AN INQUIRY INTO COMPUTERS IN DESIGN:

When Cardboard Met Computer…

MURALI PARANANDI
Department of Architecture, Miami University
Oxford,OH 45056 USA
paranam@muohio.edu

Abstract. This paper reflects on the experiences of teaching undergraduate design studios for past 4 years and presents a systematic investigation conducted in a classroom setting to further understand the role of computer in conceptual stages of design. A case study project inquiring the implications of using two different forms of media, namely cardboard and computer, for design development during conceptual stages is presented. Twelve novice designers were challenged to learn and use computers in a five-week design project. A conceptual framework for understanding the discovery and usefulness of computer in their design process was developed and tested. An analysis of the outcome indicated that computers played a positive role in student innovation, improving possibilities for discovery. It further revealed that the employing cardboard was useful in turning the abstract discoveries made by the computers into productive and useful design solutions. It also supported the notion that the novice designer's use of photorealistic possibilities offered by computer visualization (rendering, animation) during conceptual stages of design had an effect of distraction rather than a design aid.

1. Introduction

Designers such as Gehry, Eisenman and Greg Lynn demonstrated innovative use of computers in their architecture. Many of our colleagues presented innovative student designs done on computers in recent ACADIA, ECAADE, and SIGRADI conferences. With the advent of increased power and reduced cost, computers have become standard tools in the designers' arsenal in recent years in both academia and the profession. However, most of the software programs available for designers (such as PhotoShop, AutoCAD, form·Z, 3D Studio, Maya etc.) are based on computer graphics principles and algorithms that are

devised for either documenting well-conceived ideas precisely or for special effects and animation [Dorsey & McMilan, 1998]. The internal representation and operational behaviour of available computer programs are not really geared for architectural problem solving [Yessios, 1986], but for assembling objects into scenes for creating imagery and animation effectively and efficiently. This encourages looking at the problems in parts than holistically [Turk, 2001]. Using such tools during conceptual stages of design in the place of conventional tools such as pencil and cardboard presents new challenges and problems in learning and teaching. This paper examines the computer as a design tool in an undergraduate studio-teaching context and the consequences presented by this condition to the student learning through a case study.

1.1 ROLE OF MEDIA IN CONCEPTUAL DESIGN

Goel [1995] demonstrated that cognitive processes associated with the preliminary design phase benefit from ill-structured, non-computational symbol systems such as pencil sketches. Dorsey & McMilan [1998] observe from a system designer's perspective that computer interfaces do not provide the fluidity and flexibility necessary for recording and exploring ideas during conceptual stages of design. Current computer graphics systems lack the ubiquity, accommodation for ambiguity and the elegance of pencil sketches on yellow trace to record the design process and compare multiple solutions simultaneously. Also they do not compare with the simplicity, tactility and flexibility offered by cardboard to work fluidly. For successful use of computers for design Clayton views both digital and tactile designs as necessary components of contemporary design teaching [Cuff, 2001: p202]. Further, the ability to change modes rapidly between traditional and digital domains is seen as a key by Dorsey & McMilan [1998].

It is widely accepted that novice designer's ability to use representational media for design is not innate; but is nurtured carefully through instruction along with practice, discussion, and contextualization [Lockhard, 2000; Welch et al, 2000]. However, in practice, most curricula do not integrate digital media well into the foundation level where students learn to apply representation for design. Instead, they are often taught as upper level elective courses with emphasis on specific software programs. There is little or no instruction of procedures or concepts about how to negotiate the interface between digital and traditional media [Bermudez & King, 1998]. This leaves a gap in students' ability to apply digital media for design. Consequently novice designers find it extremely difficult to adapt their design methods to computers and at the same time produce 'good' designs [Hanna & Barber, 2001]. Generally they resort to conventional media to deal with ideas in abstract to solve artistic and creative challenges, and only then seek computers to tighten up and present their designs after they evolve into a concrete stage. The project presented in this paper

examines this issue up close. It aims to provide the students with an experience in applying digital representation at conceptual stages so that they can see "what computers might do to and for them" [Simon, 1987].

2. Case Study

To provide a context, for the past 4 years, the author has been teaching a studio focused on using computers for design as an elective. The class typically consists of a total of twelve students (a mixture of Juniors, Seniors, and Graduate students) with a range of expertise with computer graphics media. All the undergraduate students in our program get a 7-week introductory exposure to digital media in their freshmen graphics media class. Some of them further their skills on their own through work experience and self-teaching. The majority of students lack experience in designing with computers, especially using 3D modeling. Self-assessment of each student's computer skill levels and attitudes towards their expectation of computers for design recorded on the first and the last days of the class that have helped continuously develop the course. The course consists of two successive projects. The first, normally four to five weeks in duration, focuses on "what we can do with computers and what computers might do to us" portion; the second, lasting for the rest of the semester (about 10 weeks) addresses "what we should do with computers and what computers might do for us". The project described in this paper provides an example of the effectiveness of the first project.

