NO MORE FEAR OR DOUBT: ELECTRONIC ARCHITECTURE IN ARCHITECTURAL EDUCATION

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Abstract: Operating electronic and Internet worked tools for Architectural education is an important, and merely a prerequisite step toward creating powerful tele-collabortion and tele-research in our Architectural studios. The design studio, as physical place and pedagogical method, is the core of architectural education. The Carnegie Endowment report on architectural education, published in 1996, identified a comparably central role for studios in schools today.

Advances in CAD and visualization, combined with technologies to communicate images, data, and "live" action, now enable virtual dimensions of studio experience. Students no longer need to gather at the same time and place to tackle the same design problem. Critics can comment over the network or by e-mail, and distinguished jurors can make virtual visits without being in the same room as the pin-up—if there is a pin-up (or a room).

Virtual design studios (VDS) have the potential to support collaboration over competition, diversify student experiences, and redistribute the intellectual resources of architectural education across geographic and socioeconomic divisions. The challenge is to predict whether VDS will isolate students from a sense of place and materiality, or if it will provide future architects the tools to reconcile communication environments and physical space.

1. Historical Background

1.1. DISTANCE LEARNING AND ARCHITECTURAL EDUCATION

There are many definitions of distance learning as general; however, all have one common characteristic. The instructor teaches and the student learns at different locations. Although the term distance learning has been receiving a lot of attention at the institutions of higher education during the last ten years, it is not a new concept. In fact distance learning has been around since the last century.

In the late 1800's the University of Chicago began the first major correspondence program in the United States. Correspondence programs were designed *"to provide educational opportunities for those who were not among the elite and who could not afford full-time residence at an educational institution,"* but they were sometimes perceived as *"inferior education"* (McIsaac and Guanawardena, 1996).

At the same time, technology has provided education with new delivery methods. During the past decade the development of computer networking and tele-video conferencing has expanded and enhanced distance learning. Satellite and microwave delivery systems have revolutionized distance learning, but although they are effective, they have become increasingly expensive and are beginning to be replaced by asynchronous transfer mode (ATM) service. The Internet has opened a variety of new opportunities for communication and distance learning.

On the other hand, the creation of flexible time / place distance learning is the basis for asynchronous class communication. This system allows students to address courseware at a convenient time and place. Examples of this form of distance learning are printed-media courses using mail correspondence, E-mail and chat, video-based tele-courses, and Internet based courses.

1.2. ARCHITECTURAL PROFESSIONALISM AND EDUCATION

Over the last few years, due to the social and technological development, major changes occurred in architectural practice. These changes were accompanied, especially in Europe and North America by a noticeable client's dissatisfaction. Governments, construction and architectural organisations, and schools of architecture commissioned numerous reports aiming to assess the current state of the construction industry.

Assuming that the status of architectural education in the west can be used as an indicator for its counterpart in Egypt, a readings on the work of David Nicol and Simon Pilling who ran a thorough review of architectural education in the west, the main trends and problems in the construction industry and the propositions offered for schools to cope with the change are truly significant and problematic (Nicol and Pilling, 2000).

Accordingly, students first should develop more effective communication and interpersonal skills, so that they are better able to appreciate, understand, engage with and respond to the needs of clients and users. Secondly, students should acquire a foundation in team-work in order to prepare them for the inter-disciplinary working relationships that characterise professional life. Thirdly, there is the challenge of preparing students for a changing society where knowledge is growing at a rapid rate and the needs of society and the construction industry are continuously evolving. For this, students need to acquire skills and attitudes that are transferable across contexts and enable continuous lifelong learning.

1.3. INFORMATION TECHNOLOGY IN ARCHITECTURAL PRACTICE AND EDUCATION

The use of computers in architecture is mistakenly evaluated in isolation, as a matter of technical competence only. The revolution of information technology (IT) represents a large phenomenon that as it changes all disciplines, may ultimately change, the design/build processes, organisational structures and design cultures. IT effects on both architectural practice and education cannot be overlooked. A better understanding of these effects can be reached by documenting the account of IT and the different trends of computer usage in practice and academia (Abdelfattah, 2002).

2. The Effects of Information Technology on Architectural Practice

Professionals, generally in all industries, use IT to improve their effectiveness in practice. Technology affects architects on two distinct areas, firstly at the skills' level and secondly at the level of work processes and professional culture.

Alfredo Andia classifies the effects of IT on architectural practice into two major areas: professional skills and work processes (Andia, 2002).

2.1. THE EFFECTS OF IT ON ARCHITECTURAL SKILLS IN PRACTICE

The major effect of IT from the 1970s to the mid-1990s was at the skills level only. During this period of time, computer mainframes, PCs and CAD transformed architects' manual skills used in documentation, drawings, specifications, and written reports. But the transformation process, which lasted for twenty years, was not simple. Architectural firms' adoption of technological skills went through three distinctive phases, namely, according to Andia, the CAD on mainframe era, the CAD operator era, and the high computer literacy era (Andia, 2003).

