Subverting Gender in the Design-Build Studio

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Like the construction industry, the design-build studio is often assumed to be a male-dominated activity. Furthermore, the emphasis on digital fabrication in the design-build studio, as presented here, can further this masculine technological focus. On the other hand, architectural education is approaching a 50/50 gender split, and in fact the design-build studios presented here further this trend with approximately 67% female and 33% male enrollment. Even as the gender split nears equality in architectural education, this does not address differing gendered learning styles and interests taught by a male-dominated faculty. Furthermore, it does not address the contribution to studio culture that female learning styles may provide.

INTRODUCTION

The majority of my research over the last decade has focused around developing a materials sensibility through digital fabrication and the associated shifts in design culture enabled by these technologies. My interest in these technologies is how they may enable and empower the architect, and this should no doubt include both males and females. Nonetheless, in this published work I have never addressed the role of gender[1], nor am I aware of any work that broaches the subject of gender and digital fabrication in the architecture community[2]. To be sure, when I began my focused interest in digital fabrication over ten years ago I did not set-out to examine the role of gender in technology, in fact the aspect of gender and digital fabrication never occurred to me. As a male, I feel ill-prepared if not disqualified from taking a feminist position, nor do I wish to. However, what I have read in regards to gender and technology and what I have experienced in the female-dominated design studios I have led suggests there may be a contribution to design culture in broaching this issue. My central position is not that we need to address the gender issue now that we are approaching a 50/50 gender split in architectural education[3], but rather that addressing this issue is for the better of design, education, and in this case, particularly in regards to the influence of technology on design culture. As such, it is fair to say my interests are not pro-feminist, but levied as a critique of aspects of digital culture that were only made visible upon addressing the role of gender.

Methods of ethnography, particularly participant-observation involved positioning myself as an "indigenous ethnographer[4]" in the design studio through a daily practice of note taking after studio sessions as well as communal exit interviews after the projects were complete. This placed emphasis on what was said and reflected upon, not only what was produced. This method became a subtle if subversive instrument to draw out and challenge prevailing attitudes:

> This perspective allows one to be part of his own culture, and, at the same time, to be out of it. One views the activities of his own group as would an anthropologist, observing its tribal rituals, its fears, its conceits, its ethnocentrism. In this way, one is

> able to recognize when reality begins to drift too far away from the grasp of the tribe[5].

In other words, the methods allow one to get out of themselves, to see one's own interests from a different perspective. In this essay I will briefly introduce the aspect of "feminist technology" to help clarify my position in regards to gender and digital fabrication, to then introduce how gendered ways of knowing may have a positive affect on design culture. Through this understanding, I will look back at previous digital fabrication-based design-build studios, some of which have been previously published while focusing on the F-Stop Student Lounge which has not been previously published, to emphasize an iterative, integrative, and inclusive approach to digital fabrication in the design-build studio. In the end, really, these are simply good if obvious practices, but combined with the literature on gendered learning styles proposes that hands-on immersive design-build is as attractive to females as it is to males. The subtle distinction may be that acknowledging the gender issues supports a more reflective and discursive process as a shift in studio culture rather than simply getting it built.

FEMINIST TECHNOLOGY

Gender and technology has developed into a field in itself, along with a strong feminist position from the Science and Technology Studies (STS) community. At its core, "feminist technology" combines technological innovation with social change to benefit and empower women[6]. Examples of feminist technologies include breast pumps, birth control pills, and even tampons, with research into these revealing how these technologies can liberate as well as suppress women and their changing roles in society. Importantly, this research questions how the very technologies may have evolved if differing, more feminist viewpoints were asked at the inception of their design process. To make an important distinction, there are at times products that are designed for women that are merely more femine, such as the example of a jeweled cell phone, which is nothing other than altering the appearance or dressing-up a product to sell to a preconceived idea of feminity (and often a male idea at that), whereas a feminist technology would be one that liberates or empowers women. In relation to the issues here, the question of gender-bias in design does not only need to apply to the design of technology, but the design of design curricula as well.

