Experimental Approach in an Architectural Design Studio:

How Digital Technologies Could Change a Design Process

Temy Tidafi and Ivanka Iordanova

[3]*Université de Montréal, School of Architecture, GRCAO (CAD Research Group), Canada*

Temy.Tidafi@UMontreal.CA Ivanka.Iordanova@UMontreal.CA

Abstract. This article communicates results of an experimental pedagogical strategy aiming at both, introducing and taking advantage of new technologies in an architectural design studio. One of the reasons for the notorious unfriendliness of CAD software to the design process comes from the attempt to imitate traditional pen and paper design on the computer. While the whole process could be completely different when performed in a digital environment offering powerful form generation and knowledge modelling possibilities. the proposed teaching method is based on the following principles: (1) emphasis on new methods of designing made possible by the use of computer; (2) communicating the design process, and not only the final result; (3) exploring parametric design for generation of different formal expressions of a design concept; (4) using visual programming to create inter-object relations, etc. A comparison of this experimental approach to other approaches used in design studios (digital or traditional), proves that the architectural results obtained are largely related to the chosen medium and the tools of work. In our opinion, this teaching approach proves to be promising for introducing considerable qualitative changes in the architectural profession, and this way in our built environment as well.

Keywords: Architecture, digital design studio, teaching the process, parametric models, visual programming.

Introduction

The objective of this article is to communicate the results of an experimental pedagogical strategy aiming at both, introducing and taking advantage of new technologies in an architectural design studio.

Revolutionizing architectural design could be felt only if the computer is seen as an indispensable medium for the conceptual work from the very beginning of a design process (Kalay, 2004). Some old and also recent studies have shown that sketching is not necessarily the only “natural” way of conceiving an architectural object (Knight, Dokonal, et al. 2005). One of the reasons for the notorious unfriendliness of computer aided design (CAD) software to the design process comes from the attempt to imitate traditional pen and paper design on the computer. The whole process could be completely different when performed in a digital environment offering powerful form generation and knowledge modelling possibilities.

We firstly discuss the origins of the way pen and paper where associated to architectural design. Then we will present the pedagogical strategy used in studio, the background of the students, the choice of the digital medium and the studio theme. This will allow contextualization of both the methodology and the epistemology retained. As a third point, we will show how the students have discovered some of the non conventional characteristics of the software medium during a period of preparatory exercises, and how they were taking advantage of them (even when this was implying some efforts in reviving their mathematical and algorithm design knowledge). Then, we will expose some observations on the influence of the introductory exercises on the main part of the design studio. We will examine the problems that the students met and the ways in which they tried to solve them. The

origins of these problems are an issue we try to address. Finally, we will discuss the conclusions of this design studio, in terms of design process learning, and architectural results achieved.

A brief historical background

Pen and paper design method is not as old as we believe and this means it has not to be the only one used. In brief, this method was introduced at the Italian Renaissance period by Raphael in collaboration with Antonio Da Sangallo when new actors as Raphael, Brunelleschi or Bramante wanted to revolutionize architecture. These new actors came from different art disciplines to renew architecture but didn't have the sufficient technical knowledge ancients had and essential for projects concretization. To compensate, they made mockups or drawings to figure out ideas. It was a way to establish a communication with those who could concretize a building (Tidafi, 1996).

Before the Renaissance, such a kind of communication was not necessary. The know-how was 'on the field' (the construction site), and transmitted verbally from one generation to the next. The know-how was also improved 'on the field' by acting and correcting if needed. In fact, the focus was, at the same time, on the process of realizing something and on what had to be achieved.

Nowadays, most of the tools we have developed are essentially oriented towards representing the process result. This has various impacts on the design process, among which: (1) a loss of knowledge behind a result, and (2) difficulties of transmitting the know-how.

Of course, treaties have been proposed some centuries later (around the 17th) and work division appeared after (around the 18th), enforcing the new emerging paradigm of putting the interest mainly on the result, thus, diminishing the way this result has been obtained. This can be observed when reading most of the books treating architectural history. They mostly mention the style or the socioeconomic context of a great building, and very rarely the way in which the builders conceived it.