2.1.1. The CAD on Mainframe Era

During the 1970s in the United States and the 1980s in Japan, large architectural firms adopted in-house CAD systems. They invested heavily on large systems, in-house programmers, independent information technology groups, and software. Their aim was to reach the latest and best total solutions they could pay for. The prohibitive cost of purchasing and maintaining CAD's mainframe hardware and software, which averaged from 50,000 USD to 200,000 USD per seat, limited the affordability of such systems to very few large firms. Examples of such systems include ARK2 from Perry, Dean and Steward, AES from Skidmore, Owings and Merrill (SOM), and HOKdraw-HOKimage from Helmut, Obata and Kasabaum (HOK). The average percentage of CAD usage in projects during this phase was 5% to 10% (Andia, 2003).

2.1.2. The CAD Operator Era

In the mid-1980s, as faster and cheaper PCs entered the market, and better off-the-shelf software was available, large in-house systems became obsolete. Another era of skills' change emerged in the second half of the 1980s in the United States and early 1990s in Japan, when the information system departments and their mainframes were replaced with PCs and CAD operators.

Before long, architectural firms recognised the downsides of their new approach. Information was drawn twice, first by the architect's hand and second by the CAD operator. During this phase, firms using computers in general drew only 10% to 20% of their projects using CAD (Andia, 2003).

2.1.3. The High Computer Literacy Era

As time passed, IT literacy began to propagate, allowing cheaper PCs equipped with easier software to take place on the architects' traditional drafting desk. The new transition, ironically, was easier and faster for smaller firms; larger ones were reluctant to replace their high-priced large CAD systems.

In the late 1980s and early 1990s, in the United States, a major change occurred. Modern customers, also IT literates, began to require drawings in digital format. This had forced upper management in architectural firms to consider CAD technology in their strategies and, consequently, to disseminate IT skills between all their professionals. By 1995, 75% to 100% of drawings produced by large and medium U.S. firms were executed using CAD.

2.2. THE EFFECT OF IT ON WORK PROCESSES IN PRACTICE

After the successful introduction of CAD in the eighties and early nineties, the next important change came with the implementation of network technologies, a development that continues to affect the industry till the moment.

Although CAD has transformed architectural drafting radically into a more efficient process, centuries-old design/build processes did not change. The new technology offers a potential to alter the way designers, engineers, contractors and their customers collaborate. Andia mentions two phases of impacts from network technology on the architectural practice everyday work processes; the data networks era, and the concurrent design era.

2.2.1. The Data Networks Era

Architectural firms in the United States adopted the data networks trend, from 1993 till 1998. Network technologies, like LAN, WAN and the Internet, were introduced into firms to improve computation capabilities such as document management, printing and plotting sharing, system maintenance, and software administration.

The data sharing course of action did not only improve work efficiency, it also signalled new possibilities for interdisciplinary collaboration. But practitioners misinterpreted the new potentials. They thought that faster and efficient connection to information increased the competence and productivity of their organisation. Slowly, they discovered that the efficiency of the work process was more likely related to the efficiency of the design-build process rather than the quantity and speed of data sharing, and the automation of existing tasks.

2.2.2. The Concurrent Design Era

The data networks era has triggered a new vision of the use of information technology in architecture and the whole construction industry. The use of IT by itself will not improve the performance of organisations unless accompanied by a fundamental change in the way work processes are perceived.

3. Models of IT integration in Architectural Practice

Alfredo Andia mentions that construction firms in general, are constantly applying IT solutions in their practice. Most of these implementations are directly due to the settings of a particular project; nevertheless, they often take a long time to be diffused into the main core of the firm’s total practice. However, two models of practice suggest a full integration of IT in the design-build process, namely, the digitally integrated construction system and the digitally integrated building system.

3.1. THE DIGITALLY INTEGRATED CONSTRUCTION SYSTEM

This model uses a more digitally integrated system that promotes a more efficient design process and challenges traditional practices and legal conventions. This system resembles systems adopted in other industries such as manufacturing and aerospace. According to the model, new designs are originated by hand, then, the architect develops a digital model of the design using modelling software (Figure 1). Next, the building is designed from *skin-in* and another physical model is produced to check against the original model (Figure 2). Hybrid techniques like stereolithography or 3D printing and laser cut paper pack models are used to produce accurate models supplemented with the tangible feedback of working directly with materials (Figure 3).

Usually three digital models are produced: a surface model describing the exterior surface, a wire frame geometry model describing the structural grid and organisation, and an interior surface model. When the design process is complete, the final model can be used in various roles to test and evaluate the various engineering options of the building, for example acoustics, lights and the flow of air, etc.

3.2. THE DIGITALLY INTEGRATED BUILDING SYSTEM

With the gradual application of artificial intelligence inside buildings, the worlds of construction and technical systems have witnessed revolutionary changes. Development in electronic technology and the growing collaboration between the fields of information and telecommunication technologies have led some firms to make the most of the possibilities offered by centralised control systems. With the development of electronic technology, centralised control systems, from energy management systems to those for vertical transport, were possible.

