DIGITAL MODELING IN TRADITIONAL ARCHITECTURE LEARNING: The Method and Benefits

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Abstract. The traditional architecture learning with the aid of digital 3D modelling aimed to support the process of architectural design in a studio environment where things can be tested without the practicalities of the real world. The process of architectural design in itself is an unknown phenomenon for new students of architecture, so they look to digital 3D modelling to help them in understanding the vernacular or traditional architecture vocabulary. The question therefore, is how the digital 3D modelling does this in a way which will encourage a student's own design philosophy and experience? Also is there any place for the older students, in making this process more productive? The digital modelling of a sample traditional house of historical Jeddah has allowed for a study of all of these points to be investigated by assessing the digital 3D model, what makes for good traditional architecture learning. Observing students over one semester it was apparent that a more open critical ability developed in understanding the vernacular or traditional architecture vocabulary. Based on feedback from students, we have developed guidelines and recommendations for learning traditional architecture with the help of 3D digital Modelling technologies. We believe we have improved the quality of the Department's small-group teaching and encouraged students to treat communication and 3D modelling skills as valuable. Our results show techniques of creating 3D Digital Modelling can be very helpful in teaching the vocabulary of our traditional architecture. Digital 3D modelling in this way seems an ideal tool in traditional architectural education which is presently neglected.

1. Introduction

3D digital modeling in architectural design process can be taken further than its common use as a drafting tool. It can actually be involved in many stages of design process as a design tool. The cultural architecture of the historical cities may be taught to the student of architecture with the aid of

digital 3D modeling aiming to support the process of architectural design in a design studio environment where things can be tested without the practicalities of the real world.

The techniques of creating 3D Digital Modeling are seemed as the preparation of virtual reality of buildings or sites. It offers an opportunity to reproduce the virtual traditional architecture as a precise digital replica, yet most architects who are specialist in traditional studies continue to illustrate their publications, teaching materials, and research with the same 2D plans, sections, and elevations. Using the well-established traditional methods of architects, scholars and archaeologists in architectural representation combined with contemporary digital media, these models are excellent tools for architectural and archaeological education, analysis and research. (Ferenc Traser, 2007)

Today, increasing numbers of those architects have acknowledged that digital 3D modeling can help them better understand their data and we are moving beyond the type of static 2D representation. The digital-imperative to switch from analogue to digital mode has already begun to manifest itself at the schools of design and architecture. Design and architecture students routinely use the best of new technologies that provide information-rich and fully networked multimedia environments (Muir & O'Neill, 1994).

In this paper, we present a different style of teaching traditional architecture vocabulary to students of early stages of architectural design studios. In the Department of architecture at the faculty of environmental Design (FED) at King Abdul-Aziz University (KAU), we have been experimenting for several years with ways to integrate 3D Modeling skills into architectural Design studios. Our regular tutorials consist of a small group of students supervised by a teaching assistant. This organization offers opportunity for developing students' communication and computing skills.

Based on feedback from students, we have developed guidelines and recommendations for learning traditional architecture with the help of 3D digital Modeling technologies. We believe we have improved the quality of the Department's small-group teaching and encouraged students to treat communication and 3D modeling skills as valuable. Our results show techniques of creating 3D Digital Modeling can be very helpful in teaching the vocabulary of our traditional architecture.

2. The Objective

In the early stages of their engagement of computer technology, architects approached the technology as an assistive technology that would enhance the practice of architecture. The scope of the engagement was captured in the

phrase 'computer-aided architectural design.' In the four decades since, the role of computer technology in architecture has gained a marked significance. The scope has now been extended for architects to contemplate 'totally computer-mediated architectural design. (Julio Bermudez & Kevin Klinger, 2003)

The main objective of this paper is to discover how 3D digital modelling and visualization can be incorporated into a first year of studying architecture. In their second CAD course, our students learn to construct a 3D digital model, to view it from multiple perspectives and to render it. Some other courses the students learn to understand the local traditional architecture. Thus, we tried to start with three dimensional thinking and emphasize the importance of digital modelling and visualization of the traditional architecture of historical Jeddah.

The students discovered that this approach was exciting, challenging, and relevant process. They learn to capture their ideas as 3D digital models, and gain an understanding of the greatness of the local traditional architecture.

3. The Method

Educational objectives best achieved through the use of small group teaching methods include the development of higher order intellectual skills. There are many methods now available for the generation of 3d Digital Modelling, ranging from simple applications, to highly sophisticated applications. However the generation of realistic and believable virtual reality visualizations requires considerably more than a rendered 3d model.

There have been various ways to integrate computation and digital media into design teaching that led to alternative models for digital design studio including computer augmented design studio, CAD-plus studio, virtual and web design studio, cyberspace design studio, intelligent building studio, and toys and tools studio (Do & Gross, 1999).

