The pedagogy of virtual design studios

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Abstract

Virtual design studios (VDS) are proliferating as schools of architecture experiment with the technology of the Internet. Discussions about VDS typically focus on technological issues — which hardware, what software — or environments — MOOs, ftp. Recently, some papers have been written on the perceptual issues and the social aspects of remote design collaborations, thus contributing to some of the contextual issues within which virtual studios are conducted. This paper contributes another perspective, presenting a review of the pedagogical issues raised in a VDS. It examines the difficulties and opportunities that present themselves in teaching a VDS. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction

Virtual design studios (VDS) are proliferating. Schools of architecture are eagerly experimenting with the technology of the Internet using various collaborative environments (such as MOOs) and technologies (such as whiteboards or JAVA), allowing their students to experience collaborative design projects. Discussions about VDS typically focus on technological issues — which hardware, what software — or environments — MOOs, ftp. This paper will examine the experience of VDS and pose some questions which we, as teachers, should address if we are to use the experience of a VDS to the students' advantage.

As students or teachers of architecture, we are all familiar with the elements of design studio teaching: the setting of a design problem in the form of a brief or program, the explanation and exploration of the brief by the students, presentations of ideas and reviews of proposals. What makes this setting effective for architectural education and how does a VDS fit? In order to limit the discussion, I shall address the teaching that occurs in a typical first design degree setting, commonly an undergraduate degree.

1.1. Why run a VDS

Is a VDS an effective or necessary means of teaching design? The environment introduces problems that work against the pedagogical ends. The technology is not cheap to acquire and difficult to support. The problems of communicating over a computer network appear to multiply geometrically based on the number of participants — a large class can therefore be very difficult to support. At a time when many universities are reducing funding, how can we justify spending money on such experiences?

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I think the justifications lie in both the educational and professional worlds. First the professional. Some aspects of architectural practice are increasingly becoming a knowledge business. No longer is the practitioner reliant on local presence to obtain a commission. Some firms have become truly global; able to deliver their services in locations wherever they have an architectural value. For others to compete in the same arena they must become adept at delivering their expertise wherever it is needed. These practices have entered into a professional world where their knowledge is of higher value than their presence or their particular skills.

Not all practices are knowledge firms. Using the model of architectural practice described by Coxe et al. [2], it is the "idea" firms which have engaged in selling their knowledge and increasingly the service firms which are now competing on this level. These firms are increasingly called upon to deliver their particular knowledge throughout the world, using whatever communication technologies are available to effect such delivery.

Some firms (the "delivery" firms in Coxe's model) will remain forever local but even they will find it competitive to communicate with their consultants using communication technologies more extensively than they do now. Thus, architects have to acquire a new skill in communication and computer technologies offer such opportunities. Many of our students will enter into such practices. As part of our training, therefore, we need to expose students to the technologies and give them the opportunity to master the skills of communication in this new medium, just as we encourage them to develop appropriate skills of communication through drawing, model making and jury presentations, among others.

There are educational reasons too. I teach students who have limited financial resources. They are unable to travel easily, usually waiting until they have earned some money of their own after graduating. These students therefore have limited experience of the world and other cultures. This is a significant problem in our educational process. Most of the example of architecture we use come from abroad and must be understood within the cultural and social contexts of these other places. It is difficult to give our students adequate exposure to these other cultures without travel, but a vicarious exposure to

other cultures through interactions with students from overseas is helpful. While journals offer some means of exploration, the immediacy of contact with students and teachers from abroad is substantially better.

2. Design studio teaching

Let me now present some background to this discussion. Currently, architectural education is centered on the idea that we present students with a real design problem and allow them to explore solutions, encountering failure, success and frustration along the way. This approach, which we have practiced as *studio teaching* has been formalized in recent years under the rubric *problem-based learning* (PBL). It can also be found in other disciplines such as medicine, engineering and mathematics, among others. The essence of problem-based learning is the setting of a problem and allowing the student to direct their own learning through the seeking of solutions to the problem. Under the watchful eye of a teacher, they engage in a search for solutions, learning not only the facts of the situation and the solutions but also the process. For example, they may embark on proposing solutions at first, only to discover that they must instead engage in the search for the issues and then for the solutions.