In the 1990s, all networks that carried digital information (computer data, telephone signals, and signals for environmental control and security) were integrated. In the year 2000, the paradigm of the Internet and the possibilities of connecting through a PC are separating the networks' functions from their infrastructure. At the same time, new digital technologies have opened the way for virtual configurations previously unthinkable. The phenomenon has produced several new synonymous terms like building automation, smart building and computer integrated building.

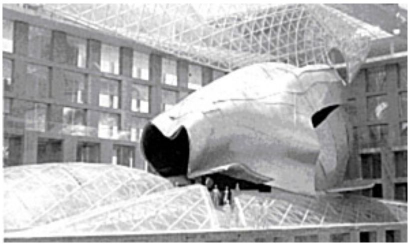

Figure 1: The check model for DG Bank, 1995-2001, Berlin, Germany (Lindsey, 2001).

Figure 2: DG Bank, Interior courtyard with horse head conference centre, nearing completion (Lindsey, 2001).

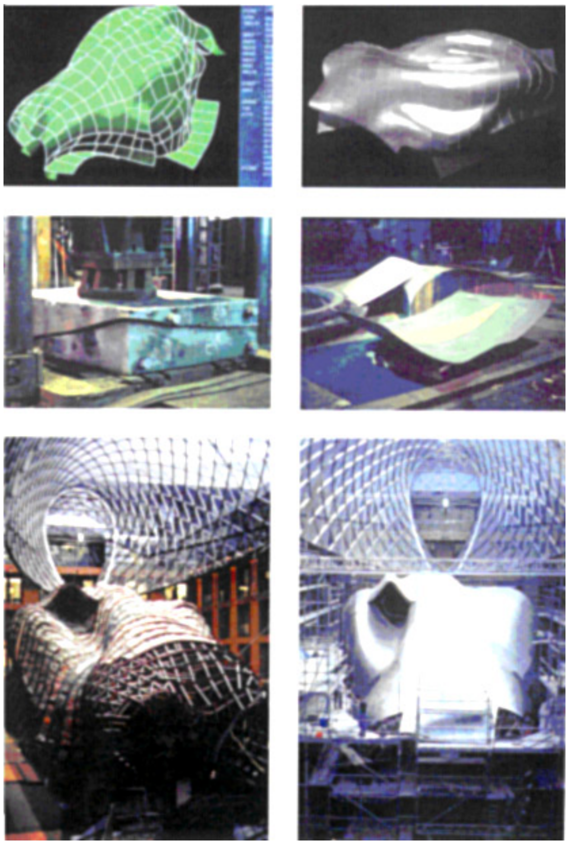

Figure 3: Top: CATIA model, physical model. Middle: hydraulic forming of skin panels. Bottom: horse head under construction (Lindsey, 2001).

4. The effects of Information Technology on Architectural Education

In most western architectural schools, the use of IT is aimed to challenge the traditional role of computers in practice: to produce CAD visualisations and to digitally record and share drawings and documents. Schools has become, according to Andia, experimental laboratories for creating design machines, new architectural imagination, exploration of materials, and extending the architectural realm to cyberspace. In the coming sections, it will be seen that IT continues to affect architectural education till the present moment.

Andia conducted a survey on the effects of computers on architectural practice and education in the United States, Europe and Japan, through the past three decades. He identifies five trends of discourse developed in the architectural academic community. The five trends are design methods, CAD visualisation, paperless architecture, information architecture, and virtual studios (Antably, 2004).

4.1. DESIGN METHODS

Early attempts to bridge the gap between technology and architecture started in the 1950s, when the design methods movement emerged. Most of the pioneering efforts were born inside academia as direct line of the problem-solving or systematic methods tradition that dominated the computer science community at the time. This was followed, in the 1960s and early 1970s by intensive research on the computability of architectural design in the architectural academic community.

After almost two decades of increasing expectations, the design methods theories and gurus quietly retreated to a small number of courses in architectural schools. The minute number of courses that survived was the foundation for some of the first commercial CAD systems.

4.2. CAD VISUALISATION

Between mid-1970s and mid-1980s, cheaper PCs and commercial CAD emerged and gave birth to a second discourse of computerisation in academia. CAD proved to be a key tool for project documentation and the digital visualisation of architecture. But this did not go without critique. Professionals criticised the simplistic nature of CAD systems, while academics, both in architecture and computer science fields, argued that CAD lacked the informational potential of software design. Numerous design studio professors banned the use of CAD from their studios in fear that it will hinder students from acquiring traditional drafting skills.

From the early nineties, CAD courses became widely accepted and started to become part of the core curriculum of architectural education. Tutors and students developed practical realism as they had to cope with change in practice. CAD proficiency became a prerequisite to employment after graduation. The most widely used software of the time was AutoCAD, Microstation and 3D Studio on PC platforms. Computer station per student ratios rose from 1:50 or 1:100 during the mid-eighties to an average of 1:20 to 1:10 in the nineties (Andia, 2003).

