Using Computers to Aid Creativity in the early stages of Design - or not!

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Using Computers to Aid Creativity in the early stages of Design – or not![i]

Rehabilitating the 2D/3D physical representation in Computer-Aided-Ideation.

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Abstract. The introduction of Rapid Prototyping technology such as 3D printers and diverse Numerically Controlled machines such as laser cutters and milling machines, has made it obvious for many educational institutions, that a paradigm shift is occurring these years, that will forever change the design- and architectural practice, - for better or worse. This paper discusses the current change of role and status of the representation as a means to communicate design in the digital era. It outlines two opposite directions for the development of software technology, and brings forward previous and current research, on the didactic aspects of introducing digital software into the curriculum of architecture and design education. The paper describes a workshop held at the Danish Design School, where students proficient in using digital media, were challenged to use analogue models instead, to rediscover and utilize some of the creative potentials offered by this medium. Two other workshops discussing similar themes with different foci and different participants have been held since. One hosted by the Glass & Ceramic School on Bornholm, where the students are trained as traditional Craftsmen and another hosted by Nordes2009 at AHO in Oslo, where the participants came with a background in the research community. My own research interest lies in establishing or refueling a discussion on the importance of the ambiguity in a physical representation, as opposed to the finite interpretations offered by the digital modeling environment, that the profession is accustomed to work within. This interest has recently been confirmed and renewed by reading "The (soft) Architecture Machine(s)" from 1970+75 and by studying the works of Professor Julio Bermudez and Professor Bennett Neiman.

Keywords. Ideation; Representation; Ambiguity; Heuristics; Design education.

Introduction and motivation.

Many of the young design students these years question the real need to learn to draw traditional, technical, orthographic paper drawings, and they see no need for spending valuable time in model shops creating elaborate cardboard models. As part of my current research into the subject "Computer-Aided-Creativity", I've been interested in discussing this topic with a group of students in the first half of their design education.

Private discussions, with recently graduated students, have confirmed that this topic is more relevant than ever, though the discussion is practically non-existing at the school where I'm employed as a teacher. It seems to be the case that the students of 2010 shall pass the same curriculum as the students of 1990, and on top of that, learn all the digital aspects of contemporary design practice as well as academic disciplines/theory.

In my research I have discovered that some of the most interesting design results often arise from a unique "blend" of analogue as well as digital tools and methods, which can only be achieved by combining the two instead of teaching and learning them in separate domains, as we still often tend to do. Seen from the student's point of view, many are struggling to get their priorities right, and they risk to loose fundamental knowledge, because it's too hard to find or rather: It's too hard to find the time to find.

By describing the two workshops first, I hope to make it easier to follow my thoughts, which could better be described as afterthoughts or reflections in the sense of Schön (1983).

