Available online at www.sciencedirect.com

ScienceDirect

Procedia - Social and Behavioral Sciences 176 (2015) 526 – 530

Procedia
Social and Behavioral Sciences

IETC 2014

A critical look at the digital technologies in architectural education: when, where, and how?

Dr. Levent Kara

University of South Florida, School of Architecture & Community Design, Tampa, Florida, USA

Abstract

In the past decade, architectural education has seen an increasing amount of digital technologies being involved in the design studio curricula. Following the trends in the profession, these various technologies of computer aided drafting, enumerating, modeling, and analysis became not only key pedagogical nodes in the design studio, but also started to shape the overall curricular structure of architectural education as they also needed to be implemented as support courses in order to compensate the learning curves and the number of software available to architects. These digital technologies range from one end of simple drafting, conventional three dimensional modeling, and more sophisticated animation of buildings with a computer, to the other end of inventing new tectonic and spatial geometries using parametric computations. In this context, it will be unrealistic to argue against teaching and using digital technologies in architectural education. When one thinks how the profession has evolved in the past decade, it is necessary to embrace these tools in the architectural curriculum. However, a discussion that has not been clearly resolved is when, where, and how these digital tools are thought and used in the architectural education. My paper argues that the conventional tools of hand drawing, physical modeling, and hand making should be embraced in the foundational levels, and the digital tools should be introduced after developing a certain set of skills of one-to-one physical making where a sense of tectonic resolution, scale, and spatial experience is cultivated as a basis of architectural thinking with digital tools. In what follows, I will discuss this viewpoint through examples from architectural design studio education in the United States and in Turkey.

Peer-review under responsibility of the Sakarya University.

Keywords: architectural pedagogy; architectural design; digital architecture; CAD; CAM; computational design; architectural design studio; architectural drawing; architectural modeling; architectural thinking; architectural geometry

1. Three schools, three practices

I will discuss the use of digital tools in the architectural education by focusing on three universities. Two of these universities are in the United States and one in Turkey and all three programs are accredited professional degree programs. I will first introduce the general structures of the schools, and discuss the approaches to the digital tools in

Peer-review under responsibility of the Sakarya University.
doi:10.1016/j.sbspro.2015.01.506

the context of overall curriculum and design teaching attitudes. I believe a proper understanding of the general design pedagogies of the schools is an important part of when, where, and how the digital tools are implemented in the architectural education as a normative curricular question.

1.1. Background

School A is a 4+2 professional program in the United States. There are 8 undergraduate studios, 3 graduate studios, and a thesis semester. Digital tools start at the 3rd year of the undergraduate program, usually second term, and the rest of the program heavily uses digital technologies in the studios. Drawing and modeling programs are taught as a separate required one semester support course in the 2nd year, before the students start using these in the architectural design studios. However, the digital course uses projects from the 2nd year studios as base for its assignments.

School B is a 2 year professional graduate program in the United States, with also a 2 year core program that accepts students with other majors. There are 6 studios, and 2 semesters of thesis. Digital tools start in the 1st year of the graduate program, or the 3rd year of core program, usually the first term. So, there are only two design studios that use digital production and incorporation into thesis depends on the particular student. Digital tools are taught as elective courses, and there are no required courses. Depending on if and when the student chooses to take the digital elective, studio projects may be used as basis for the digital course assignments.

School C is a 4 year undergraduate program in Turkey. There is a masters program, however, due to professional licensing requirements in Turkey, the masters program does not count towards professional credit. There are total 8 studios that count towards professional credit. The digital tools are introduced in the 1st year and the rest of the program heavily relies on digital production and presentation in the studio. Drawing and modeling software are taught in required support courses in two semesters in the first year of the program along with the graphic component of the design studios.