4.3. PAPERLESS ARCHITECTURE

Despite the booming development of computer software and hardware, and the dissemination of CAD visualisation in the nineties, many argue that the conventional design methods did not change. Architects still produce plans, elevations, sections and models almost in the same way. This has led the architectural academic discourse into another debate: computer implementation in architecture.

The School of Architecture at Columbia started a paperless design studio to eliminate conventional design methods. It used high-end software, originally designed for the movie industry to produce animation and special effects, such as Alias/Wavefront, Softimage and Maya. The software ability to create special effects was used to produce studies of building circulation, mobility, and program variations (Antably, 2004).

In conventional design studios (Figure 4), instructors normally rely on discussions and rationalisations to inform the student about what is not portrayed in his drawings or models. The learning process grounds on the tutor's expertise and credibility. This hypothesis is shaken by the paperless architecture paradigm, as visualisations can be tested immediately and decisions are made spontaneously (Figure 5).

According to Antably, digital pioneering firms such as Greg Lynn FORM, Reiser+Umemoto, Denari, Lars Spuybroek at NOX, and F.O.A., led the way for new architectural imagination by publishing their unconventional designs as quickly as they could invent them. They created a whole range of new ideas, but at the same time, they provoked resistance on two fronts.

The first criticism came from the professionally oriented practitioners and academics, which criticised these eye candy projects and unbuildable utopias. The lack of built projects was the biggest intimidation for this generation of academic architects which motivated the School of Architecture at Columbia to react. In 1999, the school hired Frank Gehry, the most productive non-Euclidian contemporary architect, as a distinguished professor. Today, many amorphous structures are built or under construction around the world.

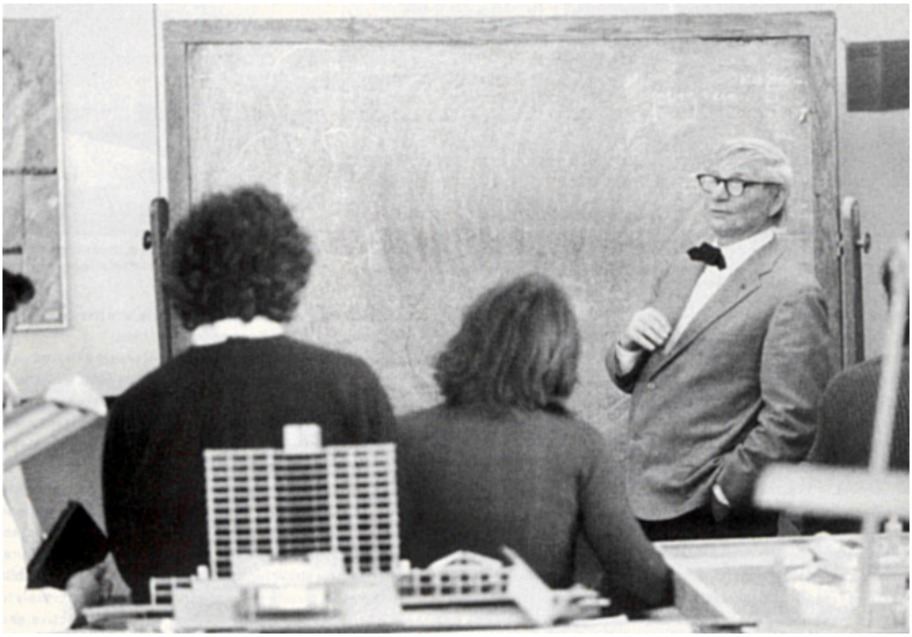

Figure 4: Louis Kahn's studio at the University of Pennsylvania, in 1974 (Architecture Magazine, September 2000).

Figure 5: Hani Rashid's studio-in-progress with Columbia University students at the 7th Venice Architecture Biennale (Architecture Magazine, September 2000).

The second and more serious front of criticism claims that these efforts are far from pushing architecture theory and practice into new directions. They merely lock architecture into endless loops of aesthetic experimentation along with a disregard of the human user of both the physical and virtual space.

4.4. INFORMATION ARCHITECTURE

In the mid-nineties, many academics were proposing different alternatives regarding the implementation of information technology in architecture. They argued that the introduction of IT may create a parallel way of practicing architecture, creating not only physical space but also a communicative and psychological one. A new architectural drift, that goes beyond exclusive concerns for buildings toward a mixed urban reality, both real and digital.

Many building types such as banks, shopping centres, office buildings, schools and academic campuses are radically changing. The type of activities that was characterised by a need for a pure functional physical building now migrates to more distributed cyber-real spaces. Jargons such as e-commerce, Internet banking, Internet shopping and e-learning, are not unusual to our vocabulary. Ironically, the business community in the United States now describes companies that engage in virtual commerce as click companies, while conventional physical companies are labelled brick and mortar companies (Prasarnphanich, and Gillenson, 2003).