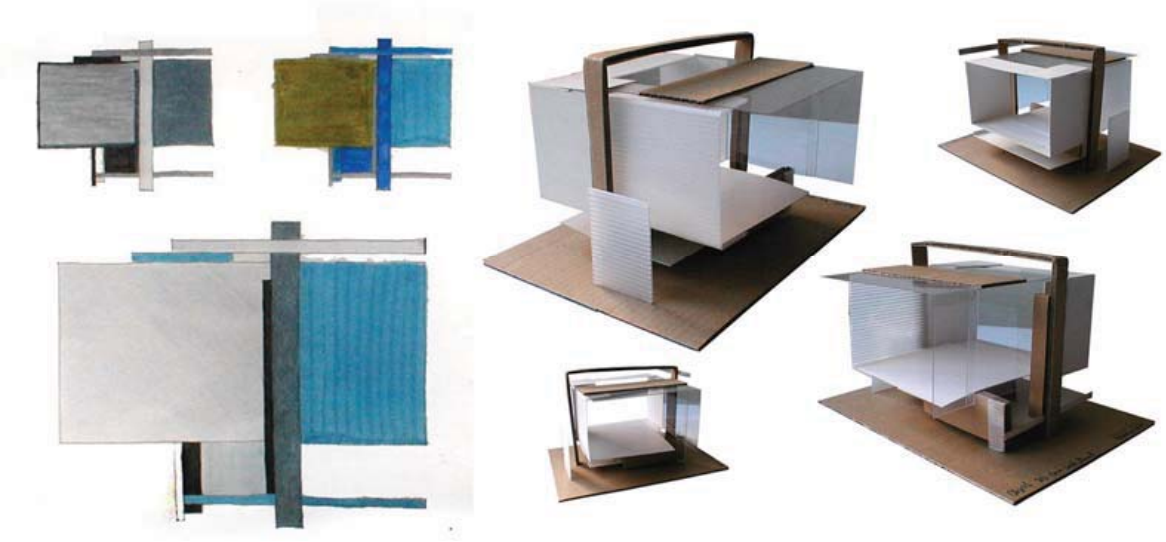

Figure 1
Student work from the workshop "Re:Presentation" hosted by the author at the Dansih School of Design.

Re:Presentation (From 2D line drawing to cardboard model to digital 3D model).

This discussion took place during a workshop where three different assignments were given to students who usually work with computers as in integrated part of their design process. The workshop was organized in a way very different from the traditional design studio or computer classes/environments. Not having visited many different schools of architecture and design, I might be prejudiced in my assumption, but often I see traditional drafting tables filled with sketches (and teachers) on one or several floor(s) and traditional computer labs (20-40 PC's) totally void of table space (and also often teachers) on a separate floor, or sometimes even in a separate building. By organizing the workshop to take place every Tuesday, four weeks in a row, in a dispatch style, all of the students could keep working with their individual projects and assignments "on the side". This approach was inspired and informed by a project[ii] organized by Dr. Leandro Madrazo Agudin from Universitat Ramon Llull-Barcelona.

The title of the workshop was "Re:Presentation" and the 24 students were asked to work individually and without access to their usual computer labs or laptops. Instead they were given only scrap paper and cardboard leftovers to communicate their design proposals. At each "crit" the design students were told to present their own design intent but select another student's work for their next assignment. This has, in my opinion, boosted their creativity, allowed them quickly to "kill their darlings" and opened their mind to see hidden potential in their fellow students' work.

The students were all given the same 2D paper drawing with (importantly) no annotations, orientation or scale. The drawing depicts "something" from either the top, front or side view, but it is ambiguous in the sense that at least two 2D drawings are needed to fully describe any 3D model. The students were reminded that this is also the case on existing computer displays, and they were asked to *imagine* a depth in the 2D drawing and use only colours to emphasize this perspective depth.

The second exercise was then to build a physical model of *another* student's interpretation and *finally* to create a digital 3D model of one of the physical models.

For this assignment the students were free to choose from any of the 3D modeling software available to them: Cinema 4D, Rhinoceros, 3dsmax, AutoCAD or SketchUp. Almost all of the students selected either SketchUp or 3dsmax for this last assignment.

The students in this first workshop had applied for either *furniture* or *spatial-design* as their future discipline. The workshop compelled the students to recall topics previously introduced in their first semester such as design history (De Stijl), colour theory (rhythm'n'hues), proportional studies, freehand- and 2D orthographic-drawing.

In another workshop hosted by the Glass & Ceramic School on Bornholm, the results from the above-mentioned workshop was given as a starting point, and the students were introduced to SketchUp as a 3D polygonal modeling tool, enabling them to print drawings to 1:1 scale and take these drawings to the plaster workshops at the school and realize their digital 3D models without the need for Rapid Prototyping such as 3D-printers. The plaster workshop was conducted by Tavs Jørgensen, who is a trained ceramic designer, a teacher at the Ceramic & Glass Department of the Royal College of Art, London, and a Research Fellow of the Autonomatic Research Cluster at University College Falmouth, England. (see his work at: http://www.oktavius.co.uk/).

Figure 2
Student work from the workshop hosted by Tavs Jørgensen at the Glass & Ceramic School on Bornholm.

