Walking Towards Digital Design Education: Contributions to the Initial Development Stages in Teaching

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ABSTRACT

Information technology as it is applied to digital design education has been exhaustively discussed in academic literature. Given this context, the present article is about didactic experiences involving two disciplines in the design course at the University of S: geometry and means of representation. The former has only made use of hand drawing; the latter has applied commonly available generic software, and represents a methodological contribution, which can provide immediate improvements to digital design education.

KEYWORDS: design education, design methodology, digital thinking, software customization; resources improvement.

We live in a unique time for both technology and personal skills. Technology can be applied to everything from the most common to the sophisticated of tasks, and its application affects our environment, habits and professions. Because of this, everything can, or must, be done by technology. However, we cannot forget that each activity has its roots in a traditional skill, based on manual labor and primitive tools. Today, despite all of the available technology, each profession requires specific abilities, that often require manual skills, especially in areas such as engineering, architecture and design, which maintain strong connections with their origins and their dependence on personal talent in object representation.

This article relates didactic experiences involving two disciplines in the design course: geometry and means of representation. The former has only made use of hand drawing; the latter has applied readily available generic software. We think the differential feature of this work lies in its synchronizing of counterpart methods, which emphasizes digital learning of new concepts through available resources that are seldom used in generic software. In our approach, and in accordance with Brazilian standards for traditional technical drawing, two-dimensional views are automatically generated from a three-dimensional model. Besides defusing the inherent rupture transition effect outlined—once the traditional and digital methods have been integrated in the initial training phase of the students—the available computational resources, sometimes taken for obsolete, are re-evaluated revealing new application possibilities in common software. We consider this a methodological contribution, which offers an immediate solution to the needs of contemporary digital design education, even when the conditions and available resources are far from ideal.

Contextualizing the Transition Phase

The huge gap between digital and paper-based design reveals conflicts on many levels. Peculiarities identified in each one may suggest that different concepts, approaches and procedures must be adopted to match up proper methods in order to provide good results. To be accepted or better understood, new technology can make use of task-related experiences and introduce metaphors to take advantage of traditional skills and knowledge. Software interface applies this strategy, creating electronic counterparts to physical objects. Folders, files and mail boxes are good examples that make the electronic world seem more familiar (Smith, Irby & Kimball, 1982, p. 518). This has been applied not only to objects but also to user manipulation. The classic “cut and paste” is a reference to common tasks in real life.

However, although metaphors can be a good way to learn about a new technology, their use can also have negative effects. For example, the T-square Metaphor has been researched, revealing the unsuitable approach it has brought to digital design (Flemming, Bhavnani & John, 1997, p. 354). Simply transferring manual-drawing habits to computer resulted in a mismatched metaphor, and the system has been used inefficiently. In conclusion, the researchers proposed the Detail-Aggregate-Manipulate (DAM) strategy, emphasizing the importance of "thinking CAD" as an appropriate concept to take advantage of the capabilities of the program.

Rivika Oxman agreed with this position, and predicted fundamental changes in design and production practices. She suggested requirements for a conceptual and theoretical framework for digital design, presenting the nature of digital design thinking as unique, transcending traditional methods and theories (Oxman, 2006, p. 232).

In this context, reflections on teaching digital design are fundamental in order to keep up with the evolution of technology. Charles Vincent described a didactic experience based on digital design, suggesting a disruption between traditional and digital design practices as opposed to a reconciliation of a disjunctive state between them (Vincent, 2007, p. 159).

Historically, cultural movements are cyclical events in evolution, which fall into decadence after a glory period. Sometimes, the emerging movement appears as a reaction against the previous one, in search of freedom from old concepts. In Architecture, Modernist vs. Postmodernist confrontation exemplifies this situation, but different points of view have suggested another possible evolution. "At a certain fortunate moment in modern architecture, the aesthetic identity of constructivism met with the practical spirit of strict functionalism and cohered informally. Traditions can only live through such historic moments." (Habermas, 1987, p. 124).

We can make a similar case with regard to manual and digital design. A paradigm shift should transform, but not necessarily abandon, traditional concepts and techniques. In this sense, Gehry's paper-based sketch remains valid (Dal Co & Forster, 2003, p. 508), but now offers opportunities to explore new possibilities in accordance with digital thinking (Fig.1).