In her introduction to *Feminist Technology*, Linda Layne defines technology as "tools plus knowledge" while her emphasis is on defining the feminist position within feminist technology. Of note is the combination of the two that includes "those tools plus knowledge that enhance women's ability to develop, expand, and express their capacities". I find this definition significant, as this could very well be a working motivation for digital fabrication if one were to replace the word "women's" with "architects'." After all, digital fabrication is not simply about changing the appearance or aesthetics of designed objects and environments, but fundamentally is about the empowerment of architects[7]. But is the architect male? Furthermore, is computer numerical control a masculine[8] technology? Does it empower male interests more than female, or even suppress female interests? Certainly it is and could if one sees this as an extension of the command-and-control military-industrial complex through which computer numerical control was formed[9]. Despite these military origins, the integration of digital fabrication in the design process is intended to be much more iterative, integrative, and inclusive through working across scales including full-scale prototyping as well as the development of loose and imprecise ideas to the precision of pre-fabricated material assemblies. Certainly the issue of gender is easy to overlook in the discussion of material assemblies, but there may be more at stake in the "iterative, integrative, and inclusive" aspects of digital fabrication.

By *iterative*, digital fabrication is at its best when design ideas can be tested out early and often for continual refinement which requires a critical reflection on the process, but all too often digital fabrication can encourage a brute-force jump to production at the end of design and without critical reflection. By *integrative*, digital fabrication is at its best when enabling a wider set of design issues as a result of testing out through multiple scales including full-scale, but all too often digital fabrication is seen as model making tools, or worse, becomes so infatuated with its own modes of production does not engage spatial, social, or environmental factors at the core of architecture. Finally, by *inclusive*, digital fabrication should be as equally appealing to males and females alike in its reduction of the heavy strain of manual labor, but when digital fabrication over-looks the iterative and integrative opportunities for the instrumentality of pro-

duction and isolated technological novelty, it may very well be that this focus on technological bravado alienates those whose interests are more iterative, integrative, and inclusive. Certainly these interests include both males and females, however some literature on gendered learning styles suggests that particularly females are in tune with reflection-in-action.

GENDERED WAYS OF KNOWING

While there is no longer a gender gap to speak of in enrollment in architecture schools, studio culture and curricula may still contain a long-standing gender bias. For example, architectural educator Frances Bronet has suggested that the very legacy of architectural education from master masons and carpenters through apprenticeship eliminated a gender voice to begin with[10]. As architecture education has evolved, she notes:

> the studio is laced with internal contradictions: it is founded on a competitive model with a bias towards the designer as a precious individual uninhibited by the input of others, while it prepares students for a profession that requires collaboration with engineers, contractors, clients, managers, and so forth.

Sue Rosser, a feminist researcher in gendered learning styles in the sciences, has emphasized the need for hands-on interactive approaches to engage students directly with experimental science[11]. These methods stress collaborative learning over competition placing science in its social context. Rosser, who was initially trained in Zoology, has focused on feminist approaches to teaching biology, noting in particular:

> Ecology is the field within biology where the traditional scientific theory and approach are most in harmony with a feminist approach to the subject. Ecology emphasizes the interrelationships among organisms, including human beings, and the earth[12].

Architectural historian Mary McLeod has noted the waning attention to gender since the early 1990's suggesting that this lack of attention to gender studies in architecture is likely due to young faculty's interest in sustainability and digitalization[13]. Could there be a gender bias in choosing to focus on ecology or digitalization as the combined contributions of Rosser and McLeod might suggest?

Certainly both genders have interest in sustainability, but identifying gender bias suggests there may be masculine and feminine approaches to sustainability. For example, approaching sustainability through a technological fix such as hybrid cars and solar panels could be seen as a masculine approach. Not that these technologies are bad, but to solely accept a technological fix extends the status quo, rather than a reconceptualization of our patterns of behavior and their affect on our ecosystyem, which Rosser identifies as a feminist approach in biology.