4.5. VIRTUAL STUDIOS

In 1997, Mary Lou Maher, Simeon Simoff, and Anna Cicognani wrote a landmark paper and subsequent monograph, Understanding Virtual Design Studios, on VDS experiences at the Key Centre for Design Computing, Faculty of Architecture, University of Sydney. According to them, virtual design studios surfaced as the fifth trend of information technology in academia in 1993, when the first VDS project started. The existence of this academic model is largely due, according to Mary Lou Maher, to the development and availability of the Internet and telecommunication technology. (Maher, Simoff and Cicognani, 1999) (Figure 6).

The design collaboration may be single-task, in which each participant “has his own view over the whole design problem, and the shared conception is developed by the ‘superposition’ of the views of all participants,” or multiple-task, in which “the design problem is divided among the participants in a way that each person is responsible for a particular portion of the design.”

Figure 6: Architecture student Tom Carajevski at the University of British Columbia presents his design proposal to a critic at Kumamoto University in Japan. Photography courtesy Dr. Jerzy Wojtowiczp.

Similarly, communication may be synchronous, implying "the simultaneous presence and participation of all designers involved in the collaboration," or asynchronous, in which "designers may work at different times, often on different parts of the design, and do not require the simultaneous presence of all team members." Asynchronous communication has modest technical needs—typically e-mail and file transfer protocol (FTP)—while synchronous communication imposes high bandwidth and technology requirements for video conferencing, shared electronic whiteboards, and specialized groupware.

Simoff observes that an ideal shared design representation for VDS "would incorporate the designers' goals, descriptions, reasoning paths in their design steps, partial solutions to the design task, design communications, and information exchange." But he notes that no CAD system or interoperability scheme among CAD systems currently supports all these data. Therefore, the typical VDS employs an informal hypermedia approach, presenting information as text, tables, images, 3D models, animated images, and Web links to other information.

When implementing these principles, Nancy Yen-Wen Cheng, AIA, who taught at UHK during the mid-1990s when VDS took root there, favors structuring well-defined tasks and interactions "because of the difficulty of a true artistic collaboration between people who have never met." In local projects at the University of Oregon, where she now teaches, Cheng observes, "Where students can supplement mediated communication with face-to-face talk, they see their contributions become part of a useful repository." In remote projects, such as a recent collaboration with the University of Stuttgart, "students see that though their distant peers may have different values and approaches to design, many fundamental aspects of the design process are unchanged around the world. The enlarged pool of students involved [in a VDS] allows us to identify different models of excellence. While face-to-face interaction is more direct for conveying complex aspects of architecture and urban design, even through the haze of the mediated connection we get to glimpse a wider world."

The virtual design studio is the fifth trend, which explores the potentials of communication in the digital era. It opens a window on an extraordinary cultural exchange in the traditionally protected environments in design studios.

5. The anatomy of the virtual design studio (VDS)

A conventional design studio typically includes studio instructors, students and possibly a client or an engineer. Studio instructors collaborate to carry out the aim of the project and constant communication exists between students and their instructors. Communication is a key factor in the design studio. Designers sketch, draw and model in order to communicate their ideas. They can explain their ideas verbally or textually at any time. According to Ernst Kruijff, 87.9% of the total time in a design studio is spent on communication. (Kruijff, 2001)

At the same time, there is a swift change in the toward globalisation and long-distance design collaboration. This change is supported by a rapid pace of development in computation and telecommunication. Schools of architecture have to respond to such change.

Architectural education cannot be seen any more as a technical process only but also as a social one, where communication and collaboration are fundamental. Two main stream line effected the design studio and architectural profession as follow:

5.1 NETWORKS

Many academics, like Maher, Schmitt and Andia, report that network technology is the most influencing technological factor in a VDS. The development of the Internet has extended the network to computers around the world. This subtle distinction between establishing a network of computers, to connecting to the Internet, has implications on the way we perceive computers, information, and space. This is the most remarkable feature of Internet technology; studio participants view the Internet as simply one unified space in which any computer can communicate with any other computer. All we need to know to initiate a working session is a partner's Internet address.

5.2. DIGITAL MEDIA

Digital design media is the basis on which design information can be shared across a network. It is a representation of design descriptions.

Digital media that are most commonly used in a VDS are images, CAD and 3D models, text, e-mail, Web pages, video conferencing, and lately, immersive virtual reality (VR). There are other media, such as sound and movies that are also relevant to the representation of a design description.

5.2.1 Images

Normally, images are used to represent design concepts and geometry in both virtual and conventional design studios. Digital images can be created by scanning a drawing or sketch on paper into a file. This process implies that anything that we can put on paper can be stored and manipulated as a digital image. Alternatively, there are other computer generated sources of digital images which include: rendered 3D models, digital video, etc. The increasing availability and use of digital images means that anything can become part of the information available in the VDS.

