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The Thousand-Acre Sketch Problem

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Introduction

An unusually large sketch problem in urban design was given to an undergraduate studio class to introduce visualization techniques and to explore fundamental urban design principles. This *thousand-acre sketch problem* was distributed to students on a floppy disk as a three-dimensional computer model. The availability of a large number of Macintosh ITs and access to a pre-release version of the three-dimensional modeling program ModelShopTM allowed us to conduct this prototype *electronic studio.*

This paper looks at the productivity gains experienced by our students during this project and discusses the increased level of understanding witnessed in student performance. More importantly, this sketch problem is examined as a philosophical parable for several pedagogical issues of design education in the microcomputer age.

The Debate on Design Pedagogy

The authors of this paper have an ongoing debate about design pedagogy, which we are arguing directly in the context of the design studio. In this debate, McIntosh is the Devil's advocate. He holds that design education is an oxymoron. We do not instruct students how to design, so much as we contrive exercises by which their more-or-less innate talents will be revealed. The students have a learning experience to be sure, but there is no pedagogy employed here that is worthy of the name.

Pihlak takes on the role of Dan'l Webster, arguing for Jabez Stones soul, as it were (Benét, 1937). He holds that there is a process of design that can be taught, although the instruction is by example rather than by explication. It is an evolutionary process in which students watch design taking place; they mimic, they modify, and they personalize. In this way, students evolve a richer personal design process than could possibly be developed by imitating any one style or person. By the Socratic method of question and criticism, students develop the ability to self-criticize and the ability to iteratively develop design solutions. Design is both a process and a product that is never truly complete. There can certainly be relatively or acceptably complete designs; however, design is a perfectionist's profession, an orientation that maintains there can always be improvement or another alternative.

The Devil knows that there is not time in this life for such accidental discovery. Dan´l Webster pleads that the art of design cannot, or at least should not, be taught as a science in which there is only one correct, optimum solution. Design can certainly benefit from a strong leavening of rational thinking and a demystifying of the process. But there will always be competing theories of design, and technology has simply accelerated the process by which theories of design are born, mature, and decline.

To simplify the positions, the Devil asserts that chimpanzees could be taught to produce *competently* designed artifacts on a computer, in whatever style current taste decrees to be fashionable. At the other extreme, Dan'l Webster maintains that only careful nurturing of sensitive, dedicated people will produce *great* design, which speaks to a timeless aesthetic.

The Dilemma of Design Educators

As design educators, we receive into our charge young, immature students with very little experience of the world. We have five or six years in which both to determine whether or not they have the ability and commitment to become designers and to inculcate a set of cultural values that will stay with them throughout their lives. We spend a great deal of time subtly indoctrinating students, particularly with that set of cultural values peculiar to design. Much of this is carried out formally in history courses and study-abroad programs.

Traditionally, we also spend a great deal of time training students in what are essentially craft skills, mainly drawing. But our drawing style is very abstract: it is a notation shorthand that only other designers really comprehend. Now we have the computer, and a pedagogical alternative. From three-dimensional computer models we can quickly and easily produce geometrically precise perspective views of design proposals. By electronically rendering these perspectives, we can also create very realistic, high-resolution color visual simulations.

When animated, these simulations are accurate in reproducing the experiential effects of moving through the real world (Craik, 1971). This was demonstrated with large physical models by Donald Appleyard and Kenneth Craik at the Berkeley Environmental Simulation Laboratory (1978) in work carried on today by Peter Bosselmann. Computer simulations are becoming at least as good as film taken of a physical model; moreover, the computer technology is cheap, readily available, and very easy to use.

So, as design educators, we are now faced with a dilemma. Do we spend our limited time with students teaching them traditional manual drawing techniques, or do we spend it teaching them computer simulation techniques? To semantically load the question: Do we spent our time teaching students how to vaguely communicate with other designers, or do we teach them how to communicate unambiguously with the general public? Developers realize the persuasive powers of an *artist's conception* to project the best image of their proposals. But the general public now has a healthy distrust of architectural renderings because of the *lies* that have been told with these stylized drawings (Appleyard, 1977).

The computer allows the designer to once again become *"the honest broker of information"* (Bosselman, 1989). Computer-generated visual simulations allow the general public to see proposed developments accurately, to say nothing of allowing designers understanding their own creations. The designer can escape the oversimplification of plan, section, and elevation when an endless number of accurate perspectives can be quickly and inexpensively produced on the microcomputer (Sheppard, 1986).