2.1 THE PROJECT

The design challenge was to design and build a small inspirational object to be placed on their desks (for the duration of the semester) based on a character that they liked as a child. This object was to be built from a single 18"X24" piece of cardboard, and it must be portable, monolithic, no larger than 6"X6"X6" and be able to sustain a fall of 4'. The expectation was that this project would lead to the subsequent major project: the design of a childcare center.

The Process

Stage 1: Design Manifesto; One half week;

Stage 2: Cardboard Interpretation; 1 week;

Stage 3: Computer Interpretation; 1 week;

At this stage, students were asked to interpret their design manifesto in digital realm using computer. Learning objective, to put it in Greg Lynn's [Cramer & Guiney, 2000] terms, was to take an inventory of what the machine wanted to do.

Stage 4: Cardboard Reinterpretation; 1 week;

The students were then asked to build a cardboard model of the solution

they had generated in computer, to distinguish what the computer wanted to do that cardboard could not.

Stage 5: Design documentation, presentation, & discussion; 1 week; See plate 3.

Analysis of the Outcome:

The student projects are summarized in plates 1 and 2. Each row (numbered 1-12), represents an individual students work and consists of four columns (labeled A-D). Column A shows the character student drew inspiration from, the subsequent columns B, C, D show an image from stage 2 (cardboard exploration), Stage 3 (computer interpretation), and Stage 4 (cardboard interpretation of digital solution) respectively. Column E records the influencing factors as noted by the student reflections using a conceptual framework provided to them by the instructor.

Summary:

Out of a total of twelve projects:

Three (1-3) had a high, five (4-8) had moderate, and four (9-12) had low level of discovery.

Eight accepted the transformations caused by digital as useful and desirable (1-8: corresponding to high and moderate levels of discovery) and four did not (9-12: corresponding to low level of discovery).

2.2 DISCUSSION

For brevity and to respect the page limits for the conference proceedings presentation of an analysis of individual projects is omitted. The conference presentation will include discussion on how computer differed from cardboard in materiality, generative and manipulation capabilities that affected student designs along with images. There were significant consequences to student learning because of the computer use. An important consequence is that the digital medium seduced the designer into exploring what it does best. The lure of facility for generating photorealistic imagery with relative ease had an effect of distraction rather than a design aid on some designers. Almost all students could not resist tinkering with rendering, even though the project did not ask for it and in fact required the project to be ultimately built with cardboard. Students explorative journey took a conspicuous detour from the moves normally permitted by cardboard, to novel image manipulating features of the computer medium. These explorations revolved around such attributes as transparency (for example: turning the cardboard translucent), reflectivity (making the cardboard shiny), surface patterns (applying decals of such material patterns as sand, wood, metal to change the looks of cardboard etc.). Although this resulted in the creation of spectacular looking imagery, most of these effects were erased

when the solutions were fabricated in cardboard eventually. This is consistent with Balfour's [2001: p268] cautions that computers can fool us into believing that we are empowered when, in fact, we are seduced.

Limitations of the study

This study, although systematic, is not scientific and has a several limitations. The inexperienced student sample used represents one limitation to the generalisability of our results to practicing designers. Skill of the designer (dexterity with visualization medium), nature of the project, time allowed for design, and the direction provided in the critiques could significantly affect the outcome in a design context. We did not adequately address these issues in this analyzing this project outcome.

3. Concluding Remarks

From an educational point of view, do computers improve or inhibit architectural design process? What are the consequences to student's learning and studio culture? The general consensus among the students is not that one was better than the other, but using them in concert enriched the design process. Employing cardboard to concoct the abstract discoveries helped students to make their design more useful and meaningful by bringing the physical issues to the forefront. This is consistent with Parson's [1994: p175] observations virtual environments have the potential to contribute as much to the design process as traditional design processes if used in conjunction with them. This leadoff project had a positive effect on the subsequent major project by improving the student restraint of irrational possibilities offered by the digital imagery during design development. In summary, this paper concludes that incorporating computers in architecture studio curricula calls for changes in course content and teaching practices to develop sensibilities in students about technologies (when/how to use and when/how not to use), and the learning environments to accommodate the interactions of the new media in a way to enrich but not to displace the traditional. Teacher's familiarity with the scope and limitations of software, hardware available at hand seem very important in effectively guiding the students through the process. When computer falls short, we need to know to use our knowledge of design and teaching to guide computer use.

Acknowledgements

I sincerely thank my colleagues Prof. Ann Cline and Prof. Tom Dutton for reading a preliminary draft of this paper and providing valuable comments. I also thank my students

whose work is presented in this paper for their dedication and enthusiasm. Last but not the least, I thank Ms. Tina Sarawgi for being a wonderful graduate assistant for this class.