In *Women in Green*, Gould and Hosey (a female and male) borrow from ecologist David Orr's distinction between technological sustainability, which is quantitative and relies on doing the same thing more efficiently, and ecological sustainability, which is qualitative and requires a fundamentally new way of doing things[14]. Furthermore, in alignment with Rosser's feminist stance on learning styles, Gould and Hosey draw from contemporary research that girls learn through social interaction rather than through the simple transmission of information[15]. They interview three leading female architecture professors, each with a focus on sustainability, and each of these professors identify that the best way for students to learn is to experience themselves as part of nature through physical experience and in so doing, develop their body knowledge through hands-on, kinetic, field-related learning and the immersion in tangible experience. Francis Bronet's empahsis on gender in the design studio emphasizes the "reciprocity between space and movement" developed through design-build in which the design process is continually "in-the-making"[16]. But the improvisational and quilted approach that Bronet

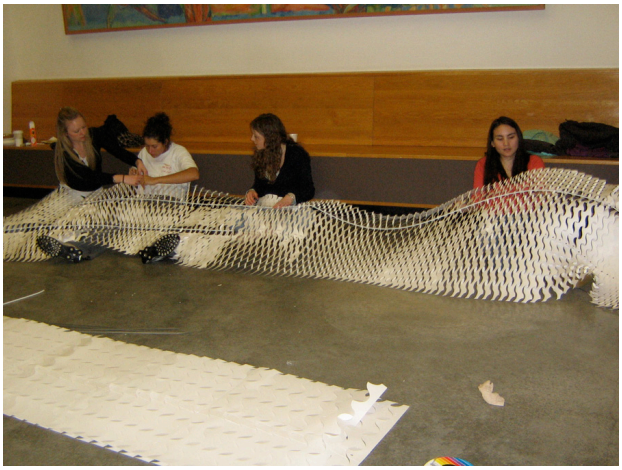

Figure 1. While the term "digital fabrication" places emphasis on the technology, the process of assembly is often a very social process and is certainly hands-on.

Figure 2. The Moveable Feast installation employs a zero-waste process to address issue of sustainability within digital fabrication (Spring 2009).

advocates may indeed be suppressed by the context of digital fabrication which by necessity requires computer code to be thought out in advance. To be sure, this does not preclude digital fabrication as being integrated into a more material oriented, even quilted approach, as I have written about[17] (figure 1). It is not simply technologies that suggest gender bias, but how they are appropriated and employed may include gender interests as well. If we can accept there might be gendered approaches to sustainability, then could there not be gendered approaches to digital technologies? The absence of such a proposition may simply be that digitalization has indeed been so male dominated.

To repeat, my suggestion is not that now that we are approaching gender equality in architectural education we need to include a more gender-neutral approach to digital technology, but rather, a more iterative, integrative, and inclusive approach is for the better of architectural education. Perhaps not unrelated, there has been a two-cultures approach to design research, one emphasizing sustainability and the other in digital technologies. Clearly what is needed and is indeed beginning to turn is a more ecological approach – both in terms of the environmental sustainability and systemic integration – of digital technologies. In many of my studios the emphasis on zero-waste processes in digital fabrication has emphasized environmental sustainability while achieving digital integration, such as in the Moveable Feast installations (figure 2). As one female student remarked of this experience, "more process, less material.

DESIGN-BUILD: BRUTE-FORCE VS. REFLECTION-IN-ACTION

My interest in the design-build studio is more about a reflective process than simply about getting it built. Nonetheless, as anyone who has taught a design-build studio knows, there can indeed be a