The position is slowly changing today for two reasons: (1) new technological tools are emerging or available on the market and (2) those who conceive buildings are more and more aware of the necessity of exploring and understanding what they are trying to obtain. By consequence, this implies also the exploration of new teaching strategies that allow not only knowledge preservation and transmission but also the development of new architectural possibilities, for the great benefit of all.

Pedagogical strategy

In order to revive work on architectural knowledge, rather than only on a process result, we have conceived an experimental educational project in a students' digital design studio. The need for putting forward architectural knowledge, especially when designing on a computer, has been underlined by Akin (2002) as well.

The pedagogical approach used in this master's level architectural design studio, was inspired by a constructivist teaching methodology (Piaget, 1970). This implies that relations between elements are more important than the elements themselves, and that changing one element or relation in a given structure will influence the organization of the whole. This way, a new kind of « *objets pour penser avec* » (as defined by Papert (1980)) can be used for design exploration by the students. Further more, some of the relations defined in such a structure can refer to design knowledge, and thus, bring it as an important actor since the conceptual design stage.

Another major point in the constructivist theory that we refer to (and this is especially important when learning a profession) is the position that a person has to use a newly learned thing in order to well comprehend it, internalize it, and make it

ready for future use (Piaget, 1970, Schön, 1983). Hence, the pedagogical strategy proposed adheres to the 'learning-by-doing' approach described by Schön (1985) as particularly promising for an architectural design studio.

One of the ways a process can be described, and transferred, when mediated by a computer, is the algorithm. The potential of algorithmic programming and parametric design for architecture has been shown in a spectacular way in recent years through the works of some of the well know architects of our time. Generally, these methods, are well-kept know-how of these avant-garde teams, accessible uniquely by the scientific literature to the general professional public (Abel, 2004; Leach, 2004).

Few reporting of introduction of such methods in architectural design studio is found in literature. The design studio methodology of Weinand (2004) is an outstanding example.

The pedagogical approach described in this paper promotes architectural design exploration by process modification, instead of only depicting a result of it. In practice, the studio methodology is based on the following: (1) emphasis on new methods of designing made possible by the use of computer; (2) communicating the design process, and not only the final result; (3) exploring parametric design for generation of different formal expressions of a design concept; (4) using visual programming to create inter-object relations.

Diversifying and stimulating architectural methods was the principal educational objective in the architectural design studio. To support this creative process, computer tools had to be selected to satisfy (at least partially) the studio objectives. Then, students had to be familiarized with them, and brought to be comfortable with some of their essential possibilities. That is why, the term was divided into two parts: exploratory period of preparatory exercises, and the main studio project.

Preparatory exercises

The medium exploration by the means of preparatory exercises was introduced with the following objectives: initiate the students not having previous experience with 3D modeling software to the new way of working; putting those who have already used 3D modeling for representation purposes only in a different (conceptual) context; and offer to all student the possibility to try several different strategies for design with the computer tool proposed. This last objective also aims at satisfying the design methodology needs of students with possibly different cognitive styles. Having seen and worked with various methods during the preparatory period, in the end, they will be able to chose one or two of them as their preferred one.

The choice of the modeling software (Cinema4D) was based on several criteria among which: relatively easy to lean (compared to other professional 3D modeling software); providing various free-form creating functions; offering the possibility to organize objects in a hierarchical way in an object-tree structure, which assures as well the 'non-destructive' character of the software; and last but not least, integrating all possible ways for parametric modeling and algorithm design (parametric objects, algorithmic plug-ins, graphic programming window "Xpresso" and script language "COFFEE").

So, in introduction to the studio, students had around one month to develop their new computer skills. For that, they had to learn not only the use of software but also to discover its possibilities. They had to become skilled at programming principles and understand what an algorithm means. It was for most of them the first time they discover such advantages of computer tools. This preparatory phase included two elements parallel in time: first, students followed a methodological course where most of traditional design methods and historical acceptances were studied and put in

perspective; and, secondly, they had to design a very simple project in order to be able to explore the new methods learned and to view the result of their new knowledge.