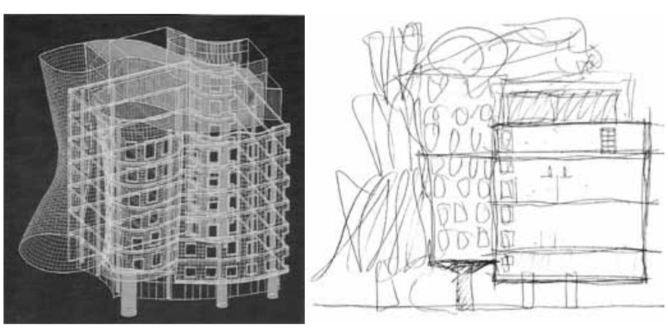

Figure 1. Gehry's paper-based sketch and digital model

For some time, CAD procedures were very close to traditional techniques, representing little development in comparison to conventional methods. Therefore, converting 3D objects into 2D objects is an important feature differentiating digital from manual design. A tutorial was identified to broaden the views of students and professionals about CAD system possibilities. It was based on long-available resources in the AutoCAD generic drafting software, i.e., two commands: SOLDRAW and SOLVIEW, which allow the user to construct, automatically, orthographic projections from 3D solids (Soares & Cova, 2007, p. 1). The authors concluded that, simply inverting the flux of traditional representation technique would yield significant methodological improvement, but were concerned about skipping an important stage of graphic construction in the learning process. Such concerns are not applicable to our case because of the connections that are made between digital and paper-based design. Starting with the insight provided by Soares and Covas, we focused on its didactic potential, customizing the software to lead students straight to digital design practices

Experiment description

The design course at the University of São Paulo is very new. Beginning about four years ago, its course was altered in order to cover the large number of subjects and activities that must fit into evening classes, in roughly half the time available for the daytime Architecture and Urbanism Course.

The disciplines of geometry and means of representation, offered simultaneously during the first year of the design course, make use of counterpart methods, hand drawing and commonly available generic drafting software, respectively. Keeping in mind the paradigm shift of digital design discussed in the previous section, we chose a methodological approach focused on future global trends. Although we agree with the need for a unique digital design culture, transitioning to it requires time, investment and hard work. Thus, the immediate response must be to make use of the resources available. Because of this, we have followed the strategy below:

- Research: in order to improve resources;
- Didactic application: in order to include the present stage of the process;
- Resources versus limitations: in order to make the most of the available technology, to surpass or mitigate present limitations.

While improving resources, which involves software acquisition, upgrading equipment and improving teaching staff capability (first topic), the present requirements may be included in the process (second topic), thereby optimizing the use of the available resources (third topic).

We started this experiment with the third topic, applying a group of procedures seldom used in the generic software AutoCAD, to reveal a powerful tool similar to specialized software, hidden in the generic one. It results in a "Digital System" introduced in the means of representation classes, whose contents are closely connected to another discipline, geometry.

By using two exercises (Ex-A and Ex-B), the purpose in means of representation was to generate orthographic views (2D) from a 3D object by digital means, resulting in technical drawings in strict conformity with Brazilian standards ABNT.

The geometry discipline made use of hand drawing to represent objects on ISO A3 size paper sheets, in three orthographic views and in isometric projection. One of these objects was adopted in the Digital System first exercise (Ex-A), allowing students to notice methodological differences of both approaches. The second exercise (Ex-B) introduced the conceptual phase, gradually analyzing the results of the changes from 3D objects to 2D projections, by modeling a 3D geometric solid. This permitted students to explore the object shape in a manner different from that of traditional drafting.

The digital system is implemented as a customized work environment, a drawing template (file extension DWT) in AutoCAD. In the paper space (presentation) section, "VIEWPORTS" associated to "SOLVIEW" commands were previously established, creating a kind of window that connected model and paper space sections. Variables and setup configurations which affect graphic elements - line type, dimension style, text styles, layers and colors - were included in the Digital System, together with complementary files, such as plot style (CTB), plot configuration (PC3) and plot parameters (PMP), in a starting kit, whose operation followed these steps:

- Unpacking the kit, locating each file in the proper AutoCAD folder;
- Starting a new drawing using the Template;
- Modeling a desired object as a 3D solid entity;
- Generating orthographic and isometric projections;
- Adding measurement annotation to each projection;
- Plotting (into a file).

When these steps were finished in the first Means of Representation exercise, the student was at the same stage reached in the Geometry discipline (Fig.2). Next, the students were asked to alter the original 3D object. At this point, methodological differences were clarified, because orthographic and isometric projections were generated from the 3D model (Fig.3), while in the paper-based representation the drawing flux was inverted, from the 2D views to the 3D object, and modifications were made separately for each projection.

Applying the same Digital System, the second exercise (Ex-B) focused on the conceptual phase, providing a golden ratio rectangular block to be sculpted (Fig.4). The students were motivated to start sketching by hand. Here, the object of each student was unique, and their creativity could be excercised.