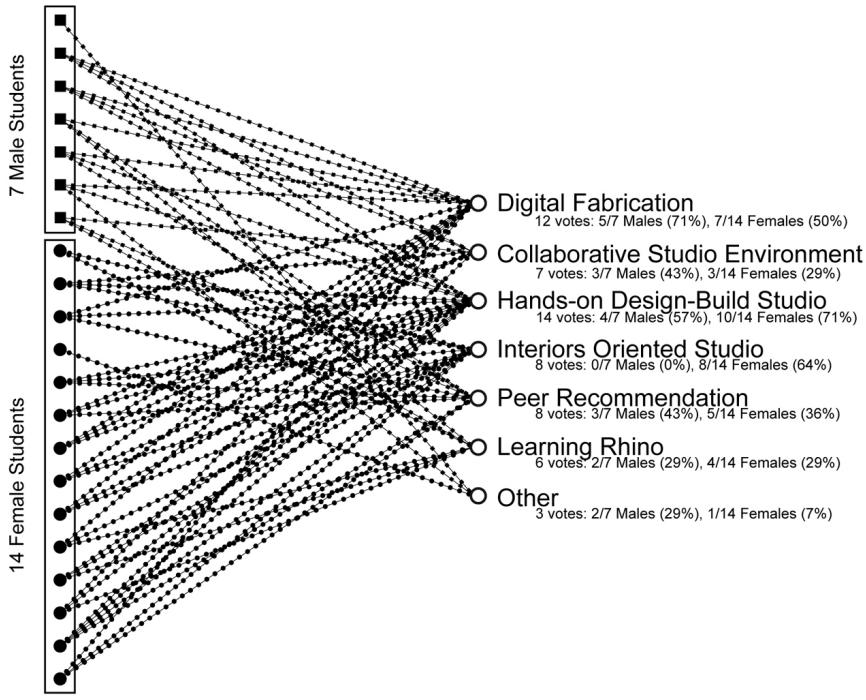

Figure 3. Survey graphical analysis which shows fairly evenly distribution of interests, with a subtle distinction between interest in digital fabrication + hands-on design build for males, and the inversion of these shared interests with females showing a slight interest in hands-on design-build first, then digital fabrication.

rush-to-build desire that is often supported by a brute-force grab-a-hammer and start swinging mentality. Ideally, the introduction of digital fabrication in the design-build studio is intended to enable a more iterative and integrative, if not inclusive design process due to the need to pre-process through pre-fabrication. The automata within digital fabrication allows for a reflection on action as a way to shift positions briefly looking in from the outside[18]. In other words, the reflectivity required in this process should support reflection-in-action over brute force. But could gender indeed enter as well in this distinction between brute-force and reflection-in-action?

In Donald Schön's analysis, his pseudonyms Petra, for the studio master, and Quist, for the student, are such obscure names the issue of gender is not apparent, and perhaps intentionally so[19]. However, in my ethnographic analysis, I only noticed after the fact that I was selecting female reflections more than male[20]. I found females to be more reflective and conscious of their actions in class discussions, whereas males were more focused on getting the technology to work, but didn't care much to discuss it after the fact. This analysis was developed from studios conducted in Fall 2005, Winter 2006, Spring 2008 and 2009, and Fall 2009 which totaled 28 males and 57 females, or 2 times the number of females. This includes three studios which were not advertized as design-build but included full-scale installations, and their enrollment due to gender varied widely: Winter 2006 had 16 females taught in the Interior Architecture Program at University of Oregon, and enrollment in the Spring 2008 and 2009 studios at Cal Poly was inverted one year to the next with 6 males and 11 females in Spring 2008 and 12 males and 6 females in Spring 2009. What was consistent was the studios that were announced as design-build were preferenced by females over males by large margin with the Fall 2005 studio at RPI with 3 males and 10 females, and the Fall 2009 studio at Cal Poly with 7 males and 14 females. These numbers surprised me, as I was concerned that I would get a totally male studio due to the design-build announcement, but in fact, the inversion of my expectations and preference for hands-on by females both supports Rosser's female learning styles as well as interest in hands-on as reflected in *Women in Green*.

As I became aware of the role of gender in my previous design-build studios, in the Fall 2009 design-build studio for the F-Stop Student Lounge, I not-

Figure 4. The F-Stop Student Lounge (Fall 2009).

ed the large female enrollment in this studio and became curious about the gender interest in this studio. On the first day of class, after introducing the syllabus I gave a simple survey to see if there were any obvious gender interests (figure 3). While statistically too small of a sample to have any authority, there are a few subtle distinctions which may be suggestive. Some stereotypes do tend to be upheld, such as 64% of the females preferenced the studio due to the stated focus as an interiors-oriented studio, while no males prioritized this. On the other hand, only three males and females selected the collaborative studio environment, though due to the smaller male enrollment, as a percentage more males than females prioritized the collaborative nature of the studio. Despite what the feminist literature might show, men are interested in collaboration too. The revealing statistic is a very subtle one. Both genders expressed a strong interest in digital fabrication and hands-on design-build as males preferenced digital fabrication slightly more than females (71% males to 50% females), whereas these numbers were inverted as females slightly preferenced the hands-on aspect more so than the males (57% males to 71% females). The nuanced inversion of these numbers suggests that there is not a categorical difference between genders, but a slight shift in emphasis. This shift in emphasis can be balanced in an iterative, integrative, and inclusive design pedagogy.