What changes when we move the design studio into the medium of computer-mediated collaboration? What becomes of the role of instructor and what changes in the participation of the students?

To review this, I shall consider the experiences of a number of VDS held in 1994–1997 between the University of Hong Kong and schools of architecture overseas. The review is limited, therefore, by our experience and by the particular configurations of these studios. These were configured to cause our students to participate with students in remote locations in the exploration of architectural solutions for problems defined to be shared by each remote location. The pattern changes from one year to the next as we look at different issues in the interaction.

For example, in a recent VDS, students in each school were required to work together across time and space to find a common solution. Under this formulation, students in Hong Kong were teamed

with students in Vancouver, for example, to design a building in either Vancouver or Hong Kong.

In another VDS experience, the students worked within their own schools as teams but shared their ideas and discussed the proposals of other teams in other locations. Thus, the students in Hong Kong designed buildings for Shanghai, as did students in Harvard and other schools, each team looking at the others and commenting as the designs progressed.

In a third configuration, we have run design studios in Hong Kong linking the two schools of architecture locally, taking students over by bus to visit each other as well as collaborating using the Internet. Thus, we have tried a wide variety of situations to varying effects.

2.1. What are we doing in studio teaching

As Cuff [3] notes, our current teaching methods have a brief history, being little more than 150 years old. The aggregation of students into large groups based on age cohorts is a model developed in the 19th century to cope with the need for mass education. Studio teaching appeared in architectural education around the same time as a means to teach design since it was recognized that classroom teaching was unable to succeed in teaching design. This brief history therefore suggests that we not have found the best method of teaching and that the possibility exists for other forms to emerge.

The purposes and actions in studio teaching have been examined by many, most usefully by Donald Schön [6]. In analyzing design studio teaching, Schön describes the interactions of Quist, the studio master, and his student Petra and examines the nature of the exchanges between them. In this analysis, Schön highlights for us the distinction between teaching explicit knowledge and inculcating tacit knowledge — the experience of "knowing-in-action." Tacit knowledge constitutes an important part of architectural knowledge and the teaching of design relies heavily upon developing the skills and knowledge comprising this tacit knowledge.

Schön identifies also the process of "reflection-in-action" by which the participants explore the realms of solutions by carrying out the process of design, shaping the outcomes through reflection on the process as it is executed. Schön calls this "a conversation with the situation."

As we teach in the design studio, therefore, we are engaging in the transfer and inculcation of knowledge through several means. We engage the students in conversation about their design intentions and decisions so far. Exploring their ideas, the teacher helps them to unravel their intentions from decisions that thwart the intentions. Using words and drawings, we explore the implications of decisions and demonstrate alternative means of achieving various ends. In these interactions, we are showing the students how we reflect-in-action and we convey some of the tacit knowledge which is essential to architecture.

In addition to the transfer of knowledge and the guidance of the student in the acquisition of knowledge, the studio master is also participating in the socialization of the student into the ways and concerns of the profession. The design studio introduces the student to the social roles that are represented in a typical design process. The student learns that design occurs not in a vacuum but within a broad network of participants, including professionals such as other architects, engineers and consultants, as well as non-design professionals, such as clients, bankers, users, etc. In a design studio, we try to evoke this web of participants to varying degrees, with the studio master often playing one or more of the roles while engaging in a review of the student's work.

Through the choice of topics and avoidance of others, through the approaches to discussion and dismissal of others, the studio master is introducing the student into both the explicit and the tacit conventions of the architectural profession itself. Through these choices and through the activities of studio teaching, the student is introduced to concepts of social roles, or social knowledge and is socialized into the profession of architecture. These social aspects of architecture are discussed further in a recent paper [4].

3. Pedagogical issues

There are several pedagogical issues that arise in changing our medium of instruction from one based on face-to-face meetings to another which allows us to interact at great distances. Of course, we should

not assume these arise only when oceans and time zones separate us; the same issues arise if we teach from just the other side of town.

3.1. Design teaching

A typical cycle of design teaching takes the student through a number of settings. First, the design problem is introduced. Students and teacher gather to discuss the specifics of the problem set (size, site, building type) and the intentions for the studio itself — what is to be investigated in particular (structures, construction, social issues, etc.) We review too the constraints — time, resources, outcomes. At this point, the student has a chance to ask questions and then retires to digest the information conveyed.