5.2.2 CAD and 3D Models

CAD drawings are an essential part of the representation and communication of design information in a VDS. The design development is represented as CAD drawings. In order for the students to collaborate on the development of a design, they need group access to the CAD drawings.

The realism of visual simulation allows the comparative evaluation of design alternatives based not only on technical and functional criteria, but also on the aesthetic impact and user’s needs. Where the clients and expected users of a building were previously shown drawings of plans and elevations, the use of realistic 3D models provides the ability to understand a design without requiring an understanding of the notation of technical drawings.

3D models are the data source for creating walk-throughs, thus designers have the ability to explore design solutions both from outside and inside. This technology is filling niches in a spectrum of fields connected with designing spaces from architecture, to the design of game and educational environments and even to movie production. In design, such a facility allows the designer to go beyond the stage of documented ideas to simulate the use of their design configurations.

5.2.3 Text

Designers who use text to augment their images are able to communicate their ideas and meaning associated with their design, where others who rely entirely on the images rely on the viewers' interpretation of the design.

Text-based information communication is used in the VDS for the introduction to the studio, the description of the design brief, the site analysis, the understanding of the design problem, the description of the student's design concept, and for the annotations of the images and drawings.

5.2.4 Web Pages

As part of the move toward integrated information management, considerable efforts have been taken towards development and implementation of standards for exchanging information. The Internet’s World Wide Web (WWW) has provided the solution. The basic idea is to separate the content of a document from the document structure and presentation style. Documents can be described in a way that is not dependent on any hardware, operating system or application software, which complies with the standard. This approach is currently used in creating the documents that are stored as Web pages.

5.2.5 Video Conferencing

Video conferences have broadened the nature of computer-mediated human and inter-organisation communication patterns. As an interactive communication medium, two-way video stands out in a number of ways. A videoconference can improve retention and appeal to a variety of learning styles by including diverse media such as video or audio clips, graphics, animations, computer applications.

In the VDS video conferencing sessions are scheduled regularly. The early sessions are planning sessions in which tutors discuss the studio's organisation and the brief. The later sessions are used entirely by the students to get to know each other and to discuss problems in getting information from one site to another. The final video conferencing sessions are used for work on particular portions of the design.

5.2.6. E-mail

The students use email to communicate with each other and with the client, studio tutors, and studio teachers. To promote interpersonal communication, the virtual design studio provides an e-mail tool to allow messages to be delivered to an electronic mailbox which can be read by the recipient at any time. This allows e-mail messages to be archived centrally and be available on the Web. This system also provides a way of navigating through the messages according to date, subject, or the person who sent the message.

5.2.7. Virtual Reality (VR)

The use of VR techniques is becoming increasingly popular in design education, as Andrew Roberts discusses when he summarises the benefits of VR as a teaching tool. He describes VR as experiential, that it allows students to have real life experiences with the built environment. Some of these experiences may not be possible in real world because they are too expensive, too dangerous or excessively time consuming. VR offers immediate feedback on design decisions and, in the presence of adequate networking infrastructure, VR is a superior tool for CSCD. It can help in the conceptualization of abstract ideas and if the user uses a head mounted display (HMD, Head Mounted Display) or a projected CAVE interface, it can provide a real sense of scale, particularly in architectural and urban design projects.

Lately, VR was introduced in the VDS, creating what is referred to as the virtual environment design studio (VeDS). In a VeDS, participants use VR in the design and the design evaluation of spaces. The space experience can also be shared in both synchronous and asynchronous modes depending on the network speed available.

6. The Communication structure of the VDS

In a computer mediated environment, communication is still the key factor but communication tools are largely different. The choice of these tools can highly affect the ease of communication in the studio.

All design information can be handled in a digital form which results in a large amount of computer files. In the absence of the appropriate communication tools, these files are typically bouncing between individual desktops, reducing the server technology to its most primitive and elementary operations of data storage and sharing. In such environment reports of loss or unnecessary and ambiguous duplicates of files are very common.

Maher defines the term VDS environment as the set of software tools installed in a computerised and networked studio to support VDS activities. At the start of any VDS, it is imperative to spend time setting up the VDS environment. This setup should be clear and transparent to all VDS participants (Maher, Simoff, and Cicognani, 1999).

Maher and Schmitt distinguished two modes of design collaboration, namely asynchronous and synchronous. In an asynchronous mode, the simultaneous presence of all design members is not required. Members work on different parts of the design at different times. Information is shared through the Internet or a local intranet using a variety of computational tools.

Contrastingly, in a synchronous mode, all design team members are simultaneously present. This implies the existence of real-time communication systems, real-time data sharing and shared drawing applications. This type of instantaneous collaboration is hindered by the computational and networking infrastructure available and the Internet traffic.