As shown on Figure 1, at the beginning of this preparatory period, students had been shown an example of architectural object creation, together with the generating method behind. The link between parameters, algorithm and generated form was explained and proposed as a possible design exploration method.

Figure 1: Spatial explorations proposed on the base of an algorithmic model in the conceptual phase

The preparatory exercises were proposing the following methods of design creation and exploration: free form creation and modification; parametric objects composition; animation; linking objects and their properties by graphical programming "Xpresso" (shown on Fig.2); using the Jenna plug-in which provides an algorithmic distribution of objects in space; and finally, designing an algorithmic object in a 'Coffee' script. All these methods were tried in a design context by the students, the last one being embraced only by a few of them.

Figure 2:Establishing relations between objects of the design scene in Xpresso

The design project for this phase of the studio was a train stop, chosen because of the relative freedom from most social and other aspects generally involved in architectural design processes; as well as because of the movement intrinsic in the function of the design object. The intention was to stimulate dynamic presentations of the object itself that, in our hypothesis, would stimulate more reflection on the process involved.

The students used with particular interest the algorithm-distribution providing plug-in for their projects. It seems that they were curious to discover this unknown world. The fact that the shape reacts to changing a numeric value, but always keeps the same logic, was new to most of them. The possibility to introduce random variation in the form generation was a strong stimuli for design variations. Some really fruitful explorations were noticed.

Animations were especially appreciated too, both for design stimulation and for process communication. All the other methods were used as well, with variable passion depending on the person. This might be due either to the relative commonness of some of them (free-form creation), or the difficulty of using others (Xpresso, and Coffee). However, some students accepted and enjoyed a lot the challenge of programming.

Students did not create projects with equal quality, of course. However, the fact that they saw what can bring a new design approach with new technological tools, was for all of them a much appreciated experience that lead to a renewal of their definition of a design process, something that they have not expected before. Here after, are some illustrations of results obtained by some students but unfortunately not animated:

Figure 3: Students' projects from the preparatory phase of the digital design studio. Form generation and building functioning were communicated by animations and explication of relations between the elements

As we could state in the following phase of the design studio, the preparatory exercises were a necessary and rewarding strategy towards the main term project.

Focus on an original architectural project

The design context of the architectural studio was the participation in an international competition for a museum design. This kind of design task was chosen in order to let students explore more freely new "skin" based design, rather than being "captured" in traditional functional constrains, like in hospital or housing design for example. In our opinion, the "Iakov Chernikhov Museum-Gallery of Modern Architecture" student competition, held in Moscow, Russia, this year, was the perfect fit for the digital studio. The theme of the competition was interesting at two levels: first, a museum design can allow students express unconventional ideas, and secondly, a research on the creative work of a constructivist like Chernikhov could bring in fresh metaphors, new methods, and original ways of thinking. All these were performed in an entirely different context (post-revolutionary Russia) – a 'jetlag' the students were going to 'feel' as well, when using the computer medium in an innovative way.

As we already stated, the studio method was focused on the 'process' as a source of knowledge transfer and design exploration. Communicating a process is always an issue. Especially in architecture, one is always inclined to show the outcome, the final result of any process. In the studio context, two requirements were aiming at developing a sensibility towards the 'process': keeping traces of the project development (for better comprehension, and for future reference); and communicating the design process during all presentations with critics.

Keeping traces

Three strategies were used to preserve traces of the design process of each student. First, each student had to transmit regularly his solution on an internal (for the department) web site accessible by all the students and tutors. This way, each person could take a look at the progression of a colleague. Alongside, regular filming of the students, while working, was put in place. And finally, the programming code of each participant was recorded at regular phases. This last operation gave us the possibility to follow the logic of each student during his design process using the software proposed.

Another important topic of discussion in the studio, related with the issue of the 'traces', was architectural precedents. We consider that they can very positively influence the introduction of new digital tools and the exploration of new design methods. Precedents are not only seen as objects, but as a specific attitude towards given parameters of the design task, like acoustics and lighting, for example. In this regard, we noticed considerable referring to previous parts of the studio and reuse of some elements in the new design. In our opinion, this is an advantage made possible by the 'non-destructible' character of the software used. It might have been positively influenced, as well, by an augmented consciousness of the design process.