After the brief is introduced, further interactions occur in both formal and informal settings. Formally, the schedule will call for design presentations at which the student has to "declare their hand," committing themselves to a position consisting of a formulation of the problem, an approach to solving the problem and a solution itself. These presentations typically consist not only of the final presentation (a final jury) but also interim juries from which the student will be able to receive formal criticism of their project.

Informal settings will consist of desk crits — reviews held at the desk or the student or at another desk to which the students bring their work. The material brought to these desk crits is typically rough, often multiple in intent and unresolved in outcome. Students participate in these desk crits in two ways — by bringing their own material to be reviewed and by observing the review of others, for often these desk crits are held in open areas which permit observers to participate. Indeed, I always encourage such participation, as there is much to learn from observing another's review.

At all of these reviews, the students are free to use a range of materials. Some studio problems may be formulated to require or predispose the student to investigate particular media; for example, a studio may be based on the notion that sculpture can be used as a medium for design investigation. Others may allow the student to use whatever media they wish. Regardless of the media suggested, students will employ a variety of media both as resources and media for exploration. Books, video, photographs, models, sketches and even real life typically contribute to any design evolution.

3.1.1. Teaching in a VDS

Virtual studios occur in a number of formats, with the only common feature being that some of the participants are remotely located from others. Thus, in one permutation, we link up students in one university with those in another, each location having a complete complement of participants (teachers and students) but the problem posed requires the participation of both sites to satisfy the studio objective. In another permutation, the teacher is remote from the students, perhaps because the students are working from home and traveling to the campus infrequently. This permutation finds its ultimate expression in the setting of distance learning where the students are unable to attend classes at the campus without great difficulty in traveling.

In all of these permutations, the basic communications are still required. A program has to be issued, a design problem stated. Students are then to explore and evolve ideas and propose solutions. Reviews are needed along the way, with tutor reviewing student submissions.

3.1.2. Changes the setting

In establishing this new setting, a number of problems present themselves. Issues of place, time and channels need to be addressed.

Is the relationship of teacher to students going to be limited to one-to-many or is the setting going to allow many-to-many communication? How are communications going to be facilitated by the technology? Using e-mail, the communications are private between the participants addressed.

Is the communication going to synchronous or asynchronous? How does this affect the level of communication? What changes when you teach using a network as your means of communicating?

Most obviously, communication channels change. Sitting adjacent to a tutor, listening to their comments as they work, the students observe the acts of knowing-in-action and reflection-in-action which Schön identifies. How can this be achieved when the bandwidth is substantially less than that available when teacher and student are co-located?

The tutor must address these changes by considering both the technology and the procedures of teaching. One immediate reaction is to try to recreate the face-to-face setting by relying on communications technology to establish a maximum facsimile of immediacy, using video and audio systems to convey presence. It is possible, however, to overcome many of the problems of remote presence by developing new conventions of communication such as acknowledging receipt of a communication immediately, periodic announcements of attention (such as an e-mail saying "still here"), etc. These issues arose when the telephone first appeared as a tool for mass communication and we have all learned to say "Hello," an invented term to signify presence.

3.2. The teaching compact

Teaching in a design studio includes not only the explicit actions within the studio but also the implicit agreements (the compact) which bring the teachers and students together. This compact rests on the motivations that drive the students to participate. The teaching compact also exists with the professions, as expressed by the regular accreditation reviews, and, within a professional course of study, with society.

Each participant in the studio has expectations of the others. The students have expectations of the tutor: that the tutor will illuminate the problems, be a fair and attentive sounding board for ideas and to facilitate the process of exploration by solving problems which crop up. Some students expect the teacher to dictate the outcomes, to set the boundaries within which exploration will take place. The tutor expects the students to apply themselves to the task set, to engage the problem in an intellectually effective manner and not to shy away from exploration.

