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ANALOG:DIGITAL, The Digital Spine: A 1 x 1 Strategy for Integrating Digital Tools in Foundation Design Studios

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ANALOG:DIGITAL

The Digital Spine: A 1 x 1 strategy for integrating digital tools in foundation design studios

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Abstract

Architectural education today needs to foster the inherent conceptual and creative thought processes the profession demands but also knowledge of all of the tools that allow architects to create and produce their work. Over the last 25 years the number of digital tools used in the practice of architecture has increased exponentially. Incorporating these digital tools, together with analog ones still being taught in most undergraduate programs today, is overstretching already overloaded architectural curricula. This leaves us to consider how we maintain the quality of teaching as the quantity of content increases and the amount of time with students remains the same. Additionally the inclusion of these tools has not only impacted the content of curricula but has also propelled us to reexamine the classroom environment and transform the way we teach and communicate with students.

Undergraduate architecture curricula tend to engage both digital and analog tools in early exercises of visualization and representation. These tools are typically taught in separate skills based classes. Alternatively an innovative program called the Digital Spine, instituted in the Department of Architectural Technology, at the New York City College of Technology, incorporates the learning of digital tools, together with analog ones, into the design and technical studios.

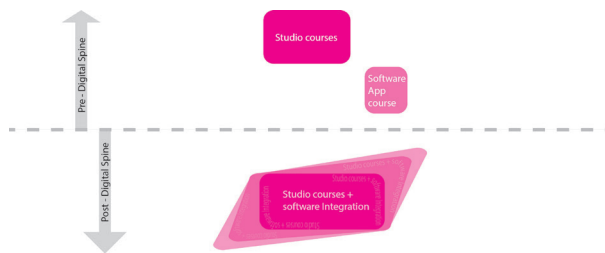


Fig. 1 Diagram of the studio course curriculum before and after implementing Digital Spine

The Digital Spine not only acts as a mechanism to teach software as needed during the design process but also encourages its use for rigorous iterative testing and developing a broader capacity to think critically and analytically when applied meaningfully. Additionally, strategies and models for

teaching such as the inverted classroom and active learning methodologies have been introduced so that new content is not being forced into old models of teaching. Incorporating digital tools has brought further challenges such as preparing faculty to teach these new skills and developing mechanisms to support learning them while still allowing for a rigorous and well-rounded design education.

This paper will use the Digital Spine as a case study for how digital tools can be integrated with analog ones in foundation level design courses and debate the merits of each. During these formative years should there be a 1:1 relationship between digital and analog skills? Should they be reinforced equally? The representational media and technique one uses has a direct and lasting effect on architectural making and thinking.¹ How do these different tools each affect the teaching and learning of cognitive design thinking?

Analog : Digital

Analogous to the world we live in architecture is becoming increasingly complex with higher expectations for building performance, construction, optimization and speed. This places a higher burden on students of architecture as they not only need to understand traditional notions of conceptualizing architecture through ideas about site, program and context but they must also be digitally fluent in computational design in order to develop rigorously tested design solutions based on performance, data and parameters. It is at the interface of both analog and digital mediums that architectural education lies today. In his essay "The Future that is Now," Stan Allen writes, "Clearly no single design direction dominates today, and while it is possible to map shifting intellectual agendas, the situation is not so much that one agenda supplants another as it is that one is layered over another, multiplying the possibilities and points of view." This multiplicity of outcomes and opportunities that students need to be exposed to shifts the relationship of analog and digital skills from 1 to 1 (1:1) to 1 times 1 (1x1). The relationship between analog and digital skills is not exclusive but equal (1:1) but rather intertwined and symbiotic (1x1) leading to an ever increasing array of potentials and possibilities that need to be taught and learned.