The thematic framework of this second workshop (and partly the first) was the studies called "Laboratory Exercises exploring Space and Volume" (Elliott 1986) and the early 1920's work conducted by students, avant-garde artists, and architects at the Higher State Art-Technical Studios (Vkhutemas/Vkhutein) in Moscow. Renowned faculty members at the time were: Vassily Kandinsky, El Lissitsky, Kasimir Malevich, Alexander Rodchenko and Vladimir Tatlin (www.euroeducation.net/euro/ru541.htm).

The recession between WWI and WWII and the scarcity of materials and public finances made it possible for those architects and artists to imagine Utopias and dream spectacular dreams of the future to come. Today architects and designers are accused of being self-indulgent or superficial, when they try to do the same with the current tools at hand! At least you are running the risk of being regarded more as a researcher

"studying" practice, by exploring the impact that new technology or new materials has on professional practice. Maybe this is why only few architectural office in Denmark (e.g. www.3xN.dk) currently has a R&D department (GxN) dedicated to investigating new materials in connection with "sustainability issues" in future building programs?

Didactic aspects and considerations.

Some of the didactic aspects of learning and using the emerging digital tools are pioneered by educational institutions such as Graz University of Technology in Austria, who use the NURBS based modeler Rhinoceros (http://www.opennurbs.org). Stavric, et al. (2007):

"Architects are constantly searching for new tools – digital inspiration – in other disciplines and manufacturing processes.... in order to define an aesthetic which can reflect the new phenomena in architectural computing. Due to the rapidly growing digital possibilities students need to know and learn the new topics and tools, which are relevant in modern architectural design practice. Our students should be empowered rather than overwhelmed by the arsenal of digital tools available today".

Their paper suggests a change in direction from the focus of the late 90^{s} on the mere technical aspects of using IT in the last part of the design process, towards the technique by which today you can extract information from conceptual models in 3D at a very early stage of the design process as part of the design ideation. This change in direction will greatly impact the education as well as the whole business of Architecture & Design and demand for *new* types of software to be further developed. For example, Kristian Agger, Michael Lassen, Martin Møller and others have recently developed the open source software "B-processor" in a joint venture between the "Alexandra Institute", the "Institute of Technology" and the "School of Architecture in Aarhus", Denmark. Their preliminary work was presented at the eCAADe in 2007.

Emerging software and its impact on the design process and "creative thinking".

Prior to the eCAADe conferences in the recent years the participants have had the opportunity to sign up for some interesting, intense and quite intrinsic pre-conference workshops hosted by McNeel and Bentley and dealing with some of the new software, (Grasshopper and Generative Components GC) which expands or improves the CAD-packages from the two companies *or* uses either a scripting (Monkey/Rhino-Script) or a "spreadsheet" approach for doing the same in a stand-alone application (ParaCloud).

Many of these new parametric approaches to Computer Aided Architectural Design can better be compared with constructing a "machine" rather than erecting a building as in traditional Building Information Modeling: Project >Design >Realization >User.

In his two seminal works: "The Architecture Machine" (1970) and "The Soft Architecture Machines" Nicholas Negroponte argued (40 years ago!) that a designer's *"creative thinking"* can be affected by the *"machine",* and suggested that the designer should consciously distinguish between "heuristic of form" and "heuristic of method".

According to Negroponte, this would enable a more symbiotic relationship between the individuals and their tools. The future will prove whether this (or the opposite) is actually true. As Kvan & Mark (2003) pointed out, it is still a frequently expressed opinion of academics and architects, that computers are "just another tool" filling an ancillary role in the design process. Benton (2007) argued that recent studies have shown that many users, particularly of the "Building Information Model" tools, strongly disagree:

"Our design concepts and ideas need to become less ambiguous, so as to translate them into the tools, and we need to communicate the ideas earlier to other collaborators. This ultimately pressures the time a designer has for discovery and exploration of design ideas". This directly contrasts with Negroponte's (1969) suggestion: *"Heuristics in method presents an opportunity to coalesce multiple agendas of individuals and tools....without removing ambiguity, which is so desired in creativity".*