The study of architecture is a demanding curriculum. What motivates a student through the course of a design studio and keeps them going? As the term progresses and the design problem appears to get more difficult or complex, the students experience different motivations to continue pursuing solutions. Some students are highly motivated by a need to complete, to find the shortest path to the end; others find themselves engaged in an intellectual quest which risks diverging from the intent of the studio; yet others are motivated by the activity of others, a peer pressure or peer competitiveness. As every studio teacher knows, some lose all motivation and have to be redirected or their enthusiasm revitalized. Of course, there is always an underlying need to satisfy the examiner which motivates many students; this motivation cannot be ignored as it colors and constrains the thinking of students, encouraging them to try to second guess the examiner.

A studio teacher needs to be aware of such variations in student's motivations as they influence and constrain the range of explorations undertaken. Over concern about examiners hobbles exploration, encouraging safe thinking; peer pressures encourages conformance; personal explorations can lead to remote dead-ends. A teacher is always looking to see which direction the students are heading, bolstering the enthusiasm for exploration but encouraging productive exploration of possibilities.

3.2.1. Teaching compact in a VDS

The essential compact between teacher and student does not change when the teaching is carried out remotely. The teacher assumes an additional obligation, however, as the need for facilitation in the teaching is greater. Not only does the teacher need to guide and encourage the students, they must also help the students master a new medium, a medium which is currently unreliable, difficult and cumbersome. The facilitation role then takes on a much larger importance than in the traditional setting.

There is a corollary obligation that cannot be ignored. The VDS setting imposes a greater responsibility on the student to control their work. Communication between the teacher and the student has to be more structured than the more casual interaction that can occur when face-to-face. For example, seeing discarded alternatives which lie nearby when carrying out a desk crit, the teacher can draw this additional work in to the discussion and illuminate the discussion with the student's own effort. In on-line communication, the student has more consciously to present work for review, thus assuming an significant editorial role in the communication even during the desk crit phase and not only in the formal reviews.

3.2.2. Changes in the compact

When engaging a student in a virtual studio, the tutor has additional obligations imposed by the distal setting. Firstly, the tutor must recognize the problems inherent in the communication medium and set up a working style that overcomes the remoteness from the student. Students often seek immediacy in a reaction, they wish to know if their tentatively offered idea meets with acceptance, or they wish to have a statement reinforced before offering up the next idea. Face-to-face, we encourage progress and we guide by numerous non-verbal interventions in a conversation. On-line, these non-verbal clues need to be replaced by some other convention, such as rapid responses indicating acceptance of a statement or notations on a shared whiteboard drawing indicating that notice has been taken. This is especially difficult in asynchronous exchanges.

Additional assistance has also to be given as the students struggle with the difficulties of the digital medium. At this early stage of the technology, there are few trails to follow and the students are faced not only with grasping architectural issues but also communication.

3.3. The studio master's contribution

The studio master (or tutor) is present in the design studio to provide two essential contributions. In Schön's terms, the tutor is there to demonstrate the knowledge-in-action and to introduce the student to the process of reflection-in-action, as well as to inculcate the values and processes of the profession. Additionally, the tutor contributes a structure to the course, provides impetus to proceed and guides the student away from excessively problematic directions but permitting more manageable problems to arise as it is through them that the student learns.

The format of studio teaching permits a variety of interactions and methods to be employed. Some tutors direct, pronouncing on the degree to which a solution belongs to a set of permissible solutions. Other tutors will engage in Socratic dialogue with the students, opening up opportunities for discussion, bringing the students in to the exploration of a solution, much as illustrated by Quist in Schön's documentation of such sessions. As noted above, the tutor is also introducing the student to the social

aspects of architecture, socializing the student to a professional perspective, identifying the social roles of the participants and establishing a social knowledge in which the student can participate.

The student too has a significant contribution to the design studio beyond the mere generation of output. Although the studio master and the school timetable dictate the overall time frame for a project, the student is in control of the pace of their learning to a far greater extent than in a lecture or classroom format. Time spent at various points along the way and the effort allocated to investigations at each moment are very much decided by the student.

3.3.1. The tutor's contribution to a VDS

As noted above, the tutor in a design studio introduces the student to the realms of tacit knowledge that cannot be accessed through book learning. By working alongside a student, the tutor demonstrates the processes of exploration and solution finding Schön calls knowing-in-action and reflection-in-action. At the same time, the students come to understand the implicit social compacts within the profession. How can this be done when the tutor and the student are communicating through a reduced bandwidth? Even the most generous telecommunications bandwidth is substantially less than that of face-to-face. This exposure to the tacit is easily lost when proximity changes and synchronous communication is replaced with asynchronous.