Communicating design process

As an obligatory requirement for each presentation, design process had to be communicated. Concepts, variations, ideas abandoned or not, methods of design exploration, difficulties and inspirations had to be communicated in a concise form. Animations and picture sequences were by far the preferred method used. Snap-shots of Xpresso were shown in order to explain object relations. Parameter variations were

animated for better understanding. Reasons for preferring one mathematical curve to another one were exposed.

Accentuating the process during the design process does not mean that traditional architectural aspects were neglected. Functional and structural characteristics were as important as in a traditional studio, environmental aspects were extremely appreciated by the students as well. What is regrettable in the present state of computer design tools is that these aspects are not included in the creative modeling software, which hampers their integration from the beginning of the design process. This is an issue we are addressing in a continuation of this study.

Some pictures of the museum design can be seen in Figure 4. The effort to explicit the design process can be noticed. In the first case, form generation is based on free-form creation and modification, while in the second case, some algorithmic programming was used to support the design. This method seems especially useful for the generation of the structure of projected buildings.

Figure 4:Communicating a design process: a) design by free-form creation and transformation, b) design aided by algorithm form generation.

Discussion and conclusion

A brief overview of these results can show that one of the outcomes of this experimental teaching method was the augmented understanding that students achieved about designing on the computer, as well as an improved awareness of their own design process. The future architects were able to feel the new possibilities given by the computer and try exploiting them from the very beginning of the design process.

Of course, other methods, based on architectural knowledge could be added to the ones already explored in the preparatory exercises. They would imply a special development, and could be put into practice in future architectural studios.

A comparison of this experimental approach to other approaches used in design studios (digital or traditional), attests that the architectural results obtained are largely related to the chosen medium and the tools of work. In our opinion, this teaching approach proves to be promising for introducing considerable qualitative changes in the architectural profession, and this way in our built environment as well.

Acknowledgments

We thank the students from the 2006-Winter ARC-6813D design studio for accepting the challenge of this experimental pedagogy approach. We thank Lorna Heaton for the video-recording, and all the members of our CAD research group for inspiring ideas for the digital studio.

References:

Abel, C.: 2004, Architecture, Technology and Process, Elsevier, Boston.

Achten, H.: 2003, New Design Methods for Computer-Aided Design Methodology Teaching, *Journal of Architectural Education.*

Akin, O.: 2002, Case Based Instruction Strategies in Architecture, *Design Studies,* 23, 407-431.

Iordanova, I. and Paoli, G. D.: 2005, Hypotheses Verification on the Role of the Medium, *23th Conference on eCAADe,* Duarte, J., Ducla-Soares, G. and Sampaio, Z. (eds), Lisbon, pp. 99-107.

Iordanova, I. and Tidafi, T.: 2005, Using Historical Know-how to Model Design References, *CAAD Futures 2005*, Martens, B. and Brown, A. (eds), Springer, Vienna, pp. 197-206.

Kalay, Y.: 2004, *Architecture's New Media*, The MIT Press.

Knight, M., W. Dokonal, et al.: 2005, Contemporary Digital Techniques in the Early Stages of Design, *CAAD Futures 2005*, Vienna, Springer.

Leach, N., Turnbull, D. and Williams, C.: 2004, *Digital Tectonics*, Wiley-Academy.

Papert, S.: 1980, *Mindstorms: children, computers, and powerful ideas*. New York, Basic Books.

Piaget, J.: 1970. *Le structuralisme*. Paris.

Schön, D. 1983. *The reflective practitioner*: Basic books.

Schön, D. 1985. *The Design Studio*: RIBA

Tidafi, T.: 1996, Moyens pour la communication en architecture - Proposition de la modélisation d'actions pour la figuration architecturale, PhD thesis, Universite de Montreal

Weinand, Y. : 2004, *New Modeling*, Presses polytechniques et universitaires romandes.