TEACHING ARCHITECTURE, LEARNING ARCHITECTURE

Technology in Support of Design Learning

THOMAS KVAN
Department of Architecture
University of Hong Kong, Hong Kong
tkvan@hku.hk

Abstract. In the many years of conferences on the teaching of computer skills or application of computers in design studios, we see discussions about the needs, methods and benefits of teaching the use of computer tools. A few of the papers review how students learn but none report how computer tools can be directly beneficial to the student’s learning of design. This paper reviews design learning and illustrates how computer tools have been used to support learning.

1. Web Supplemented Teaching

A group of students at the University of Hong Kong have been using a web bulletin board to support their design studio learning. The reason for choosing this particular software was its ease of use through a normal web browser interface, rapid access over dial up lines, capacity for customization in the interface, ability to include graphic images and URLs directly in messages as well as its ability to attach other files. The web board was used to supplement and support traditional face-to-face desk-based design teaching, not to replace such contact. The reason for using the web board, though, is to introduce an element of asynchronous textual communication to the design studio in the belief that this support will increase the learning of design. This belief is founded on several theoretical bases which will be explained in this paper.

The students were in the second year of a three-year undergraduate BA in Architectural Studies that leads to a two-year Masters as a professionally recognized degree. Thus, the students in the second year are beginning to come to grips with the larger issues of architecture and its multifaceted problems. The design task set for the students was to (1) survey a community area; (2) prepare a design brief for a community center from needs identified in the survey; (3) find a site for the center; and (4) design the structure. The first step was carried out collectively and the remaining individually. The design project ran for nine
weeks overall, with the team-based survey taking two weeks. The year consisted of 70 students, divided into six groups, each led by a design tutor. The task was common to the whole year, although each group was assigned a different part of Hong Kong in which to carry out their investigation. Each design tutor was expected to teach in his or her manner although an overall schedule for the studio was adhered to. There were eleven students in the group using the web board; all other groups communicated through face-to-face or paper means. This arrangement allowed for direct comparison between the group using web-based communication and those working in the traditional modes, acknowledging that the different tutors would be a variable between groups. Most importantly, the context of teaching is not completely disrupted by the technology and is easy enough to integrate into any course.

1.1. USING THE SYSTEM

A bulletin board is accessed by user name and password. Each student was assigned his or her own access, as was the tutor. A configurable cookie supported easy access by recording access codes for those who wished to allow cookies. A user enters the board and is presented with a screen divided into two parts – on the left is a list of topics presented by headings (called conferences) and on the right an area in which messages are displayed (Figure 1). In this instance, a number of class-wide conferences were established – a forum in which general discussions took place, announcements in which the tutor posted information not intended to generate discussion (facts, instructions, etc.), and a help area in which users could post messages related to the operation of the board. In addition, each student was assigned a conference, labeled with his or her name. The group was asked if they wished the individual areas were to be opened for group access and decided that they agreed that each person could read and write to any conference. This was an important decision for the group as it supported the goal of the class – peer learning – but it was also important that the group as a whole decided this rather than having it imposed upon them.

In addition to access of the web board, each student was assigned a server quota on which to store data files that could be linked to messages. This was necessary as image files were expected to be large and we did not want to burden the board with large embedded images.

The class was scheduled to meet twice each week for 3 hours each afternoon session. The tutor was unable, for various reasons, to attend all scheduled meetings. Students accessed the board by network or dial up connections from wherever they were, as did the tutor. The tutor typically accessed the board each morning and spent 30 – 45 minute online each time, participating in the discussion or addressing specific questions posed.
2. Conceptual Foundations

As can be seen in the description above, the implementation of the teaching environment is straightforward and perhaps unremarkable. The reason for implementing this system, however, was the result of experimental work in computer-based interaction and the examination of theoretical grounding for teaching and learning.

Virtual studios have proliferated and a large number of design schools now engage in them. Typically, they bring together students in several institutions, although some are used to support teaching in a single studio. We in Hong Kong have been using virtual studios since 1993 and have collaborated with a wide range of institutions in that time (Cheng, et al. 1994; Virtual Design Studio 1995).

2.1. THE FALLACY OF “BEING THERE”

We have to ask why we engage in virtual studios. The process is not easy, certainly not easier than teaching at a desk locally. Some are driven by an instinctively feeling that virtual studios are important and represent an essential learning for practice of the future (Mitchell 1998). Others perhaps undertake such studios to exploit their ‘sexy’ veneer to attract attention and perhaps resources to a studio program. For others, it is a context of research into the nature of design communication and processes (Bradford, et al. 1994; Vera, et al. 1998). Many, however, search for ways in which we can use virtual studios to improve the educational experience of a student (Kvan 1997; Engeli & Mueller 1999).
Typical of the explanations is the reference to this widely used matrix which is used to provide a taxonomy for categorizing means of work (Table 1). You will see this in almost any discussion about virtual studios. Some authors have contested that it is an invalid taxonomy as it draws a distinction between co-located and remote participation. They argue that this distinction is an artificial distinction, drawn only because our communications technology is so poor that we cannot achieve co-location even though physically removed.