2. Curricular structures and approaches to architectural design teaching

Despite the difference in number of design studios, School A and B follow similar approaches in design teaching. The first foundational studios emphasize hands-on making in different media, from hand drawings and sketching to physical models. Both schools structure these foundational studios around a concept of making that takes the product as a one-to-one scale made object rather than representing an architectural construct on the world in another scale. Therefore, the early studios aim at establishing a sense of tectonic making and seeing space in one-to-one crafted constructs even before they can be called architecture in the general sense of the term indicating habitable structures. Designing habitable structures, or the notion of building, is introduced gradually towards the second year and third year of education. The first year's assignments focus on ideas of space making and tectonic construction in volumetric and expanded conditions, introducing concepts of internal scale, joint resolutions, hierarchy, repetition, movement, and iterative relations between elements, materials, and spatial and tectonic moments, without making these part of a broader notion of building. Thus, a fundamental sense of spatio-temporal experience is cultivated through hands-on, one-to-one making, laying the ground for the basic strategies of controlling and managing the complexity of architectural space. The transition from these tectonic and spatial constructs to designing habitable structures and buildings takes place with the introduction of design problems that address questions of experience, movement, sight, light, and sense of enclosure relative to human scale in the form of fragments rather than full programmed buildings. The advantage of introducing architectural typologies and fragments as design questions is that the students transition from spatial and tectonic constructs to constructs that house human body much efficiently and steadily, being able to think about architectural experience with only focusing on certain aspects of it rather than tackling the problem in the complexity of a building. The result of these transitional assignments follow the complexity of the one-to-one constructs, carrying the knowledge of space and tectonics acquired, and thus a rich sense of architectural experience. In this way, the architectural typologies, or fragments, like door, window, stair, etc. become problems of boundary, threshold, movement, visibility, scales of enclosure, etc., parameters of spatio-temporal experience, rather than given known elements. Thus, along with a highly developed sense of space,

tectonics, and experience, architectural design and making becomes a process of inquiry into the domain of lived human experience.

School C introduces a notion of basic design in the first semester, gradually going towards habitable space and even to the questions of interventions and context immediately in the second semester. This basic design approach follows the Bauhaus pedagogy of making things as discussions on basics of geometry in two and gradually three dimensional systemic constructs. Even if this basic design approach sounds similar to what Schools A and B introduce in the foundational studios, the main difference is the basic design approach takes the systems as ends in themselves and does not address the questions of space and tectonics as rigorously as the foundational design approach. (Please see Angelil 2003 and Franzen 1999 for further discussion of systemic versus spatial and tectonic making.) Typically the basic design starts with two dimensional graphic exercises that concern pattern relations, rhythm, hierarchy, in an elemental system. Then these get extruded in relief studies, gradually unfolding into three dimensional constructs. Similar to foundational design approach, the products at this level are one-to-one makings without a scale relative to human body or habitation. However, the questions that these systemic constructs focus are the elemental relations that iterate onto each other, thus the systemic resolution takes the priority as an end in itself rather than giving way to discussions of spatiality as a key concern. While a systemic construct can be deemed successful in terms numerical proportion and rhythm relations between its elements, it may not necessarily result in a successful spatial system if the elemental relations are controlled by iterative steps or numerical hierarchy rather than the space formulated and constructed as a relation between these systemic elements. These more pattern oriented two and three dimensional studies unfold into a larger scale site comprehension study with a system of interventions on a usually chosen real site. While there is a strong connection between pattern studies and large scale site operations, because the complexity of initial pattern studies fall short of addressing phenomenal experience in terms of tectonic and spatial resolution, the lessons of the pattern studies do not carry into the architectural scale required by the site assignments. Similarly, the basic design skills acquired in the first semester, gradually fall back into a more conventional architectural making as the program advances in the later years. Typically, the second year immediately starts to address questions of buildings and sites in small scale, and then the later years increase the level of complexity of building programs and scales of site operations.

3. Digital tools in the curricula

Schools A and B start to use digital tools in the studio only after establishing a very strong background of hand making in drawing and physical models, and only when the program starts to address buildings in the complex sense of a given architectural program on a given site. Because the students already cultivated the skills of thinking and making space with a strong sense of tectonic resolution, the digital tools can be utilized in their full potential from establishing difficult geometries to representing speculations of architectural experience in two and three dimensional digital constructs. The two schools differ in that School A teaches digital tools as a required support course in the second year of the 4+2 curriculum and School B only teaches in elective courses. While the digital course in School A uses the second year design studio projects as assignments, it is not before the third year the digital tools are used in the architectural design studio as part of the process and presentation of an architectural problem. School B requires digital tools in the third year of the Core program, or the first year of the Graduate program. In terms of production efficiency and the strength and variety of process and presentational techniques, the level of digital incorporation in the studio does not differ recognizably between the two schools. This shows that teaching digital tools as a required support course vs. electives, or even workshops, does not make a difference in the overall success of integration of digital tools in the design studio. Students learn the tools when they need them in the studio more efficiently than as a separate course. Because the assignments in the separate support courses tend to focus on the basics of drawing or modeling with software, these tools do not find their full potential before the students use them as tools of thinking and presentation for complex design problems they encounter in the architectural design studio. While the learning curves for each software vary, and there are a number of different software to learn, they usually share a basic common ground in vector and surface based operations, and each software start to show its strengths and weaknesses when applied on real time design problems. Thus, each student, regardless of what they can do with digital tools before they start to use them in the architectural design studio, starts

to develop her/his own set of digital tools and techniques through working with them on particular design problems, and refine their skills through various process and presentational challenges they face in the design studio. Even if some students do not have much knowledge of digital tools, in a few weeks they start to use the tools without the learning curve becoming a hindrance for the design process. Also, when they learn the tools while applying them in the studio, the knowledge becomes much more permanent. This is indeed not very different from a professional office environment, where particular software are learned on the job through particular applications.