3.4. Peer learning

Problem-based learning permits a wider range of learning situations to arise. Students draw upon a variety of people to assist in the learning, not only the teacher. Typically, teaching is considered to be a one-to-many relationship between the teacher and the student. Peer learning recasts the setting as a many-to-many situation.

Our experience in Hong Kong tells us that students succeed in learning far more when they work together on a problem. Dividing up the tasks, they are able to cover more ground and examine more issues. Discussing the problem between themselves allows them to examine the issues and test ideas in a more comfortable setting. It is not an uncommon experience to find the students gathering to review

and discuss the comments of the studio teacher once the latter moves on to the next desk or the next room. We must not underestimate the importance of peer collaboration and learning.

3.4.1. Peer learning in the VDS

Peer learning plays a very important role in computer-based activities. Peer learning is an important mechanism in learning computer skills — by sitting next to another, more expert, user, a student can acquire the skills necessary for executing work. This can be seen in traditional design studios to as students acquire the basic skills of drawing, model making, painting, etc.

Working with peers remotely, however, highlights a problem that does not need to be considered in a traditional studio. Vaitkus [8] draws our attention to the fiduciary responsibilities of group members. He notes that effective groups cannot be formed if anonymity is present. Thus, effective fiduciary relationships cannot be established when members do not know one another. Peer learning is difficult when the group has not been established. The development of trust between participants is an important part of developing an effective VDS.

This was highlighted recently for me when debriefing students after a VDS. As usual, the students complained about the difficulty of communicating with someone who is not in the same time zone or same place, that the channels of communication available being inadequate. When probed further, the remarks are sharpened to identify the following problems:

- familiarity — the difficulty of gaining any sense of the other participant and hence to gauge their reactions;
- response and reactions — difficulty getting any or knowing how to interpret;
- need to convert all communications into one digital medium.

One student crystallized the issue when she identified the role of *trust* in the success of her work. Once she and her remote partner had established a level of trust in their communications, the two participants were able to comment with confidence on the other's work. The trust permitted a true collaboration

to develop such that the resulting design was not clearly one person's or the others. In Vaitkus' terms, they were able to work together by reaching the level of "simply submitting and giving oneself over" to the process and their partner. At this point, they achieve the necessary condition that Cuff [3] identified for successful design interaction where "the design process is characterized by warm, almost familiar relations among the actors, as well as conflict and, at times, tension."

3.5. Knowledge resources

In the process of exploring design solutions, students reach outside the immediate confines of a design studio and draw on other resources. In a university setting, the extensive multidisciplinary library is always used. Non-academic materials, such as product catalogs, professional magazines, etc. are often found in a departmental collection such as a reference bureau. Local practices, the construction industry, material suppliers and the alumni also offer resources to be used by students, both during design explorations and also in the review process and juries. While these are important resources during a student's design effort, the student is also learning about their existence and accessing them is an important learning component itself.

3.5.1. Resources in a VDS

The Internet is a tremendous source of information but this is not unique to a VDS. You can take advantage of the same resources in a traditional studio setting. What is different in a VDS is that the student's work is accessible on the network and potentially accessible therefore by remote advisors. Thus, the student is no longer constrained by the proximity of practitioners or consultants but can ask remotely located experts to offer advice. Some schools of architecture are already taking advantage of this by inviting experts to provide desk crits remotely as the design studio progresses. Students are able to search for their own sources of contribution as well, much as they may do by visiting a local supplier of building materials or technology to answer particular technical questions about their design.

Working within a virtual world permits the student to build links to these resources and, in this way, integrate them into their work in a more intimate manner than a physical resource can be integrated. The VDS setting invites the student to reconsider the meaning of external sources of knowledge and their presentation. Thus the VDS raises a new pedagogical issue for the student to consider.