References

Balfour, A (2001). "Architecture and Electronic Media", Journal of Architectural Education, Vol 54, No 4, May 2000, ACSA Inc, Washington DC, Pp 268-271.

Bermudez J, King K (1998). "Media Interaction and Design Process: Establishing a Knowledge Base", Eds Seebohm T, Van Wyk S, Digital Design Studios: Do Computers Make a Difference? (Association for Computer-Aided Design in Architecture Conference Proceedings) Pp. 6-25.

Cramer N and Guiney A (2000). "The computer school: in only six years, Columbia University's grand experiment in digital design has launched a movement", Architecture Sept 2000, Vol 89, No 9. Pp.94-107

Cuff D (2001). "Digital Pedagogy: An Essay". Architectural Record. September 2001. Pp 200-6.

Dorsey J, and McMillan L (1998). "Computer Graphics and Architecture: State of the Art and Outlook for the Future," Computer Graphics, Vol 32, No 1, Feb 1998. Pp. 45-48.

Goel V (1995). Sketches of Thought. MIT Press.

Hanna R and Barber T (2001). "An Inquiry into Computers in Design: Attitudes Before–Attitudes After", Design Studies, Vol 22, No, Elsevier Science Ltd, Great Britain. Pp 255–281.

Lockard, W, (2000). "Where We Have Been. The Recent History of Design Communication". Design Communicators Association 2000 conference Keynote speech. http://scholar.lib.vt.edu/ejournals/JDC/Spring-2000/kirby/kirby.html accessed 01/15/2002.

Parsons P (1994). "Craft and Geometry in Architecture: An Experimental Design Studio Using the Computer", Eds. Anton Harfmann and Mike Fraser, Reconnecting (Proceedings of Association for Computer Aided Design in Architecture Conference) Pp 171-6.

Simon H, (1987). "The Steam Engine and the Computer: What makes Technology Revolutionary?", EDUCOM Bulletin 22, no. 1, Spring 1987. Pp 2–5.

Turk, Z (2001). "The Reasons for the Reality Gap in CAAD", Ed Penttila H, Architectural Information Management (Proceedings of 19th Conference on Education in Computer Aided Architectural Design in Europe), Helsinki, Finland. Pp 156-60.

Welch M, Barlex D, & Lim H (2000). "Sketching: Friend or Foe to the Novice Designer?". International Journal of Technology and Design Education.

Yessios C (1986). "What has yet to be CAD". ACADIA Workshop '86 Proceedings. Houston. Pp. 29-36