1x1 in Foundation Design Studios

Although by the end of an architectural education most students are primarily working in digital media, if foundation level architecture students were to work solely on computers they would miss out on the tactile experience of creating architecture. Architecture is ultimately about the experience of a physical space that is reliant on the tangible forces of materiality, tactility, perception and tectonics. Without actually experiencing these qualities through physical model making, hand drawing and visiting architecture beginning design students are too far removed from the inherent nature of architecture. On the other hand students need to learn the digital tools used in the profession to be employable and to understand new ways of conceptualizing architecture based on digital processes. Many of these processes lead to outcomes that optimize buildings, construction and fabrication in innumerable ways but lack a concern for traditional notions of experience, site and context. The digital age continues to provide architecture with countless possibilities, and it is our challenge to explore and take advantage of these opportunities, but we must not sever our responsibility to the ultimate goal of thoughtfully crafting spaces that are physically realized and experienced. It is thus imperative that the beginning design student be exposed to the merits that both digital and analog tools and processes afford and offered the knowledge of how to evaluate, choose and apply the appropriate tools for apposite purposes. This leads to an untold combination of possibilities for how these skills can be taught and learned leading to a relationship of multiplicities, or a 1x1 relationship, between analog and digital skills.

NYCCT

NYCCT has a history as part of the trade school movement that enveloped New York as a reaction to the industrial revolution. The development of trade schools in New York was seen as a way of integrating immigrants into the local workforce. This history is still relevant today as 42% of the enrolled students were born outside of the U.S., 58% come from households earning less than \$30,000 per year and 80% of incoming freshmen receive need-based aid. Enrollment has seen a 48% growth in the last ten years demonstrating the need for an affordable education that is geared towards preparing students to enter the workforce. With reasonable tuition and a large enrollment capacity the Department of Architectural Technology at NYCCT is the most accessible architectural education in the New York City area. The program serves 700-800 students each year and offers both an Associate of Applied

Science degree in Architectural Technology and a Bachelor of Technology.

The curriculum centers on a design education that is integrated with knowledge of the technology that is used in design and construction. Our design studios are coupled with building technology studios with each having the same number of credits and typically taken in tandem. In both studios students are expected to learn and understand the conceptual thinking behind the design and construction processes but also the tools used in them.

In 2011 the Department of Architectural Technology at NYCCT received a three-year NSF funded grant, entitled *Fuse Lab*, to rewrite, pilot and implement curriculum changes at the Associate Degree level to reflect, teach and support the technologies and software applications being used in the applied field. The objective was to equip students with the technical skills necessary to become viable candidates in the job market. One result of this grant was that in the period of a year the department went from having approximately 13 software applications available to the student body to over one hundred applications. It became instantly apparent that the department would not be able to provide courses to support all of these tools. In response to this a new strategy was developed called the *Digital Spine*. The Digital Spine was conceived of by the department as a way of integrating many of the newly available tools into the curriculum. This paper will discuss the process and outcomes of integrating the Digital Spine with the teaching and learning of analog skills in foundation level design studios.

1:1 OR 1 x 1

In order to devise a strategy for deploying the Digital Spine in foundation studio courses, we first had to establish an attitude and set of goals to help constrain its implementation. We began by asking the following two questions:

1. What is the role of the beginning design studio?
2. How can integrating software applications within the studios support this role without compromising the teaching and learning of analog tools?

To answer these questions we visited several institutions that offer degrees in architecture and related fields, studied their curricula and consulted with industry partners and our advisory board. Through this investigation we came to the conclusion that the role of a beginning design studio is to introduce

foundational tools and processes that will support and inform a student’s architectural education. Both analog and digital skills should be integrated into these early studios to expose students to a wide variety of methodologies and design strategies. Studios would be designed not to enforce a particular design methodology but rather to show students techniques for investigating design problems and communicating design solutions through a multiplicity approaches and media. The primary learning objective would be to prepare students with an array of tools and processes and the critical thinking skills necessary to discover their own individual approaches and explorations.