The Undergraduate Experience at ASU

Within the College of Architecture and Environmental Design at Arizona State University, there are three departments: Architecture, Design, and Planning. Within these three departments are five programs, which deal with designed artifacts of progressively larger physical size: industrial design, interior design, architecture, landscape architecture, and planning / urban design. The national renown of these programs, with respect to each other, is probably ranked in that order also: industrial design is very well respected, and planning is too new to even be accredited yet.

The Devil argues that the academic success of these programs is in direct proportion to the degree to which students can simulate, and thus understand, their design artifacts: industrial design students usually build full-scale models, often working prototypes, of their designs; interior design students construct mockups; architecture students sometimes build large-scale models; landscape architecture students create large-scale drawings; and planning students draw oversimplified diagrams of cities.

The first two undergraduate years at ASU are traditional environmental design: basic sciences, a heavy emphasis on drawing, and elementary design courses-very much a craft approach. The first formal computer course comes in the third year; it concentrates on word processing, data base systems, paint programs, and simple computer-aided drafting.

Once accepted into the upper division, students encounter their first design studio, which in the Planning Department is a site-planning studio. It introduces the mainstream ideas of landscape architecture and physical planning to undergraduates. Their second studio introduces urban design; it is the subject of this paper.

In the past ASU might have been charitably described as a good regional school, whose graduates had excellent drawing skills. We were (and still are) known as a *desert school*, whose students had some sensitivity to energy issues in a hot/arid climate and had some understanding of passive solar design strategies. At present, we are in rapid transition, with a predominantly new faculty, a new dean, a new building, and a lot of new technology. In the future, a lively debate is promised between the Devil and Dan´l Webster; between a design position that is analytic, quantitative, realistically simulated, and computer based and another position that is cerebral, symbolic, largely conceptual, and rhetoric based.

There is also the *Raising Arizona* phenomenon at ASU (from the movie of the same name), from which even the Devil shrinks in terror. Students do a lot of simply growing up during their undergraduate years here.

With occasional exceptions, we get *average* students at ASU. We draw from an eclectic talent pool: these students may have relatively poor professional design skills but at the same time a surprising aptitude for spatial manipulation. Some of our undergraduate students do go on to the Ivy League graduate schools of design, and many find employment in the computer-aided design section of major design firms.

The Urban Design Studio

Planning students first exposure to urban design occurs during their Spring Junior Semester of their four-year undergraduate program. This joint landscape architecture and urban planning studio is organized around three projects: the first develops basic urban design visualization techniques, the second examines theory and the application of urban design principles through guidelines, and the third is a design project within the Phoenix metropolitan area. In this last project-scale design, the students are expected to illustrate their grasp of urban design theory and practice.

Four traditional, basic urban design visualization techniques are taught in this studio and are usually introduced in the following order:

1. The *figure/ground* drawing is used first to introduce students to large-scale analytical techniques. This two-dimensional technique allows quick visualization of urban patterns, density, pedestrian connectivity, and the general scale of development. It is a very easy technique to master.
2. The *illustrative master plan* is another two-dimensional technique that is relatively quick and thus allows the student to simulate a number of alternative designs. It is a diagramming technique.
3. The *axonometric* is the simplest three-dimensional drawing technique. It allows the student to begin to visualize the form of various urban design proposals.
4. The *aerial perspective is* a true visualization of three-dimensional reality. The big disadvantage of this powerful technique is the time it takes to produce this image manually. Usually only one or two accurate aerial perspectives are produced for large urban design projects.

We had a pre-release version of ModelShopTM written by Mark Van Norman, formerly of Harvard and then of ParaComp. We also had a three-dimensional ModelShop model of the Arizona State University campus and a contiguous area of *Old Town Tempe,* which had been built previously by a senior undergraduate landscape architecture student in an independent study course with Pihlak. Thus, we could give each student this thousand-acre site on one floppy disk, which he/she could modify in any way. An urban design project of this scale would be very difficult using manual techniques, but a thousand acres is quite a doable proposition on a computer.

So, on this project we worked backward. Instead of a base map, we gave the students a three-dimensional model from which aerial perspectives (figure 1) could be produced in unlimited numbers, at no cost in terms of time. Axonometrics (figure 2) could also be derived from the computer model by a simple menu selection. The illustrative master plan, which is much simpler with respect to information content, is actually more complicated and clumsy on the computer than with manual techniques. Consequently, the students produced far fewer illustrative plans and far more three-dimensional views the exact opposite of the usual undergraduate studio. The figure/ground technique (figure 3) was also difficult because the plan view of the computer model had to be cut from one program and pasted in another. It was the least well completed portion of the assignment; many students *cheated* by completing their figure/ground diagrams manually.

