice relationship inside this approach. The aim is to improve the learning environment by supporting interactive analysis and discussion of architectural projects, encompassing a range of available tools and technologies at university.

Goals and Means

According to the previous research and experience, this paper defines the following goals to provide a good learning experience by supporting interactive analysis and discussion:
1. Drive the attention of students (group) to the main object of interest in the current discussion.

2. Support the comparison between projects in order to highlight a concept that is common to the proposed solutions. This allows to avoid subject repetition between projects. It must be possible to present a lesson for all students at the time, not only for the project developers.

3. Integrate guest participants (who are outside of classroom or university campus) into the session.

4. Remember information about experiences and people involved in previous sessions.

As regards the means to reach the goals, this work suggests:

1. A Large-Format visualisation system. The system allows to manage the volume of information displayed in the current discussion, this could drive the attention of students.

2. A mechanism to express ideas with sketches as communication language. These ideas are annotations to the current discussion.

3. A tool to create a mosaic of the projects’ documentation. This might allow to set a context for a lesson.

4. A standard set of colours. This will give a meaning for sketches; for instance, red sketches for corrections by teacher and blue sketches for recommended solutions.

5. TabletPC as an interaction device to present ideas (drawing and communication device).

6. A mechanism to remember information, experiences and people involved in a session of Architecture Studio, contributes to strengthen the learning process and knowledge management of architecture lessons.

7. Teleconference services to integrate guest participants in a session.

As figure 1 illustrates how the proposed means support the achievement of the goals defined to provide a good learning experience.

**CONCEPTS AND SESSION METHODOLOGY**

Four important concepts have been defined from the learning experience insights and the users’ interaction in a session: Catalogue, Stage, Mosaic and Sketch-Based Annotations.

To put these concepts in perspective, a Catalogue contains the architectural documentation of a student’s project. Every image in the
Catalogue has a title (i.e. “proposed location for the project”, “site analysis”, etc.). In a session, the students load/share their documentation (load a Catalogue in the venue). Subsequently, to present the project, a student chooses the image of interest to display.

It is possible to present a lesson based on the comparison amongst the different solutions proposed in every single project for the same issue. Therefore, the teacher creates a Stage (i.e. “The main building core”), and this Stage has as background (context) a Mosaic created with the students’ solutions (images from session catalogues). In this context, the teacher makes Sketch-Based Annotations to illustrate a lesson (i.e. a design principle).

Overall, a Session is composed of Stages, for instance “Service areas”, “facades”, “structures”, and each one has related Sketch-Based Annotations (figure 2).

A Session is composed of Stages and each one has Sketch-Based Annotations.

**FURTHER RELATED WORK**

There is a wide research about collaborative annotations and sketches as thinking tools. The work presented by Eppler (2010) provides insights about the advantages of hand-drawn sketches: engage people keeping them focused, abstract concepts, help to articulate previously implicit notions, and sketches are documentation for later reference and analysis.

Some other important concepts are presented by Tversky (2009), sketches without much detail, focus on the essential avoiding distracting information. In collaborations, they represent a collective idea. This supports the hypotheses about a mechanism to express ideas with sketches as communication language that could drive the attention of students.

Several systems already exist for tele-collaborative architectural design, collaborative design and e-learning. One such systems outlined by Otto (2003) uses projection-based virtual reality technology in order to provide an environment for exploring project designs at human-scale in undergraduate studio experience. Likewise, the Media Space set-up deployed in this paper includes projection-based technology. However, this is intended for distribute and manage information, not necessarily at human-scale in a full three-dimensional visualisation. The classroom set-up described by Richards (2006) has a similar approach to the Mosaic concept. Students can display their work in a tiled display, providing a better overall context.

To align software with the needs of Architecture Studio courses, Caballero (2010) presents an extension of a Shared Application (SharedPaint [2]) for Access Grid, considering Computer-Supported Collaborative
Work (CSCW) topics. This application software can record annotations (drawings on a shared image with a text description) from the participants in a collaborative session. This prototype, tightly integrated with AG-MOX infrastructure [3], has shown a good solution for some user requirements. This was the first experience where a whole system was deployed for the analysis of architectural projects. There were identified technical and user interaction issues to overcome: record scheme, data workload and management, and visualisation functionalities, among others.

THE MEDIA SPACE

The aim behind media spaces is to connect people in order to create a social connection, support close collaboration, and teleconferencing (Harrison 2009). The Media Space system is based on the AG-MOX infrastructure [3]. A suite of modular applications and well-defined hardware are the system foundation, engineered to provide interactive visualisation, collaborative tools and teleconferencing.

AG-MOX Overview

The Collaborative Working Environments (CWE) are designed to provide services and resources to people who are working together, sharing a common interest. Although the CWE are utilised by people who are geographically dispersed, this may be utilised for working together in the same location. AG-MOX [3] is an infrastructure based on Access Grid (AG) [4], implemented to provide communication services and computing resources for collaborative work at Universidad de los Andes. This infrastructure allows to deploy CWE that includes application software (i.e. shared whiteboard), high definition video services, large-scale display, echo-cancelling devices and interactive environments, among others.

AG manages venues. A Venue is the virtual representation of a meeting place, and as a real place, there are access policies, services, etc. A venue is the virtual place where people attend a meeting and work with Shared Applications. A Shared Application is a tool meant to empower a collaborative session, participants can load, view and modify objects of their interest, for instance an MS. PowerPoint file, 3D model, etc. Moreover, AG includes the Video Conferencing Tool (VIC) [5] and the Robust Audio Tool (RAT) [6], making possible full HD video transmission (1920x1080 pixels - 40 Mbps).