Maher notes that each participant in the VDS occupies a node (desktop) in the networked studio. The setup of each node depends on the setup of the VDS environment and available software and hardware. The degree of integration between a node's tools and other nodes can be the base to assess the possibilities of a VDS. Integration deals with, following Maher's description, the compatibility of hardware platforms and networks, the common applications running in the VDS environment and the interface metaphor that unifies the accessibility to files and applications.

Figure 7 illustrates levels of integration and autonomy in a VDS environment. Rectangle A represents a VDS environment where all nodes use the same computer platform. Rectangle B represents the case where different platforms are used within the VDS. Both A and B have all software tools installed at each node, reaching a high level of autonomy. Rectangle C represents a VDS with a unified platform but the same software tools are not installed at each node. In such a case, each node (or group of nodes) is assigned a specialized task. Rectangle D is similar to C with the exception of the diversity of platforms installed at each node. This diversity may offer more flexibility and potentials to the VDS. The limited number of software licences in scenarios C and D represents an economical advantage over scenarios A and B.

VDS environments can be therefore classified, according to the levels of integrity and autonomy, into a distributed environment or a centralised environment (Figure 8).

Lately, Sadik Artunç, introduced a diagram on the VDS components and level of integration in which they state that Establishing an interdisciplinary distance-learning centers within the College of Art and Design will provide schools of architecture, art, interior design, and landscape architecture with opportunities to offer online education courses to their students to enhance

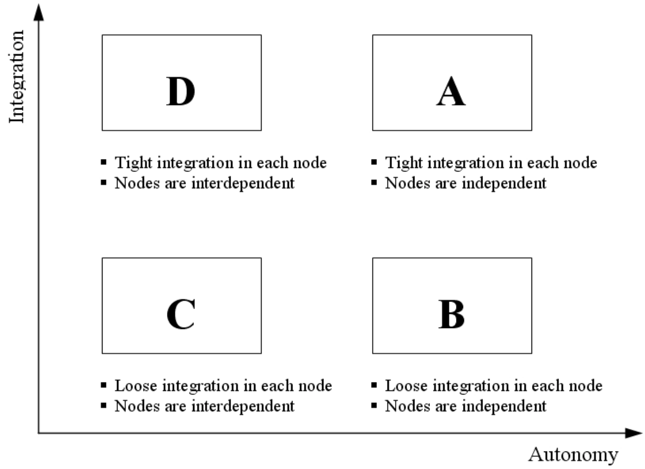

Figure 7: Integration levels in a VDS (Maher et al. 1999).

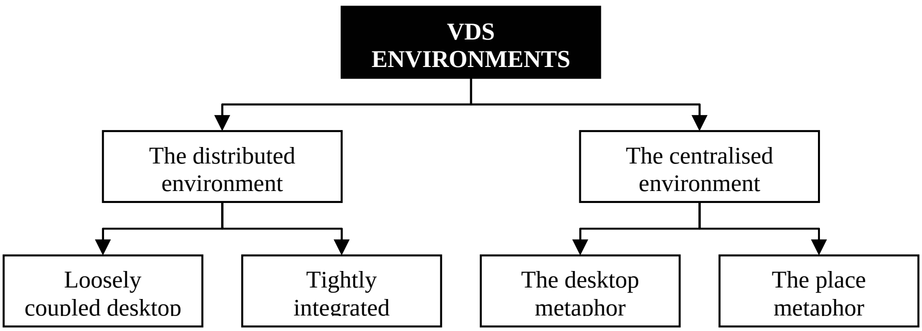

Figure 8: VDS environments (Antably, 2004).

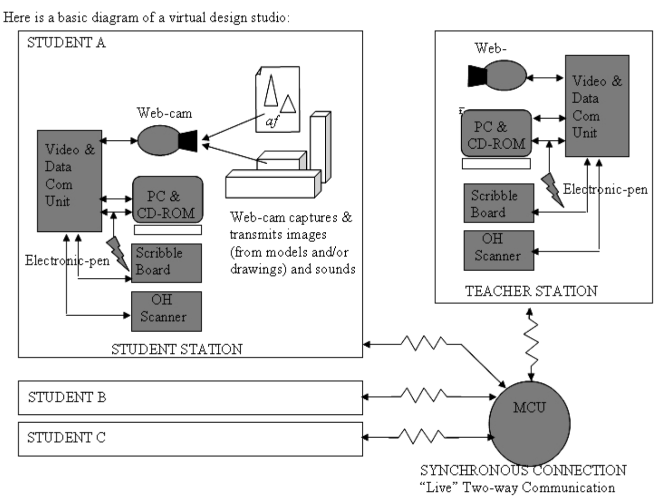

Figure9: Model of VDS environment (Antably, 2004).