F-STOP STUDENT LOUNGE

The F-Stop student lounge is organized around a minimalist display wall of maple veneer plywood with lighted niches and moveable model stands and pin-up space, along with an adjacent window wall with built-in sitting boxes, all set within a horizontal datum line of black chalkboard-painted MDF panels (figure 4). The design feature of the space is a parametrically developed ceiling "cloud" constructed of 1,000 uniquely fabricated parts, each individually labeled and prefabricated into hexagon assemblies.

COLLABORATIVE DESIGN PROCESS

As a digitally-enabled design-build studio, this project offers a different model of studio education shifting the studio from a collection of students working on individual variations of a given design problem, to an atelier model of a collaborative studio bound through the design and realization of a single project. By subverting the cult of individuality engendered in the traditional design studio, this digitally-enabled design-build studio projects a lasting image of a more collaborative design culture. The success of this studio is due in large part to the number of strong female personalities in this studio.

Figure 5. The F-Stop Studio worked across numerous scales from full-scale sketch models in the background, prototype assemblies in the middle ground, to highly precise model-as-prototype in the foreground laser-cut from full-scale fabrication cut files as a test of construction prior to full-scale fabrication and assembly.

The social dynamic of the studio and the highly discursive environment aligns with Rosser's research on the social dynamics of female learning styles[21].

At the same time, the design and execution of this design-build studio in an 11-week term was made possible through the speed and precision of digital fabrication and a rigorously digitally mediated design process. The balance between rough sketches to refined prototypes exemplifies a more iterative, integrative, and inclusive approach to digital fabrication (figure 5).

By *iterative*, design propositions were developed from loose and imprecise physical sketch models to precise laser-cut prototype models which were constantly refined for further detail from design ideas to subtle shifts in joints required for sequence of assembly issues. By *integrative*, full-scale prototypes in rough cardboard models were quickly developed to test design ideas and further developed as refined digitally fabricated prototypes which became a proof-of-concept testing out the entire material assembly which often sent the design team back for further refinements. Furthermore, digital fabrication was integrated not only into the design process, but into the design itself. While every piece in the project was required to be pre-fabricated through digital fabrication, only the ceiling assembly appears as something digitally fabricated. By *inclusive*, digital fabrication enabled a level of precision and detail and gave access to a scale in development to everyone in the studio regardless if they had previous experience with building and regardless of gender.

For both males and females a like, the collaborative nature of the studio and the introduction of digital tools and digital fabrication were new to them. Rough hand-cut physical sketch models gave access to all at the early stage of the design process, while the detailed and rigorous introduction of laser-cut scaled model-as-prototype were tested out from full-scale cut files from highly precise digital models. The model-as-prototype required a reflective dialogue between students on both aesthetic issues, such as the role of joints, as well as sequence of construction issues and issues of assembly. For each of the design teams responsible for specific sections of the project, from the display wall, to the "slounge" or sleeping lounge, to the sitting window boxes, to the kitchenette, 3-4 highly precise and subtly differ-

ent model-as-prototypes were required prior to full-scale construction. This suspended the brute-force desire to jump to construction, prioritizing a reflective and detailed process such that full-scale fabrication went together quickly in the last 2.5 weeks of the studio through this design-for-assembly approach. The female student who designed, developed and fabricated the sitting window boxes summarized: "This process has made me fearless, now I feel like I can build anything."

CONCLUSION

Rather than a brute-force jump to production, the introduction of digital fabrication in this studio enabled a conscious reflection-in-action that further exemplifies a working definition of technology as tools plus knowledge. The integration of technology as tools plus knowledge in the design studio suggests subtle degrees of emphasis rather than categorical differences upheld by gender stereotypes, such as "boys with their toys." Nonetheless, the competitive drive for technological innovation no doubt generates knowledge, but emphasizes novel uses of the tool. A more reflective process on how these tools generate knowledge may be supported by a more gender-aware approach. Rather than gendered differences, these are significant but subtle shifts in emphasis, and an emphasis we can do something about. If the subversive question of gender suggests a more iterative, integrative, and inclusive approach to technology in design culture, then I am all for it.

ENDNOTES

1 Beyond the work that I have presented through academic conferences such as ACSA, ACADIA, and NCBDS, my doctoral dissertation "(In)forming: the Affordances of Digital Fabrication in Architectural Education" briefly addressed the issue of gender at the request of Linda Layne, one of my advisors. This reflective essay is my first attempt to present this difficult if thorny issue in an academic conference.