TABLE 1. Common taxonomy of CSCW
(after Schmidt & Rodden 1996)

<table>
<thead>
<tr>
<th></th>
<th>Collocated</th>
<th>Remote</th>
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<tbody>
<tr>
<td>Synchronous</td>
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<td>Asynchronous</td>
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This is of course a red herring. The goal needs not be the unattainable of ‘being there’. Indeed, I will argue that the goal should be exploiting this gap for in the absence of ‘being there’ is a pedagogical opportunity we should recognize.

Focusing on the taxonomic matrix, we find that most virtual studios are engaged in to overcome constraints in the teaching process (Table 2). Using the widely used matrix of time and location, most explanations of virtual studios note that they were undertaken to bring distant students and faculty together using computer tools to overcome limitations of synchronicity or co-location. Traditional studio teaching is then assigned to satisfy co-located synchronous teaching. This is indeed a problem with the taxonomy, since it renders us blind to a variety of other benefits that are not expressed in the four boxes.
TABLE 2. Taxonomy of Virtual Studios

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<tr>
<th></th>
<th>Collocated</th>
<th>Remote</th>
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<tbody>
<tr>
<td>Synchronous</td>
<td>Traditional studio</td>
<td></td>
</tr>
<tr>
<td></td>
<td>teaching</td>
<td>Virtual studio teaching</td>
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<tr>
<td>Asynchronous</td>
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One of the benefits implied in the taxonomy is that of multiplying time and divorcing teaching from place. For some, especially those in practice, it is the opportunity to capitalize on time (when humans recreate and sleep) that holds great promise. Such benefits were obtained in a project by the Hong Kong telephone company that carried out an office redesign using design practices in Taipei and Budapest to complete the design and documentation for over 100 staff in less than 8 days. But just as computer-aided design cannot be consigned only to making us more efficient, so to can we not squander an opportunity such as virtual studios to simply doing more work (and making more money). In the context of learning about design, there are more benefits to be obtained. In the virtual studios we have been conducting at the University of Hong Kong since 1993, we have explored a variety of teaching contexts and the possible benefits which might accrue from virtual studios. We have led students to observe each others work by designing in parallel (Bradford, et al. 1994), contribute to evolving joint designs (Cheng, et al. 1994; Wojtowicz, et al. 1995), required students to exchange and create sequentially (Kolarevic, et al. 2000). Through these experiences we have collected anecdotal evidence from students that the virtual studios help them by exposing them to other ways of working as practiced in schools of architecture overseas and made them aware of the possibility of evolving design ideas (Kolarevic & Ng 1999).

2.2 FROM ACTION TO DELIBERATION

Although this evidence suggests benefits for virtual studios, there was no means of grounding these in the theories of teaching nor for testing the actual manifestation. Thus, an examination of the theories of design teaching was suggested. An initial exploration of this framework was presented in an earlier CAADRIA conference (Kvan 1997) in which the stages of design teaching were examined and potential contributions for virtual collaboration identified. As noted in that paper, design studio teaching is typically framed in the concept of “reflection-in-action” as set out by Schön (1985).
Schön’s formulation of the method as ‘reflection-in-action’ has permeated the teaching of many other professions, including teaching itself. In recent years, we have seen another theoretical framework appear, that of problem based learning (Koschmann, et al. 1994). Those who teach architecture are proud to note that studio teaching predates problem-based learning by many decades, if not a century. Common to both these theories of teaching is that they are process focused, not looking at the ends themselves. This process and experience focus is in part what makes the virtual studio so interesting and also so easy to adopt as a medium in which to teach design.

It is worth examining these theoretical frameworks closely to understand what we do in studio teaching and hence what we can achieve in virtual studio teaching. Schön, in his work on action-based learning, tells us that professional work is that which is characterized by ill-formed problems which need definition (Schön 1983). Ill-formed are a tamer version of the wicked problems of Rittel and Webber (1973). Schön notes that we engage in problem seeking through action – we do not grasp the problem except by engaging in it. This is a far cry from the positivist approach of abstraction and solution. We do not know what we will do until we do it. Schön calls this ‘knowing-in-action’. As we do it, we come to understand what it is we are engaged in.

Likewise, the materials by which you do they work are important. This leads us to developing an understanding of the problem at hand through an interaction with the materials used in the exploration. In this explanation, it is in this context that the act of drawing or model making becomes integral to that of designing. Problems then are solved, according to Schön, by identifying them through action, by then naming the problem and framing it in a context which permits a solution to be discovered.

Teaching in a studio requires the teacher to engage the student in an action-based activity. The teacher guides the student and conveys the tacit knowledge of design through working together with the student. Thus, proposes Schön, the student listens as the teacher tells (Schön 1987). By taking a pencil, the teacher demonstrates how to explore and how to act. The student observes and later imitates. The process is individual, at least as described by Schön. The participation of the teacher is only through the demonstration, not as a collaborator in the doing.