This attitude led to an exciting discovery in the development of the curriculum that as digital tools were woven into the assignments the relationship between analog and digital skills evolved from being 1:1 to 1x1. Initially there were two approaches towards adapting the digital tools in the design studios that each assumed a 1:1 relationship between analog and digital skills. Each set of skills was important and relevant but independent of the other. In the first approach digital tools were used strictly for documentation and generating output for final presentations. In the second approach digital tools were employed to investigate form-making. While the first approach does not take advantage of the iterative potentials of computational design, the second approach resulted in forms that were disconnected from ideas about spatiality, experience, tactility and context. This led us to believe that students had to be exposed to both approaches in order to develop rigorous design solutions that were based on the tangible qualities of program, user experience, scale and site while also optimizing the number of possibilities that could be explored. This resulted in a 1x1 approach that uses digital tools in tandem with analog ones to provide different lenses through which to generate and evaluate the potentials of a project’s design strategy. It prepares students at the beginning of their design education to take into consideration and be opportunistic about the variety of approaches available to them. As Julio Bermudez states in his paper “Inquiring between Digital and Analog Media. Towards a Interfacial Praxis of Architecture,”

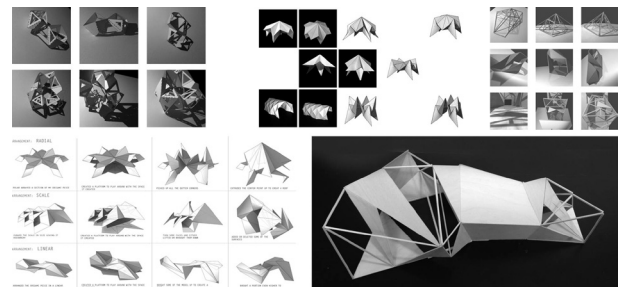
“Extremist approaches lack the necessary criticality, sensitivity and sophistication to tap into the opportunities that invariably exist in the space of betweenness. For it is in the gray areas where the dialectic processes unfold and new techniques, knowledge, and ideas first arise. It is also there where the true nature of the (seemingly) opposing ways of doing, thinking and communicating can be uncovered, grasped. The future thus is

not ahead (in the digital) but between (the analog and the digital) . . .”

The dance between analog and digital skills is a means of testing and achieving complexity, possibility and project development, not complication.

The Digital Spine: A 1x1 strategy

Most architectural curricula have a course, or courses, that focus solely on the learning of software applications. The Digital Spine instead incorporates the learning of software by teaching it within the design studio courses as it is applied to the design process. The students integrate the learning of digital tools, together with analog ones, by using them as needed during the design process. The intention of the Digital Spine is not to supplant analog tools but to generate a synergistic approach between learning analog and digital tools. As the new curriculum was launched at NYCCT we quickly recognized that in order to integrate both of these skill sets successfully it was essential for students to understand the underlining concepts behind the tools in order to establish baseline criteria for outlining the capabilities and inherent advantages of using one tool versus another. When highly digital approaches were tested the designs arrived at great formal complexity but students lacked an understanding of scale, tectonics, spatial relationships and proportion. Additionally, since the students did not possess the knowledge or dexterity necessary to manipulate the digital tools in order to achieve desired outcomes the approach became formulaic and the results, while seductive to the eye, were sculptural rather than architectural. For this reason as the courses continued to be refined, and in order to establish a symbiotic relationship between the analog and digital, a methodology or strategy for aiding the communication between the two languages had to be developed. We found that no matter whether we were asking students to design from a digital or an analog approach the commonality was that projects needed to establish rules, constraints and goals.



An example at NYCCT of how this 1x1 relationship is implemented in a foundations level studio project, where the oscillation between analog and digital tools is tested, is the Bridging Surfaces Project. In this assignment the primary elements for space and form making such as points, lines, surfaces and volumes, and basic design concepts such as balance, rhythm, repetition, proportion, order, symmetry/asymmetry and hierarchy are introduced as baseline criteria for establishing a common denominator between the digital and analog.