To facilitate this interplay of ideas, we design the method of learning that involve a range of complex tasks and problems, for which solutions can only be discovered through interactions between the students, between the students and their tutors, and between the course community and its intellectual and social contexts.

The concept of virtual environments has emerged from advances in computer networking, image processing, modelling, simulation, and multimedia representation.   (Simoff & Maher, 1997). This concept is a powerful approach for architectural design studio teaching using the advancement of information and communication advanced technologies in architectural design computing and digital media. Over one semester of the course (AR 313 – Architecture Presentation by CAD) a group of the student developed and refined methods of working efficiently together to generate

the desired process of learning traditional architecture with the help of 3D digital Modelling technologies.

Mainly the software Autodesk REVIT, was used to generate 3D digital Model of Al-SHAFAI House as a sample of the traditional houses of historical Jeddah. Some other software ware used to carryout the present exercises (Such as AutoCAD, 3Ds Max, Corel Draw and Ulead VideoStudio).

4. Old Jeddah Houses

The architecture of Old Jeddah houses is a living testimony for its response to social needs and environmental considerations. This is witnessed in the houses' design, construction material and architectural elements. Old Jeddah houses are three-to-four floor-high attached townhouses built of coral limestone and wood. The coral limestone is usually brought from the seashore or Alarbaeen pond located to the north of the old city, and used for the construction of high load-bearing walls and foundation. Wood, on the other hand, is used for structural support, roofing, windows and the famous mashrabias. It was brought from Wadi Fatma to the east, Khulais to the north or Algunfuda south. Higher quality wood was also brought by sea from Indonesia and India.

The unusual height of the old coral houses, four or five stories, was primarily a response to climatic conditions. Only at roof level could the cooling north-west sea breezes be caught and enjoyed. The highest rooms are often little more than sitting spaces shaded by screens of palm. But it is the wooden windows and balconies that are the chief glory of old Jeddah Called `rowshans', they hang on the white walls like beehives, and are as intricately constructed. They are made up from thousands of small pieces of wood, jig sawed together because timber was scarce in a desert country.

Carpenters used what they could get, creating three-dimensional screens against the sun that allowed the breeze to filter through. Inside the houses, window seats were used as beds during the summer nights and women could sit here unseen, during the day, gossiping to neighbors across the narrow alleys (Figure 1). Mortar was made from pulverized coral, and lime. Imported teak, from India or Burma, was used horizontally to reinforce the exterior load-bearing walls. Huge pottery jars in wooden stands on the balconies held drinking water, cooled by evaporation. (Rosie Llewellyn-Jones, 1995)

Figure (1)
An Arial View of old Jeddah with its wood-balconied, flat-roofed houses, and the
surrounding modern quarters. (Pesce, A., 1976)

5. The Projects Procedure

Digital Visualization is used to explore, understand and communicate architectural information associated with the production of buildings. 3D modelling, rendering, animation and VR as well as the power of digital media to permit the seamless integration of various data types are unleashing completely new ways to display architecture. (Julio Bermudez & Kevin Klinger 2003)

The project procedure was designed to allow students to discover the potential of the digital modelling techniques in manipulating and experimenting with it, using this process as a means to understanding the traditional architecture. When modelling traditional architectures in digital way with the help of computers, there are many difficulties. One of these difficulties is that the shapes of vernacular houses are much more complex than other modern buildings. In the present 3d digital modelling project, we divide the work into stages as follows:-

- In the first two weeks, the students were asked to collect all available information about the traditional architecture of the houses at Historical Jeddah. By the end of this stage of work they were asked to produce a digital presentation of the collected information of Al-SHAFAI house. The information gathered during this phase played a key role in the degree of realism of the final 3D model generation. (Figure 2)

(Figure 2)
Photographs and satellite image of AL-SHAFAI House at historical Jeddah.

- In the second week, the students moved to the house site to collect more information and photographs that required helping them for producing the 3D digital Model of the house including all building elements details. The photographs that have been used for the reconstruction contained the maximum possible information that was visible to the visitors of historical Jeddah especially Al-SHAFAI house. (Figure 3).
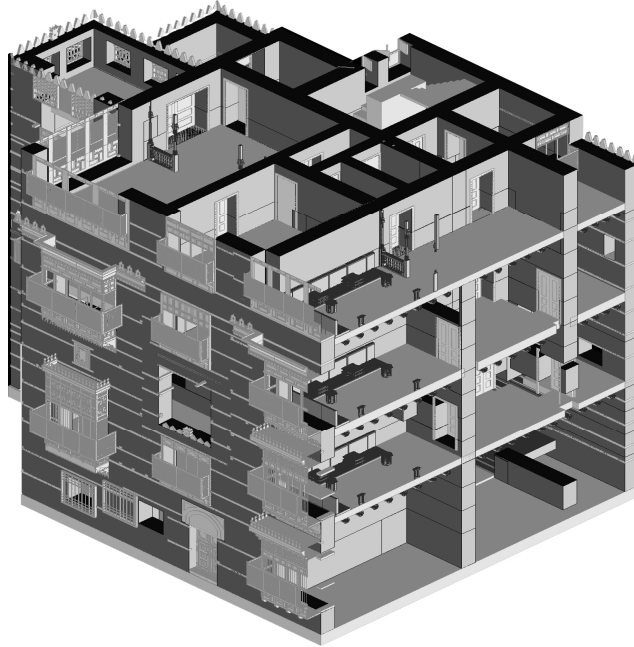
(Figure 3)
Photographs of wooden windows Called `rowshans'.