The Workspace Set-up

The deployment of a suitable media space depends on the physical space, installation design, number of people and the type of services and resources. In a space about forty (40) m2, the installation design is composed of:

- Large-Format visualisation system. System A: Projection-based visualisation (size 3x3 m and 1920x2400 pixels resolution); System B: Two TV displays (1920x1080 pixels resolution each one).
- Master node. A computer (or a group of linked computers) that allow to scale resources to the demands of a session.
- A sound system which includes an echo-cancelling device, a set of unidirectional-cardioid microphones and powered speakers.
- Video capture devices.
- Client nodes. User devices such as a tablet PC.
- A suite of modular applications.

The main display, as a whiteboard, shows a mosaic with information about four different projects. The students load and share their architectural documentation through a client device (tablet PC).
Hardware and Application Software
A detailed description of hardware and software components for the Media Space has been specified (figure 4) in order to empower the learning environment with a complete solution. This specification guarantees non-functional requirements such as performance, scalability, reliability, and manageability.

To fulfill user requirements, two applications have been developed. These applications are in the core of the Media Space software. The first application is ASquare [7], this application allows to create, edit and manage catalogues; it is possible to import images in BMP, JPG, PNG or TIFF format, as well as a MS PowerPoint presentation. The second application is AGWorkspace [7]. Users are allowed to:
• Create, edit and manage user profiles (master, single or group).
• Load and share catalogues in an AG session.
• Create a stage with a single image from a catalogue.
• Create a stage with several images from the same or different catalogues (Mosaic)
• Select a colour set standard.
• Create annotations that combine sketches, text and video.
• Save a session keeping the catalogues, stages and annotations of an AG session in a persistent file.
• Load a session from a file.

Both applications run in a standalone mode or within an application session (as a Shared Application) on Access Grid.

FUNCTIONAL EVALUATION
Evaluation was conducted in a laboratory environment during live operation of the whole system. The objectives of the functional evaluation are:
• Evaluate the support offered by the Media Space tools in a session of Architecture Studio.
• Identify user constraints in the utilisation of the Media Space services and resources.
• Benchmark the performance of the Media Space infrastructure (hardware and software).
• Identify technical issues in the Media Space infrastructure (hardware and software).

Participants
The participant pool are five (5) recently graduated architects who are working at the university as research or teaching assistant; a professor of architecture, leader of the session activities; a professor of Human-Computer Interaction, leader of the user studies; a support engineer and a cameraman.

Methodology
The functional evaluation includes three stages:
1. User-training workshop. Training for acquiring

![Figure 4](Hardware-software Stack)

Software
- MS Office
- Asquare
- AGWorkspace
- Access Grid
- O.S. (Windows / Fedora Linux / Mac OSX)

Hardware
- Large-Format Display
- Video Capture
- Audio System
- Master Computer
- Tablet PC
- Interaction Devices
  - Pen Tablet
  - Wii Controller
the knowledge and skills needed for the utilisation of the AG functionalities. Therefore, users will be able to log on to a specific venue for an AG session, load files in the data section of the current venue and launch Shared Applications, among other functionalities.

2. Presentation and discussion of projects. An experimental trial of the close interaction between participants through architectural documentation and Sketch-Based Annotations in a session of Architecture Studio. Some activities performed were present a project; create a Mosaic with the graphical material from different projects, present a comparison between different projects through Sketch-Based Annotations, record and load a session, among others.

3. User evaluation. Users were asked to fill a questionnaire to provide some background information (age, computing experience, primary computing platform, etc.) and an Media Space evaluation (from 1 to 5 where 1 is insufficient and 5 is excellent) of the support and effectiveness for the activities performed in the stage 2.

Results
During the functional evaluation sessions, users went through a reasonable learning curve according to their computing knowledge. It is important to state that they often operated multiple windows (Venue Client, VIC, RAT, ASquare, AGWorkspace, etc.) simultaneously, which resulted in a challenge for beginner users. Although the overall reactions to ASquare and AGWorkspace were positive, users pointed out several improvements and further requirements. Evaluations revealed some aspects to improve in the Graphic User Interface (GUI). For instance, the applications must present in a clear way if it is being executed in standalone or Shared Application mode. In the current version this gets confusing for users. Experimental trials have been a useful benchmark for measuring the data workload and network bandwidth.

CONCLUSION AND FUTURE WORK
The presented Media Space has been designed to improve the learning environment by supporting interactive analysis and discussion of architectural projects. It encompasses a range of tools and
Design Tool Development

Furthermore, concepts behind the users’ interaction were defined, such as Catalogue, Stages, Mosaic and Sketch-Based Annotations. A suite of modular applications and hardware were engineered to provide interactive visualisation, collaborative tools and teleconferencing. Custom-made software has been developed (ASquare and AGWorkspace) in order to fulfil user requirements, making user experience consistent and productive in terms of the developed activities.

According to users’ suggestions, the applications will move a step forward into an effective GUI. The system could be further improved by deploying a Project manager instead of a Catalogue. A project is the basic unit of data workload and knowledge management in Architecture Studio activities. A study within course sessions is planned in order to evaluate the Media Space as a pedagogical tool.

REFERENCES


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[7] ag-mox.uniandes.edu.co/projects/agworkspace