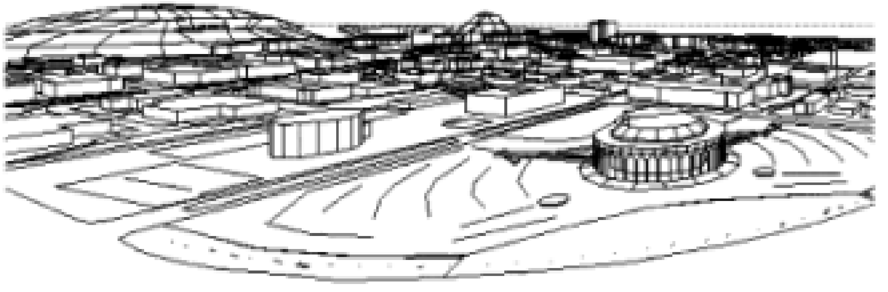

Figure 1 Aerial Perspective

Figure 2 Axonometric

The Case for Using Computers

Productivity gain was the primary reason for introducing microcomputer tools into this urban design course. We did see more deliverable product from the students; moreover, their product was of a higher overall quality than manually produced material.

We also hoped to see evidence of improved understanding on the part of students. They were able to copy and paste large chunks of the thousand-acre sketch problem site, although undergraduates do not have the visual finesse that comes with experience and with travel. The students were able to make conceptual design proposals and then to quickly produce three-dimensional images that exactly illustrated the consequences of their decisions. Many desk critiques occurred around the computer monitor. The students were not always proficient enough to alter their design proposal in the presence of the instructor, but by the next studio period they were usually able to bring an entirely different design proposal forward for critique. The iterative process of design was greatly accelerated. Each of the two-member groups was able to produce alternatives (figure 4).

We hoped that the students would acquire a better grasp of urban design theory, as evidenced by their directly applying theory to design. Whether the students did or did not grasp the theory remains moot. As instructors, we have a very strong bias about what *is good* urban design: it is pedestrian oriented, has street-wall buildings, continuous pedestrian realms, and figural space. But these students are predominantly children of the suburbs, *car kids* for whom these ideas remained very abstract, even after our field trip to San Francisco, the urban Disneyland. Urban design is a difficult proposition to study within the Phoenix metropolitan region: the automobile-oriented fabric of *The Valley of the Sun* does not lend itself to an understanding of good city form. The notion of buildings relating to the pedestrian realm, and to other buildings off-site, is a radical concept, both to our students and to the practicing profession.

Introducing computers into this course was also timely. There is a major university computer site in the architecture building, so we are not being held back by the unavailability of resources. We also had permission from ParaComp to use the pre-release version of ModelShop for instruction. And we have a new building coming online that is programmed around this concept of the *electronic studio*, so it was appropriate to work up another prototype course.

There was a final case-making argument for using computers, which the Devil terms the *Urgency Argument.* The Phoenix metropolitan area is growing out of control: we are at a population of 2.2 million now and predicted to go to 5 million by the year 2012. Many of our graduates will be immediately employed in the creation of this city, a process in which there is little time for abstract