School C starts to use digital tools in the very first year while also teaching the basic software at the same time as a separate support class. The software production becomes part of the design process and presentation very early on. While most of the students show a recognizable skill set in using the particular software they are taught, because the production in the studio favors digital over manual making, this skill set remains limited to particular problems and software. When digital production takes over early on in the studio, the spatial and tectonic knowledge that comes from hands-on making does not find its full potential in the studio. Because the digital tools immediately come with the filter of a screen or print out, thus delayed results, there are certain shortcomings in the comprehension of the notion of internal and relative scale which then result in a lack of tectonic resolution and spatial refinement. This is not exclusively the problem of introducing the digital tools early on, but it is a result of not cultivating enough the manual tools of thinking and making space. There is an immediate feedback in manual labor which controls the perception of the maker, and results in the development of an internalized sense of spatio-temporal experience. Through the filter of digital tools, this development becomes hindered. Because a distinct knowledge of space making is not developed outside the digital realm, the students also become heavily dependent upon certain software and their limitations. Likewise. because they do not have the broader conception of space making and its possibilities, they stick to what they know they can do through particular digital tools. This also limits the free flow between different digital tools, and more importantly between digital and manual tools, that is very prominent in the student work of Schools A and B. This free and transparent flow between digital and manual media is a much emphasized point in the discussions of design process and the use of manual versus digital tools. (Please see Pressman 2012, 101-103 and Yee 2013, 91-100 for further discussion on manual and digital tools integration in the design process.) Accordingly, the design process, which becomes a domain of inquiry in the Schools A and B, is reduced to more conventional ways of thinking about design problems and architecture. Thus, while an intention for architectural experimentation and exploration into the domain of human experience is visible in the work of the former schools, the work in School C tends to fall short of addressing more contemporary questions of space making as architectural research.

4. Discussion

For the past decade or two, architectural profession has seen an increasing amount of incorporation of digital tools in the thinking and making of space. New formal and structural geometries enabled by computational techniques become more and more prevalent. Also, the design and construction work flow become much transparent and smoother with the advent of integrated software environments. Within this context, these digital tools started to emerge in the architectural education as key components of general curricula and design teaching in particular. While it is inevitable that these digital tools are used more and more in the design studios, when, where, and how these tools are implemented in the curricular structure make a recognizable difference in not only whether the full potentials of these tools are utilized or not, but also in the way the future architects cultivate the necessary complex set of skills to deal with architectural challenges in today's and tomorrow's world. While the process and production in the profession moves toward digital environments -think for a moment that even the physical models are now mostly produced with CAM techniques- these tools still require an internalized knowledge of seeing, thinking, and making space which cannot be cultivated through digital environment alone. Thus the manual production, hands-on making of one-to-one drawings and models still form the core of architectural thinking, and must be kept as part of the foundational curriculum in the architectural education. It is only through a strong background of spatio-temporal experience and tectonic construction that these tools can find their full potentials as tools for thinking rather than just tools of limited making of preordained geometries. Hands-on making sets and calibrates an immediacy that digital tools cannot and cultivates a sense for space, scale, and possibilities of phenomenal experience that digital tools can express in their use but cannot cultivate in their applications. Architectural students who use digital tools in later

years of architectural programs after being given a strong manual foundation can more efficiently move between manual and digital tools and between different digital tools, thus have advantage over students who are exposed to digital tools early in the architectural program as they have a more refined and broader set of tools to deal with the complexities of architectural challenges. With this understanding of tools and the variety available to them, they also have a better sense of architectural design process that establishes a domain of inquiry and formulation for various architectural problems beyond the determination of tools at hand which may even involve invention of hybrid tools between manual and digital or between various digital tools.

References

Angelil, M. M., & Uziyel, L. (2003). Inchoate: An Experiment in Architectural Education / Marc Angélil. Zürich : Swiss Federal Institute of Technology (ETHZ), c2003.

Franzen, U. (1999). Introduction, 1971. In Education of an Architect: A Point of View, The Cooper Union School of Architecture 1964-1971, eds. U. Franzen, A. Perez-Gomez, K. Shkapich, 8-9. New York: The Monacelli Press.

Pressman, A. (2012). Designing Architecture: The Elements of Process. Hoboken: Taylor & Francis, 2012.

Yee, R. (2012). Architectural Drawing: A Visual Compendium of Types and Methods (4th ed.). Hoboken: John Wiley & Sons, 2013.