The advent of new software such as "SketchUp" developed by @LastSoftware, and "Silo" developed by NeverCenter, has now offered an alternative to traditional CAD or BIM solutions, and since their recent introduction enabled the designer or design student to sketch directly in 3D on the computer, without the need for any reference drawings or any previous considerations whatsoever of dimension, proportions or scale of the designed object. In these types of software every aspect of the design can be changed at any given time by changing the object's parameters numerically or by direct manipulation of abstract translate gizmo's, handlebars, rollcages or arrowheads.

For many years this has been possible in programs like 3dsmax, Maya, XSI or Cinema 4D, but many architects regard these types of 3D software, coming from the million dollar film industry, as either *"too technical"* or something they as architects can't spend time to master or even learn to use at a more primitive level.

This is in marked contrast to researchers/practitioners such as Ali Rahim + Hina Jamelle (Contemporary Architecture Practice), Hani Rashid + Lise Anne Couture (Asymptote) or Zaha Hadid Architects, who all use technology exploratively and extensively throughout the design process, and not just as a means of communication/presentation.

The direction they have chosen to pursue offers the architect/designer possibilities to animate or rather simulate flows of particles, fluids, and air. The above-mentioned software solutions, and e.g. "RealFlow" developed by NextLimit Technology all include in their standard educational packages entirely new tool sets to "construct" complex geometries using "springs" and "effectors" and actively experiment with natural forces like gravity and wind, or physical properties like tension or friction.

By tweaking these parameters the architect or designer is able to radically change a 3D volume or 2D shape, without actually "touching" or manipulating surfaces or curves themselves but rather changing strictly numeric input and evaluating the result.

By mastering one or several of these software "boxes", many (young) architects and designers can create both visually appealing, intriguing, and highly detailed surface geometries and very professionally looking visual presentations with limited or no real effort on the part of the student.

This apparent "simplicity" can however also present a real problem, since it can be hard, as a student *or* as a professional, to judge or document exactly which of the endlessly possible experiments actually lead to the selected design. It can be even harder later to reproduce/recreate a similar effect in another project, or at a later time.

While this approach might work for some designers, it's infertile to others, or to quote the late Arthur C. Clarke: "For every expert, there is an equal and opposite expert".

In the workshop the benefits of selecting a simple yet versatile program like SketchUp as a tool, allowed for everybody to actually master the software in a relative short amount of time. Even the not so technically savvy of the students could experience their first real “success” in 3D and get a sensation of being “in control” of what happened on the screen, in contrast to most of the current “de-facto” CAD software used in studios and offices. When you are introduced to AutoCAD or MicroStation the user more often get a feeling of being an “operator” of the software *itself* rather than the architect and /or designer you usually regard yourself to be, or to become.

In the workshops I have conducted, 3D software was applied mainly as a vehicle for the integration of theory and practice, enabling a synthesis of the tacit (the art) and the explicit (the craft) and making the current status and role of the *representation* central.

Conclusion

Returning to the title of this paper, my findings show that specialized computer software such as SketchUp indeed *can* be used to capture volatile ideas and generate 3D sketches and 2D presentations quickly, without the need of the multitude of secondary applications from Adobe’s “Creative Suite”. During the workshop many students regained an enthusiasm for the physical models and sketches. This suggests that when used appropriately, they still have something to offer, and that the digital and physical models complement each other, if you work within a limited time frame.

The ambiguity of the physical models make them well suited for early discussions, whereas the digital models often close down the creative process if used from day one.