The students are asked to fold a series of basic origami shapes out of paper in order to transform a planar two-dimensional element into a three-dimensional form. After an array of shapes are tested and experimented with the students evaluate them and define systems of organization within them. They ask questions like: Can specific arrangements (i.e. linear, radial, cluster, etc.) be identified? Are there recognizable patterns? What are the operations that create spatial conditions and how are they controlled? Can the relationships between points, lines, surfaces and volumes be identified? Once a set of rules is outlined the students input the geometry into a 3D modeling program using a digitizing arm and begin creating iterations by establishing variables within the rules. The advantage of implementing this digital approach is it allows for a range of variations to be generated and tested very quickly. Once the variations have been produced the new geometries are laser cut and revisited through physical model-making where notions of structure, enclosure and assembly are tested. It is important to note that this exercise is not intended to be formal; its purpose is to help the student recognize the elements that create and imply space and form and how one makes decisions about manipulating them through both digital and analog tools. This process establishes controls and an understanding of how to oscillate between the tools. The exercise also introduces students to a rule based design process where geometries are understood and strategies for setting up controls and parameters are established. It requires an analytical rather than gestural approach to form generation while also providing tactics for editing, controlling and iterating the design to respond to an overarching idea. This framework is intended to aid the student in formulating a process where both analog and digital tools are implemented in order to develop design concepts that respond to project needs.

This process differs from the one described in the article, *“Selective Jammimg: Digital Architectural Design in Foundations Courses,”* written by Stanislav Roudavki, in 2011, where a similar project is presented to a foundations studio at the University of Melbourne. Both projects begin by studying the transformation of a two-dimensional planar surface into a three-dimensional geometry through the act of folding. The pieces are then digitized, edited and fabricated. Where the two projects deviate is that in the University of Melbourne studies the entire geometry is a module that is deployed as a system, which has the ability to change in scale and proportion, generating beautiful sculptural objects. The assignment at NYCCT attempts to distill the geometry by establishing the variables that make up the module itself, while also studying notions of structure and enclosure with analog means. These differences endeavor to avoid the inherent seduction of complexity generated by the computational ability of the tool allowing the student to consider the why, and not only the what, and to move past a formal response and instead develop a design strategy with a conceptual premise.

The challenges of adopting the 1x1 approach

The implementation of the Digital Spine has not occurred without its challenges. Increasing the amount of coursework has put pressure on professors to not only teach conceptual design thinking and representation but to also incorporate the new tools into the courses. For the professors whose design process does not incorporate digital tools this is a pedagogical problem and for those that do it is a problem of time. The Digital Spine was implemented without a change to the number of course credits and so has effectively increased the course content without increasing the number of contact hours. In order to realize this change a number of support mechanisms have had to emerge including the incorporation of inverted classrooms and the development of video tutorials, software primers, workshops, industry partnerships, software support inside and outside of the classroom and increased faculty training and coordination.

At NYCCT these support mechanisms have manifested themselves through the development of NYCCTfab, a computation and fabrication digital media assistance website that provides access to tutorials and primers created by students and faculty who have expertise with particular digital tools and the hiring and training of Digital Media Assistants who provide in-class support, one-on-one tutoring and weekly digital dexterity workshops. The intent of the Digital Spine was that the

digital tools would be introduced in the studios as needed during the development of the design projects. To accomplish this digital tools are introduced in class, with support mechanisms in place outside of class, which are in alignment with the development of the projects.

The implementation of the Digital Spine has effectively increased the content being taught in the design studios. This affects both the time allotted to deliver content and puts a burden on the professor to know this additional, and sometimes new, material. In order to deliver the added content without compromising the quality of what is taught further measures have been put in place. Digital Media Assistants, who focus on the teaching of digital tools, are assigned to each design studio, teaching modules have been introduced by specialists in a particular software or design methodology and inverted classrooms are used where students are required to complete software tutorials outside of the classroom so that professors can focus on the teaching of conceptual design thinking rather than on technical tools.

Conclusion

The relationship between analog and digital tools and processes is not separate but equal in a 1:1 relationship but rather intertwined and symbiotic in a 1x1 relationship leading to a multiplicity of opportunities and potentials that architecture students must contend with. With the implementation of the Digital Spine we have come to the realization that these tools should not be taught exclusively of each other but synergistically with each informing the student of different possibilities. In foundations studios it is our role as educators to expose students to the range of opportunities available to them and to teach the critical thinking skills necessary to investigate and evaluate these opportunities so that they may develop their own individual design agendas.

Notes

¹ Bermudez, Julio. "Inquiring Between Digital & Analog Media: Towards an Interfacial Praxis of Architecture." *Proceedings of the 85th Annual Meeting of the ACSA: "Architecture, Material & Imagined*. 1997. p520-23. Print.

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