their level of design. According to their model of VDS, student and faculty have a virtual meeting. Images of the student's work in the form of models and/or drawings are captured and transmitted through a web-cam to the faculty station. Faculty member sees the images on his/her computer screen "live." The student may present the work with the audio connection to further illustrate the ideas. Following the student's presentation the faculty member will provide a virtual-desk top critique by drawing directly on the computer screen of the faculty station with an electronic pen while the student hears the comments and watches the faculty member's drawing superimposed to the previously captured images of his/her own work. The faculty member's comments and drawings may be captured as a separate layer to document the progress of the work and critiques for future teaching purposes (Figure 9) (Sadik, 2003)

7. TDS or VDS

A VDS, as described by Maher, enforces communication, collaboration and team-working between participants. Schmitt also claims that a VDS can lead to a breakthrough in collaboration and team-working, but only if participants are willing to learn and to share their knowledge. Branko Kolarevic and others note that, as opposed to the professional practice, the diffusion of individual authorship encouraged less competition of the negative side. Shared authorship produced better and more developed design solutions. They even state that a VDS can improve project development and project management (Kolarevic et al, 1999).

But on the other side, Kvan mention that communication and collaboration were disappointing in most VDSs, and asynchronous mode of collaboration overwhelmed the VDS. (Kvan, 2000). Another point of debate is the technical aspect of the VDS. Maher points out that a VDS provides training for students on computational tools. However, Andia records that the digital burden placed on the student's education during the VDS is "one of the greatest negative comments, this type of experience has received". He mentions that the learning of IT tools usually occupies 20% to 30% of the students time. He also notes that the current collaboration tools are not satisfactory and need further development.

Andia approaches another aspect of the VDS when he observes that this new mode of collaboration can blend the traditional distinctive design biases of architectural schools. This blend of design cultures, which has previously evolved slowly through the years, is a rich source of ideas. According to Kolarevic and others, the intense exchange of ideas was one important skill acquired by students (Kolarevic et al, 1999). Another important observation is made by Kruijff when he declared that the focus of all VDS projects until now is on the preliminary design phase (Kruijff, 2001).

Although the VDS is a fashionable trend feverishly adopted by universities around the world, it is clear from the above literature that no agreement exists between academics on the outcomes of the VDS. However, scholars who expressed negative opinions about their experiences are still running VDSs in their design studios. The cause of this disagreement may be due to the use of different VDS settings, which Maher described as paramount to the success of the VDS. Another reason may be the participants' willingness to learn and to share knowledge, which Schmitt considers paramount for the VDS, and which can differ among different cultures.

8. The Egyptian Case

The status of Egyptian professionalism bears a resemblance to its western counterpart. It suffers from the same problems. The profession changes and the scope of architectural activities are contracting.

There is a lack of collaboration and communication between designers and their clients. This is due to architectural education which promotes an inferior and disgraceful image of a business-led architect.

All of the issues of concern in architectural education exist in the Egyptian context. Schools of architecture do not have a strategy for developing communication and team-working skills in the design studio which is isolated from the real practice. There are problems with developing lifelong education and the learning climate in schools of architecture does not enhance students' learning.

This paper presumes that, unless radical change to the way IT is seen in design studios, Egyptian practitioners will be incompetent in the foreseen global world.

9. Conclusion

The study of architectural professionalism shows that there is an increase in complexity in practice. There are too many stakeholders in design decisions while, on the other hand, too many design decisions are left to vendors. The architect does not play the role of a master builder anymore; he is now expected to be an integrator.

Accordingly, the role of the schools of architecture is to prepare students for practice. However, conventional education, the design studio being at its core, lacks a clear and methodological development and assessment of interpersonal skills.

The key challenges for architectural education can be identified as the need to develop more effective communication and interpersonal skills, and a foundation in teamwork between students to introduce the no fear and no doubt in students personality.

The use of IT in architecture is an essential trend. However, schools of architecture have another interpretation of the introduction of IT in architecture; they use it to change centuries old design methods. While almost every school around the world has infused computer courses in their curricula, very few of them have structured strategies that support computation in design. The unplanned introduction of IT in education was criticised by many. While conventional education does not enhance team-working and communication skills, computers and telecommunications seem to weaken them. Among many trends of IT usage in design education, only one stands out as a premise to develop these skills, namely the virtual design studio (VDS).

The VDS premises to develop collaboration and team-working skills of its participants. It also enhances their technical skills which may reflect on the design outcome. These skills may be significantly influenced by several educational, cultural and technical factors. Being relatively new, most of the research on the VDS focused on its technical and design characteristics. Although the technical aspects of the VDS have proven feasible, not much research was done on its social outcomes.

To conclude this paper, the paper has found that the changing architectural profession in both the Egyptian and western contexts has revealed a need for architects to acquire communication and interpersonal skills. The development of these skills is an issue of concern in architectural education. Contrastingly, the conventional design studio is promoting individual attitudes. The VDS is still in its early stages of development. More research needs to be conducted on its different social aspects and design outcome. A VDS arguably develops the collaboration and team-working skills of its participants. It also develops their technical skills which potentially contribute to their design outcome. The interpersonal and technical skills acquired in the VDS may be significantly influenced by several educational, cultural and technical factors.

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