I will argue that some of the results from the first “un-plugged” workshop would not have seen the light of day, if my students were not constrained to work completely without the aid of 3D computer software. The ambiguity of the physical 2D drawing was explored by some students more than others; e.g. the students who imagined the line drawing to be a submerged building volume or interpreted the multitude of crossing rectangular 2D shapes as orthogonal projections of interlocking 3D cylinders. Even the simplest 3D tool imaginable such as SketchUp almost forces itself upon the user, who quickly tends to create very “box'y” looking design. Having hundreds of different tools however doesn’t enrich the design process as much as consciously selecting between different paradigms, tools (digital and analogue) and the continued use of different model materials, exploring and discussing their possibilities and limitations with peers and benefitting from their input.

Cardboard, plywood, chicken-wire or any other physical model material does a similar thing as 3D computer software but due to their material properties and not their tool sets: Does it break or bend easily? Can it be rolled up, and unrolled? Can it be cut with a knife? Can it be laminated, soldered, welded or blown up with air? The lack of material properties and constraints in the virtual domain is not necessarily a good thing. As a contemporary designer of furniture (or bridges for that sake) you often work 100% digitally and therefore you end up missing the malleability and ductility of “real-life” and real-scale materials, - especially in the early phases of trial-and-error(s).

PostScript

Cecil Balmond once told at a lecture, that he never compromised in his design on anything, - but that he always welcomed constraints. Personally I couldn’t agree more.

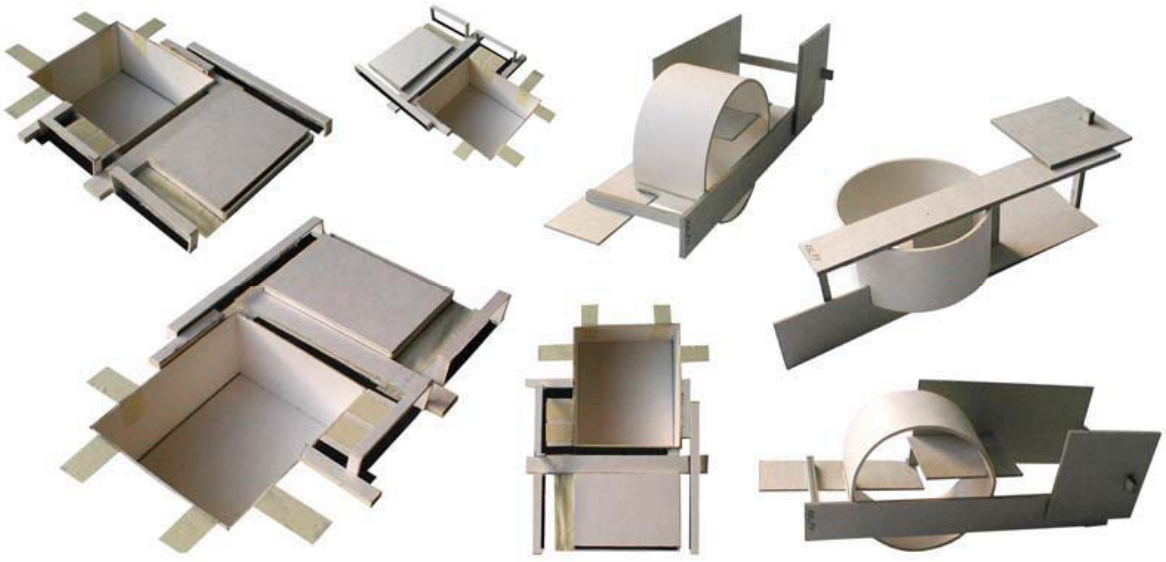

Figure 3
Student work from the workshop "Re:Presentation" hosted by the author at the Dansih School of Design.

Acknowledgements

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[i] The paper has previously (2009) been published in a shorter form and without the illustrations under the title: ”Computer-Aided-Ideation. Rehabilitating the physical representation” in proceedings from the colloquium “Communicating (by) Design” at Sint-Lucas Hogeschool voor Wetenschap & Kunst, School of Architecture in Brussels. ISBN: 9789081323802. Available online as a PDF: www.re-ad.dk

[ii] http://www.salle.url.edu/sdr/info/ ©ARC, Enginyeria i Arquitectura La Salle, Universitat Ramon Llull.