- During the next three weeks the student ware asked to generate a full detailed 3D Digital Model of the house with the help of the collected information and the existing house status photographs and all available information resources. (Figure 4)
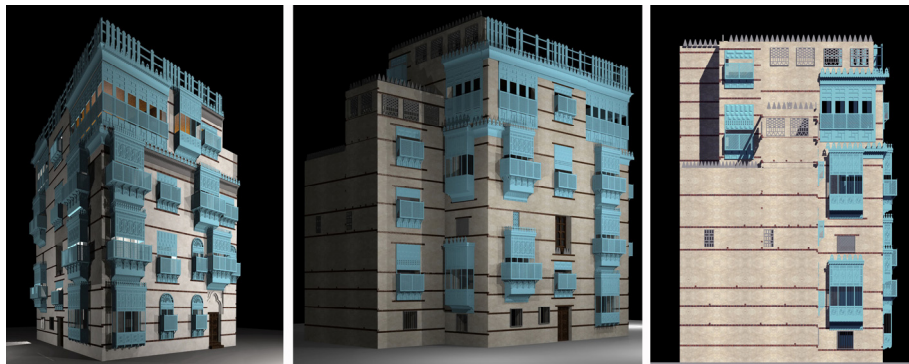
(Figure 4)
3D views and elevation of the digital model of Al-Shafai House.

- The project ended with a discussion on the architect's responsibility to integrate the learning of creating 3D digital modelling with understanding the greatness of the local and traditional architecture vocabulary in much updated techniques of architecture learning. (Figure 5)

(Figure 5)
Sectional 3D Model of Al-Shafai House.

6. The Benefits of Digital Modelling

Virtual Environment is attractive platforms for learning in which they provide opportunities for new kinds of experience that enable students to interact with objects and navigate in 3D space in ways not possible in the physical world. Also virtual environment representations including easier learning, better understanding and training, more engagement, and pleasure. It is important for a designer to be able to visualize the design ideas as they progress. It is also necessary for the designer to be able to communicate these ideas both to others and to the client.

Utilizing virtual environments in architectural design teaching advances the concept of designing with computers (e.g. in a paperless design studio), to a multi user real-time 3D virtual environment for achieving collaborative designing and learning (Reffat 2003).

The low complexity 3D digital models with detailed textures provide enough realism when the main purpose of the creating such models is presenting the traditional architecture not a scientific study or digital archiving. The resulting project was better than the traditional way of learning digital modelling because it has become more useful for the new

students of architecture to get familiar with the digital modelling software and get understanding the greatness of the traditional architecture at the same time.

The concept of representing the historical predecessors was applied onto digital models of some heritage buildings of historical Jeddah. It was not only the major exterior pieces and important details were modelled, but the interior layout as well. Thus the model of AL-SHAFAI House can be used for multiple purposes, for example it demonstrates relations between the floor plan and the building, reveals hidden structural components and shows relationships among exterior and interior elements.

The project was very effectively while it gave students an appreciation of the importance of considering the traditional architecture solutions in their future designs. Students were encouraged initially to find out what they could do with digital applications in a useful way and to develop their ideas using digital models. (Figure 6)

(Figure 6)
A digital model of Al-Shafai House compared with a real photograph.

CONCLUSIONS

From day one, our students of architecture entering the world of architecture realize that the subject is different from any other subject. The project was a good exercise to encourage students understanding the traditional architecture while learning 3d digital modelling techniques. The emphasis of our project with small-group teaching has been on methods that included group work and student presentations in tutorial classes. The present paper introduces the application of approaches representing various

dimensions of revitalizing architectural design studio learning with the aid of using information and communication technologies.

Students of architecture need to use digital techniques throughout the curriculum to understand how computing can support architecture's diverse endeavours and thinking modes. In particular, students must be able to explore and communicate design ideas fluidly using digital and traditional media suitable to specific queries. The key in the development of digital tools to enhance the practice of architecture has been the facility with which the various tasks involved in the practice of architecture have been represented, enabled or enhanced using computer technology especially in digital modellings.

Finally we believe that we have been successful in improving the quality of student learning in cultural and traditional architecture of historical Jeddah and digital 3D modelling skills by the same exercise. The developed methodology may be applied to help student in understanding traditional architecture of different cultures. It is also could be applied in different subjects of learning architecture.

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