2 This is not to say that there are not phenomenal female designers in the area of digital fabrication and design technologies such as Monica Ponce de Leon, Jeanne Gang, Billie Faircloth, and Anna Dyson as well as a younger generation such as Neri Oxman, Heather Roberge, and Elena Manferdini to name a few.

3 National Architectural Accreditation Board (NAAB). "2009 Report on Accreditation in Architectural Education." Last accessed at *http://www.naab.org/accreditation/statistics.aspx* on April 26, 2010.

4 Clifford, James, and George E. Marcus. *Writing Culture: The Poetics and Politics of Ethnography* (a School of American Research Advanced Seminar). University of California Press, 1986.

5 Postman, Neil, and Charles Weingartner. *Teaching as a Subversive Activity*. Delta, 1969, page 4.

6 Layne, Linda, Sharra Vostral, and Kate Boyer. *Feminist Technology*. University of Illinois Press, 2010.

7 For example: Sheldon, Dennis. "Tectonics, Economics and the Reconfiguration of Practice: The Case for Process Change By Digital Means." *Programming Cultures (Architectural Design)* 76, no. 4 (2006): 82-87.

8 In comparison to feminist technology, it would be grammatically more appropriate to refer to masculinist technology. However, in reviewing the term masculinist on-line, the term itself appears to be in use in varied forms and agendas which I would wish to stay well clear of.

9 Nobel, David. *Forces of Production: A Social History of Industrial Automation*. Oxford University Press, USA, 1986. Hookway, Branden, Sanford Kwinter, and Bruce Mau. *Pandemonium : The Rise of Predatory Locales in the Postwar World* (Architecture At Rice). Princeton Architectural Press, 2000.

10 Bronet, Frances. "Quilting Space: Alternative Models for Architectural and Construction Practice." *Knowledge and Society* Vol. 12 (2000): 229-61.

11 Rosser, Sue V. *Re-Engineering Female Friendly Science* (Athene Series). Teachers College Press, 1997.

12 Rosser, Sue V. *Teaching Science and Health From a Feminist Perspective* (Athene Series). Teachers College Press, 1986, pages 28-29.

13 McLeod, Mary. "Perriand: Reflections of Feminism and Modern Architecture." *Harvard Design Magazine* No. 20 (2004). Last accessed at *http://www.gsd.harvard.edu/research/publications/hdm/back/20_onhistory.html* on April 26, 2010.

14 Gould, Kira, and Lance Hosey. *Women in Green: Voices of Sustainable Design*. Ecotone Publishing, 2007, page 9.

15 Ibid, pg. 131.

16 Bronet, Frances. "Quilting Space: Alternative Models for Architectural and Construction Practice." *Knowledge and Society* Vol. 12 (2000): 229-61.

17 Cabrinha, Mark. "Life Size: Environmental Knowing Through Full Scale Installations." *Proceedings of the ACSA National Conference*, Portland, Oregon, 2009. Mark Cabrinha, "Parametric Sensibility: Cultivating the Material Imagination in Digital Culture*," Life In:Formation: the Proceedings of the Association for Computer-Aided Design in Architecture* (ACADIA), New York, New York (2010). Mark Cabrinha, "Crossing the Digital Divide through Digital Dexterity." *Proceedings of the ACSA National Conference*, Montreal, Canada (2011).

18 Canguilhem, Georges. "Machine and Organism." *Zone 6: Incorporations*, edited by Jonathan Crary, and Sanford Kwinter, Zone Books, 1992.

19 Schön, Donald A. *Educating the Reflective Practitioner : Toward a New Design for Teaching and Learning in the Professions*. ed. Jossey-Bass, 1987. See my "Life-Size: Environmental Knowing Through Full Scale Installations" for a closer look at Schön. References to "reflection-in-action" are attributed to his work.

20 The analysis I am referring to is in my doctoral dissertation. In fact, it was Linda Layne who wanted to know of the gender behind the voices in my ethnographic reflections that quickly made apparent the dominance of female reflections in my analysis. For example, in "Life-Size" I chose to use gendered pseudonyms at Linda Layne's suggestion.

21 Rosser, Sue V. *Teaching the Majority: Breaking the Gender Barrier in Science, Mathematics, and Engineering* (Athene Series). Teachers College Press, 1995.