3.6. Reviews and juries

The design teaching process culminates with the design jury at which time the student is expected to present their work for discussion by critics. Typically, the jury is open to all to observe and the student stands before a sea of faces, familiar and unfamiliar. The student is typically given some time to speak to their work, explaining it to the critics present. The critics then have the floor and engage the student in discussion, questioning aspects of the work, then summarizing an opinion. Often the jury continues into a debate among the critics in which different perspectives on architecture, leading students to learn that there are multiple acceptable perspectives.

Design juries have been an integral part of design education from the outset [1]. As Anthony [1] notes, the open juries that we know today are relatively recent phenomena, having evolved from closed juries in the past 50 years. These closed juries were held without students, the critics judging the work purely on the merits displayed on the submitted media itself. Such closed juries are, of course, still the norm in professional competitions.

3.6.1. Virtual reviews

The bandwidth problems encountered with current communications technology and channels challenges those organizing VDS to reconsider the requirements of a design review. Adopting the conventions of traditional jury presentations requires the solution of numerous inadequacies of computer-based video and audio transmissions. Several VDS experiments have attempted to replicate open juries with little success. For example, numerous difficulties are encountered in setting up such reviews [7]. The problems are not only technological but also "social and cultural interactive communication challenges" also militate against such juries at this time.

Other schools (such as the University of Miami) have attempted to avoid the problems of synchronous juries by arranging MOOs and MUDs where participants can review the material on-line and leave comments as they wish. Here the problems of bandwidth are minimized for the communication although participants notice that bandwidth still makes it very difficult to download work sufficiently rapidly to review a large quantity of work.

One aspect of the review process that has not received much attention is the need for the student to package the work in a way that is more sympathetic to on-line review. Most students participating in a VDS attempt to prepare elaborate and complex images that can only be understood when viewed concurrently with other images, for example, a rendering and a plan. In a VDS review, it is typical to have only one image available at a time. Thus, the VDS raises questions about presentation itself which are part of the learning during the studio, making the process itself more important again than in a traditional studio where the conventions are well established.

4. Questions raised

Rather than attempting to provide answers to all the issues raised regarding teaching through the communication medium of a virtual studio, I would like to raise some issues for debate.

4.1. Why teach in a studio

If the VDS is a new medium of teaching, it raises the question of why we continue to have studios for teaching, even if they are not expressed by physical space any more. Do we need to set up formal groups who collectively and concurrently tackle commonly defined design problems? Can we envisage another context for teaching design? Could we return, for example, to the apprenticeships of earlier models of design education, attaching a student to a practitioner who now can be located distant from the student, or perhaps to both a teacher and a practitioner? Could we improve studio teaching by combining VDS with traditional settings?

4.2. Should we change the way we teach design

There has been extensive research examining the benefits which can be accrued from electronic meetings and electronic brainstorming [5] which have concluded that the quality and quantity of ideas is better when structured to take advantage of electronic medium. Should be restructure the way we teach design to take advantage of these benefits? If yes, we will need to consider the software support for communication since it is likely our current systems are inadequate.

4.3. Reviews

How can reviews change? Is it time to reconsider the jury process and structure virtual studios in a different way to traditional ones? Students report learning more from desk crits than from final juries [1]. Desk crits are easier to establish within a VDS than large collective open juries. Perhaps a VDS should focus less on final juries and expand the desk crit relationship to encompass the final presentation.

4.4. The role of technology

Although this paper does not intend to deal with technological details of implementing a VDS, there are pedagogical issues raised by the technology. From the discussion above, I hope it is clear that the success of a VDS does not rely only upon effective technological support. Process is as much a contributing factor to success as is technology. Thus a virtual studio must assist the students in learning about processes which support a successful design exchange over communications networks. The techniques employed must also accommodate the capacities or inadequacies of the technology at hand.

4.5. The design program

Since the process is more important in a VDS, should the design program be changed because of the new medium? Can a program be devised which

emphasizes the processes more? Do students need instructions that guide them in their process as well as a program that specifies the product?

5. Conclusion

The advent of the VDS appears to raise promising opportunities for reconsidering the way we teach design. It changes the relationship between teacher and student and student and the rest of the world. In this way, it opens up numerous opportunities. We have an opportunity to reconsider the teaching methods we employ and adapt them to these opportunities, rather than forcing the new process into our recently adopted conceptions about appropriate ways to teach in a design studio.

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