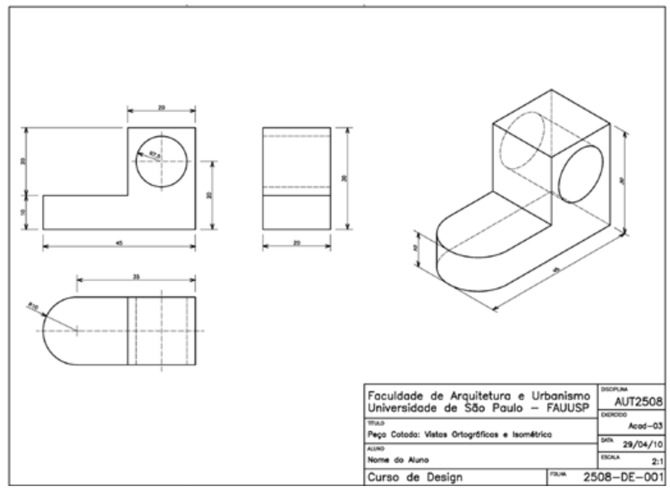

Figure 2. Digital System Ex.A: Means of Representation first exercise

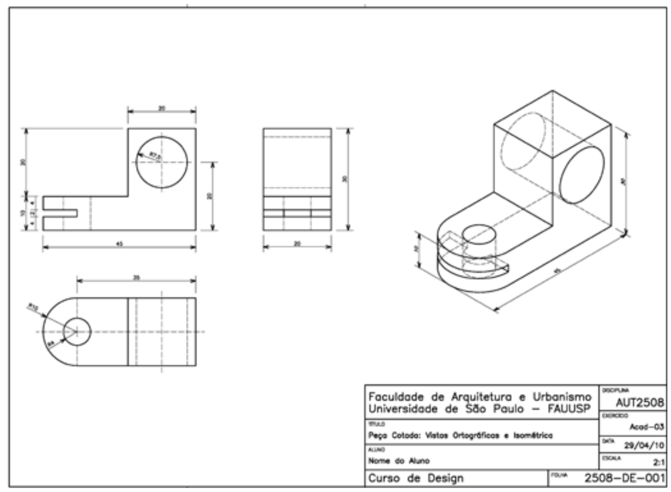

Figure 3. Digital System Ex.A implementing automatic drawing changes

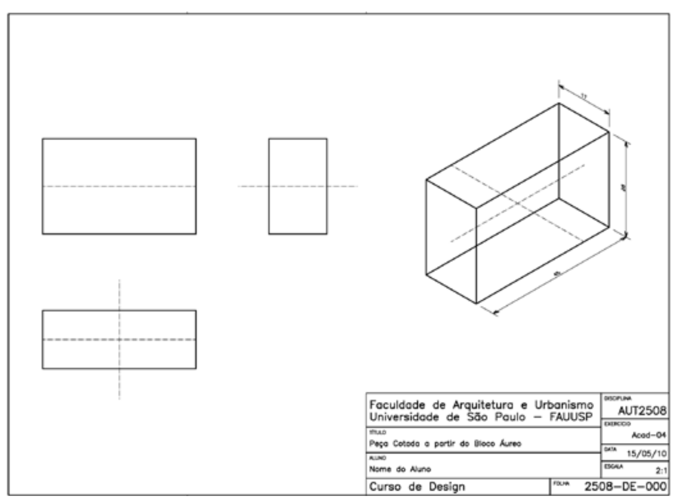

Figure 4 - Digital System Ex.B: Means of Representation second exercise

Results

The Digital System achieved its purpose, in that the general software was modified for a specialized task. Students had no difficulty in coping with the starter kit, and group performance and interest increased in comparison with previous classes.

Although the performance of the students increased, better results were expected in the second, creative phase, exercise.

The relationship between counterpart methods allowed the students to notice their peculiarities, developing, at the same time, theory and practice either unique or complementary to each one. Optimizing the digital environment provided better balance in a broad program given the limited time available.

Conclusions

A semester prior to this experience, we tried to teach technical drawing using standard AutoCAD tools. The students demonstrated little interest and argued that, at present, there is better software specifically intended for design. As these are not yet available in our computer classrooms, we decided to improve the resources that, while far from ideal, we had.. The response of the students corroborated our initiative. In addition to their motivation, the class showed an improvement both on theoretical and practical issues.

Customizing generic software demonstrated a powerful didactic option of technological evolution, but the software had to offer an easy way to be adapted. Beginning with its initial releases the AutoCAD package included customization instructions as "a way of fine-tuning AutoCAD to match your specific needs." (Autodesk, 1992, p.1). In addition, AutoLISP language and programmable dialogue boxes increase custom possibilities, providing new commands and specific interfaces that allow the user to adapt the software in many ways.

On the creative side, we noticed little progress regarding the object intended to be shaped by digital means (Ex-B). In general, the primitive block characteristics were disregarded, and no one took advantage of its original golden ratio dimensions. Despite the fact that sketching was an option, the students preferred to directly explore the 3D model shape by manipulating the virtual block. This choice, which initially appeared to be an innovative way to shape the object, resulted in common solutions, some of which represented ordinary objects. This cast doubt on the choice of the students in the exercise, and raised questions as to whether or not sketching would bring better results.

Although we agree with the need for a new paradigm for digital design, some connections with traditional concepts should contribute to its fundamentals, especially in didactic applications. For instance, Descriptive Geometry involves complex operations whose perception must be developed by the student. Today, it is more important for training spatial reasoning than solving problems related to space figures. This is the issue we presented in a previous article, showing that digital and traditional didactic resources can be complementary (Moura, Lara & Giacaglia, 2009, p. 262). In the same sense, free-form design, through paper-based sketching, should be compatible with digital methodology as illustrated by the examples of Gehry, once it incorporates new possibilities supplied by new technological resources.

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