Figure 3 Figure / ground

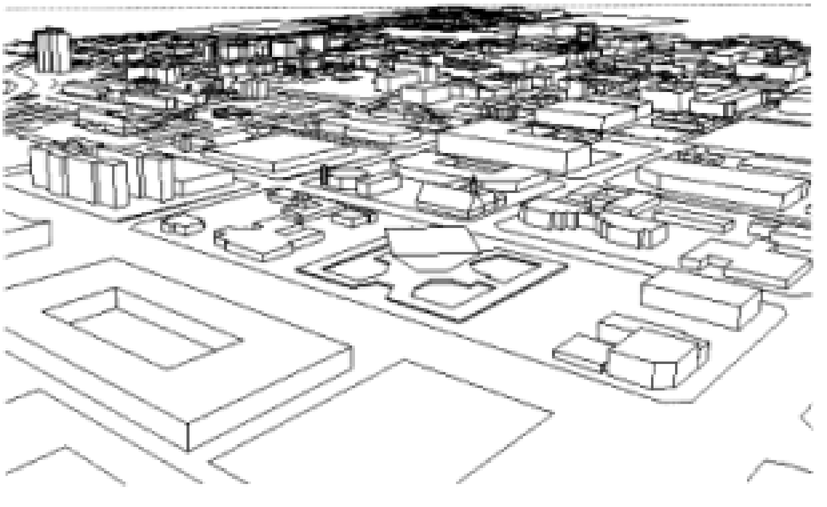

Figure 4 Alternate perspective

intellectual debate, which would be mostly lost on the Philistines anyway. We both think the only design arguments persuasive enough to carry the day with the now very-distrustful public will be built around these experiential visual simulations. Familiarizing our students with state-of-the-art computer technology might create a sort of fifth column within the design establishment. The students might become the advocates for this medium that they take for granted in school.

The Measurable Improvements

We raised the lowest-common-denominator for minimum acceptable quantity and quality of work expected of students. We saw the limits of students abilities stretched, as evidenced by their ability to accurately simulate change. All but one group of students, who essentially did not take part in the project, received an A grade.

While raising the overall level of students' skills, the computer also proved to be a great equalizer, for anyone can produce reasonably presentable graphics with a computer. We saw two patterns that tended to level-out the quality of work. Those students with superior manual skills tended to disbelieve that a computer would improve their work; consequently, they tended to stick with their high-quality but low-volume manual techniques. On the other hand, those students with relatively inferior manual skills wholeheartedly embraced the computer because it allowed them to quickly do what was nearly impossible for them before. There is an inversion of values here, with manual craftsmanship becoming severely devalued and traditional techniques, such as hand *lettering, severely* undermined. The extreme example of this was our star student, who modeled on the computer with great skill, even though he has a learning disability.

The craftsmanship issue is central to the debate about how far the computer should be integrated into the design studio. There is no doubt that a better overall design artifact is produced by using three-dimensional design software. Contrary to the notion that computers erode studio craft values, the computer produces a quantum leap of craft quality. Central to design is threedimensional thinking, mental agility, and visual acuity, all of which are accelerated with the computer. The metaphor of a *model shop* holds: skill and resourcefulness are also necessary to build computer models.

What has taken place is simply a change of medium, from foamcore and exacto knife to color monitor and mouse. As with any shift of media in a profession, there are early adopters and there are traditionalists fighting rearguard actions. Many practicing landscape architects hold dearly to the traditional craft values of the hand-lettered board presentation.

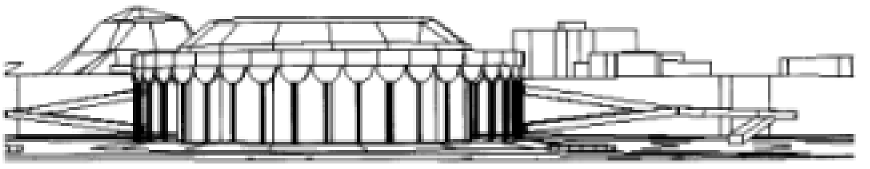

Figure 5 Eye-level perspective

The sheer size of this sketch project, a thousand acres, normally would never be considered at the third-year level, and rarely at the graduate level. We stretched students' abilities simply by dealing with a problem of this scale. Several accurate aerial perspectives were produced by even the weakest student team. All of them were able to easily develop new conceptual designs for the urban area immediately surrounding the campus. They were also able to propose major spatial changes within the rapidly expanding ASU main campus (figure 5).

In design, where the ability to visualize is so closely tied to the ability to understand, the rapid creation of images on the computer allowed students to test their ideas quickly. For example, computer-generated perspectives allowed students to understand open space in the project site and to test their ideas for improved visual quality, both from an aerial view and a ground-level view.

So, using the computer inverts the studio problem for the students. Perfect perspective views of the project are extremely easy to produce, while traditional two-dimensional paraline drafted diagrams are time-consuming. The finesse of a good hand is devalued, or at least transformed. Before the course began, we were worried about asking too much of the students; as it transpired, we set them up for success!

The Expectations of the Profession

Many practicing professionals have discovered how the computer can be used to communicate designs to their clients. Stories such as the following abound in the popular press:

"But on a computer, clients can see a multitude of solutions and contribute to the refinement of the design. The process allows us to investigate many more options... which means sometimes we stumble on creative ideas that we just would not have had time to pursue with pencil and paper" (New York Times, 1989).

In the architecture profession, a good number of the students find their computeraided design experience to be a highly marketable skill. Many design firms hire our students specifically to bring such skills into the firm.