PBL has been well investigated and well documented, far more so than studio teaching. In this exploration, it has been formalised and various models proposed to explain the process. The model set forth by Koschmann et al (1994) (Figure 2) is identifies five steps for learning, from problem formulation through to reflection. Note the term reflection here is not the same meaning as that of Schön. Koschmann et al note that the first three steps of the problem exploration are iterative. The students engage in problem exploration (just what is it that they are meant to be doing), identify what they wish to learn in order to solve the problem,
then check their progress by re-examining the problem and testing if they have learned the necessary facts, skills or concepts to propose a solution. If not, they cycle back and carry on. Once the problem is solved, the students engage in abstraction and reflection. To avoid confusion in the term ‘reflection’ between Schön and Koschman, let us apply the term ‘deliberation’ to the abstraction and reflection of Koschman. This term is used by Eraut (1994) in his review of professional learning theories, including a review of Schon.

![Diagram](image)

*Figure 2. Problem based learning model (after Koschman et.al.)*

What we can observe is that virtual studio teaching has concentrated on providing environments that facilitate learning as proposed by Schön, that is, in the action mode. There is little to support the deliberation necessary for deep learning associated with professional accomplishment (Eraut 1994).

How do we support deliberation in a virtual studio? A typical discussion for the implementation of a virtual studio emphasizes graphics and video capabilities (Shelden, et al. 1995). We know that these graphic and video images are ephemeral, conditions that do not support deliberation. Laboratory experiments examining collaborative work (Vera, et al. 1998) has shown that audio and visual communication can lead to fixation early in the design task, reducing the exploration of the problem space. Further studies have shown that text-based exploration exhibit significantly greater exploration of alternatives, with those in text conditions exploring up to six times as many alternatives as those using graphics (Kvan, et al. 1999). Taking this cue, we decided to implement text support to a traditional face-to-face condition to see if there was any benefit derived.

3. User Experiences

As noted above, a studio tutorial group of 11 students was instructed in the use of the web board for communication. Their peers continued to communicate with their tutors in face-to-face meetings only. In the web board group participation was not controlled or required, hence there was substantial variation. At the
conclusion of the semester, it was noted that some students had posted over 80 messages while others had limited their access to less than 20, although everyone did use it. Some students had used the communications extensively between peers, others more to communicate with the tutor. A research assistant who helped also as a system manager, solving technical problems as they arose, followed progress of the class. This assistant also interviewed all students in the group as well as members of another group who had not used the web board but had been assigned the same design problem, comparing through these interviews the working methods and perceived learning of each student. The final projects for all groups was evaluated by external critics who completed questionnaires regarding the success of the student project. These data were analysed to see if there was any correlation with perceived success of the project and the means of teaching.

An unexpected and pertinent result needs to be reported here. The only statistically significant correlation was found between the critics evaluation of the work and the means of production of the final drawings. Those students who used computer modeling and drafting systems to create their final presentations were consistently rated higher than those students who presented with hand drawn or painted images. This data confirms earlier anecdotal evidence that those who use CAD are more successful in student competitions that those who do not.

Significant for this study, however, was that the observed performance of those students using the web board were not differentiated from the rest of the studio group. This meant that the web board had not handicapped nor helped to distinguish the final drawn designs. Thus, we can conclude that the medium did not change the immediate output.

As we all know, however, evaluating learning is more than looking at the output. We thus interviewed the students on their perceptions and experiences on learning. In the interviews with students at the conclusion of the project, the students who had used the web board noted that they had explored substantially more design alternatives that those who had waited to talk face-to-face. The students using the web board had been exposed in greater depth to the work and thinking of their peers. They reported exploring at least four design alternatives over the six weeks of designing, while those with only face-to-face explored at most two alternatives, although many kept to their first design proposal. Web-board discussion encouraged the group to examine more aspects of the design, from cladding materials to circulation paths, compared to those who did not have access to it. More design alternatives had been explored, different approaches observed, more issues raised and examined. Prior work (Holt & Radcliffe 1991; Oxman 1999) would suggest that supporting these wider participation can only help in design learning. More broadly in terms of learning, the text environment also better encourages peer support of learning. Peer supported learning is essential and central part of successful learning for most
students (Whitelock, et al. 1995). Such broader exposure to approaches and results should also support the development of creativity (Weisberg 1993). Thus, we concluded that the web board text environment did not support better output but did support better learning.

4. Conclusion

Text support of design learning appears to be a neglected but valuable facet of a studio experience. With a web-based bulletin board, we were able to implement a simple-to-use environment in which the students could explore design ideas. Although the web board supported the inclusion of graphics to supplement text where needed, the primary mode of communication was text. Students reported that they explored design issues more extensively than those who worked only face-to-face. The experience carried laboratory results that text supported design collaboration into the real world of teaching and confirmed that it was feasible and beneficial. The technology is so simple that it has been integrated into a number of courses as a result of the reported experiences in this design studio, ranging from language education to seminars in ethics in a psychology course.

Acknowledgments

This work has been supported by research grants from the University of Hong Kong as well as Research Grants Council grant HKU 7163/99H. My colleague Dr Alonso Vera has made invaluable contributions to my thinking on these matters, as have Simon Lai, April Yip Wan Hung and John T H Wong. Likewise, discussions with many CAADRIA members over the years have been of great importance to the wider formulation of the ideas.

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