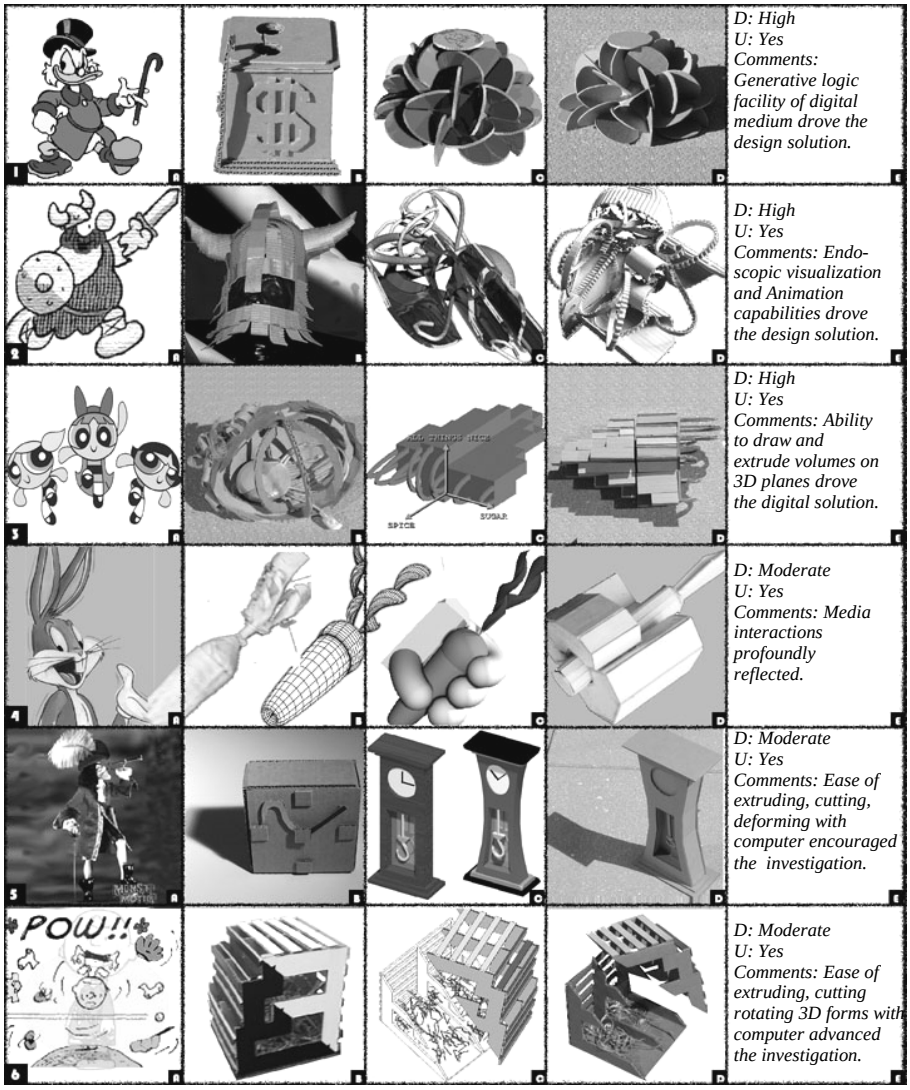

Plate 1
Analysis of student work from ARC 301, Fall 2000 at Miami University

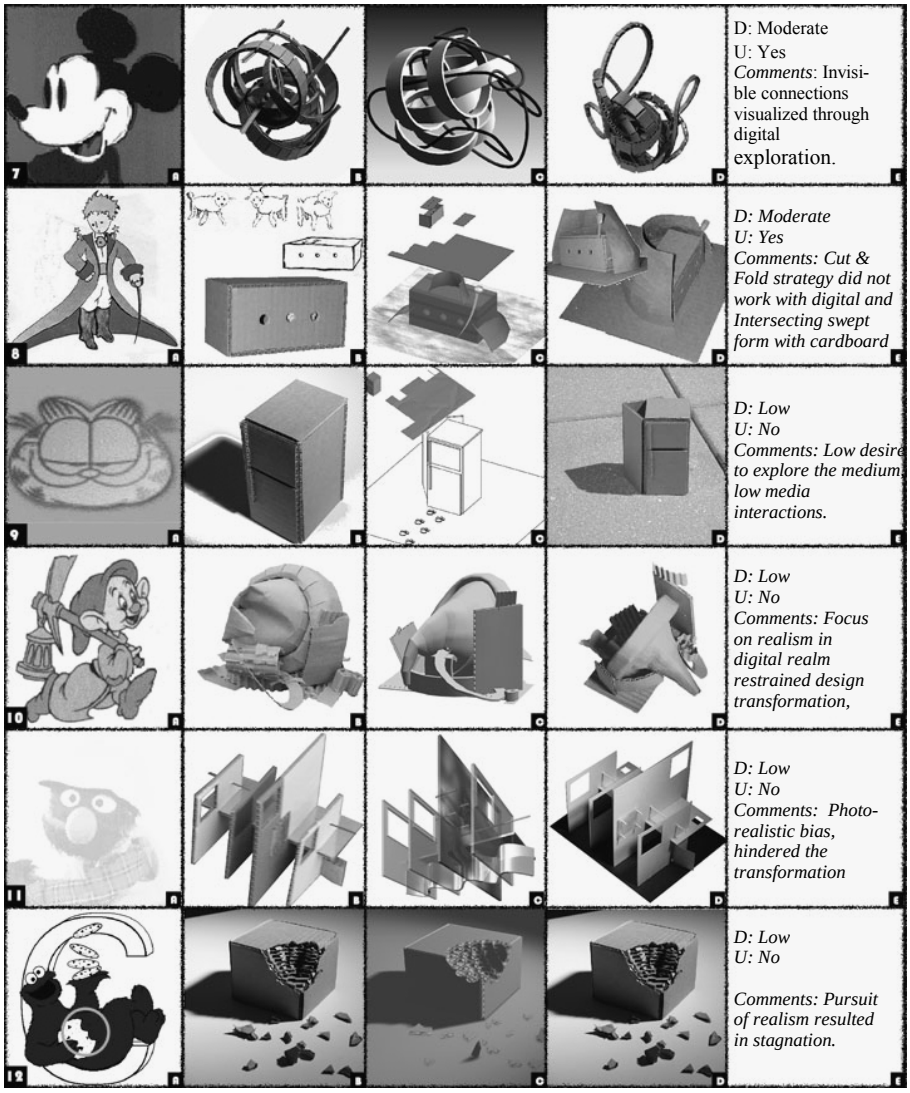

Plate 2
Analysis of student work from ARC 301, Fall 2000 at Miami University(continued)

Plate 3. Example of 24”X36” student poster (Matt Nudelman, Fall 2000) comparing cardboard and computer generated design solutions along with critical self-reflections on the effect of process on the outcome.