On the other extreme, there are many Luddites in the landscape architecture profession who resist computers while believing that using them is merely button-pushing and not in the least creative. The Phoenix landscape architecture community is conservative; many firms do not use computers, nor are they terribly interested in hiring students who use computers. And they have one very legitimate complaint; there is not yet any software for realistic looking planting design.

With respect to landscape architecture, we find academia leading the profession. The students are instantly marketable with yesterday's craft skills, but their computer visualization skills may make the students uninteresting to the old-guard firms. The trade-off is that their education will have a much longer shelf life. Within the next few years, this issue will disappear as some of the smaller, more innovative firms discover their competitive edge (Mitchell, 1988).

The Closing Arguments

Putting a computer at every undergraduate student's workstation is something we can do, and undoubtedly will do, if for no other reason than it is technically possible and economically feasible. Access to the technology is no longer an issue. The fundamental shift of the professional design culture as computer literacy among design students becomes universal is the interesting matter. Computers are liberating our undergraduate students from the tedium of being *drafting drones,* thus freeing them to develop higher-level skills.

This does raise the issue of manual drawing competence: what it is, and whether it is needed. The increasing sophistication of three-dimensional *design* software, as opposed to relatively simple *drafting* software, allows the personal microcomputer to become a true design tool. The proverbial back-of-the-envelope sketch can now be done in 3D digitally. The Devil will trade this magic pencil for your creative soul. Dan'l Webster still values the traditional techniques and evocatively describes the joy of laying graphite down on the tooth of good paper.

The great advantage of the computer that cannot be matched with manual techniques is its recording ability. One studio can create a data base of digital information, upon which a subsequent studio class can build. This cumulative impact is especially important for large, complex urban design problems, which typically require decades to be implemented. Cumulative knowledge could transform the design studio from an anachronism into the core of the applied research arena. The Devil will give you this knowledge; Dan'l Webster argues the cost.

Dealing with complexity is another advantage of using the computer; many urban scale problems are otherwise intractable. Digital simulation is the only way to deal with them effectively. A five-hundred-acre campus and its urban context, or the downtown core of a major city, are impossible to deal with manually. Along with better working models and graphics, the urban designer can also unambiguously communicate these proposals to the general public. The Devil will allow you to peer into the future; Dan´l Webster waxes poetic on the pastoral life.

In Phoenix, the automobile-oriented boom town, there is little coherence in the relentless suburban landscape. Run-of-the-mill architectural practices produce *object buildings,* sculptures in the landscape that have so little to do with the surrounding context that even the building entrance from the street has been eliminated in favor of a single parking structure entrance. The urgency of this out-of-control growth makes a deal with the Devil attractive, versus Dan'l Webster's high-minded design abstractions.

The Verdict

Our initial anxiety about demanding too much of the students caused a tentativeness about introducing this computer technology. We took a hands-off approach, while hoping that students would be attracted to the technology, which they were. And we hedged our bets by selecting fairly conventional projects, albeit outsized ones. Without being directed to it, some students chose to develop their computer skills, while others reverted to conventional manual media.

Succumbing to the urgency argument, we are adopting a proactive, advocacy position with respect to using computers within this urban design studio. In the coming semester, we will introduce urban gaming software, new three-dimensional software, and true-color computer visualization. The authors have agreed that there is such a great need for spatially literate stewards of the built environment that it is now worth the risk of abandoning some traditional pedagogy.

The debate between the Devil and Dan'l Webster goes on, but the authors have negotiated a compromise: the mortgage on Jabez Stone's soul is extended another year. The jury is still out.

Epilogue

The great benefit of publicly presenting ones ideas is the comment of colleagues, both old and new-found. Three points that are softly made in this paper crystallized after we presented it at CAAD Futures 89. First, the studio course described here is not a special computer-aided design studio; that is, the subject is urban design theory, not data base theory and computer graphics. The curriculum and the agenda were set by Pihlak, the instructor of record; McIntosh acted only in a supporting role, albeit with his own hidden agenda. Second, our students will be employed in creating this vast city in the desert, no matter how well or how poorly we equip them, because the growth of Phoenix is so fast and so relentless. Rising to this opportunity for excellence is our greatest challenge. Finally, there was an ironic twist in Benét's short story that had an initially unrecognized parallel in the authors' debate on design education. The Devil was not really after the soul of the hapless New Hampshire farmer, Jabez Stone-the students in our parable. The Devil was after the soul of Dan´l Webster himself.

Acknowledgments

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