ECOLOGICAL DESIGN | DESIGN ECOLOGY: INTEGRATING SYSTEMS THINKING INTO EARLY DESIGN EDUCATION

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1 ABSTRACT

As a professionally-oriented discipline, education in landscape architecture requires a curriculum with the fundamental capacity to both teach the skills necessary to operate within the contemporary expectations of practice while expanding the nebulous intellectual boundaries of the discipline. Emerging pedagogical frameworks in education are shifting to a more systems-based approach focusing on the recognition of relationships and functional processes of engagement over the need to identify specific and static solutions or responses. While Landscape Architecture programs may already incorporate systems-based pedagogy in their design curriculum, the scope of literature available for how this is done is relatively limited. In this paper, we present our approach to a systems-based design education through two related courses, a studio and lecture that introduce basic ecological principles and integrate them with the design process in the initial year of Landscape Architecture studies at the University of Washington. The application of this framework has had mixed results. We find students have difficulty with: 1) comprehending the complexity of core ecological concepts and their spatial relevance; 2) incorporating the temporal aspects of biophysical processes and focusing on the sometimes intangible qualities of relationship-building reduces students' capacity for form-making; and, (3) a linear approach to narrative representation of design proposals doesn't capture or express the multidimensional interactions inherent in ecological systems and in the design process.

1.1 Keywords

design education, studio, systems thinking, pedagogy

2 INTRODUCTION

As a professionally-oriented discipline, education in landscape architecture requires a curriculum with the fundamental capacity to both teach the skills necessary to operate within the contemporary expectations of practice while expanding the nebulous intellectual boundaries of the discipline. To meet these requirements necessitates that education programs continually assess curriculum structure and content, and adapt to changing needs (Schön, 1985). A primary component of this assessment is the evaluation of the pedagogical frameworks, tools, and processes used in the delivery of knowledge to initiate and expand learning potential.

It has long been acknowledged within the design and planning disciplines that a structured hierarchical and linear approach to delivering information, such as with a strict lecture format, does not adequately facilitate the learning process or engage in professional skills development (Schön, 1985). Used as a pedagogical tool for decades, studio (or workshop) courses provide an opportunity for process-oriented and applied learning (Higgins et al., 2009; Frank, 2006). The studio is a relatively rare pedagogical approach in university environments, but is particularly powerful in teaching students to identify, assess, and generate solutions for complex problems (Tasker et al., 2011; Boyer and Mitgang, 1996). It offers the opportunity to build disciplinary vocabulary and learn new technical skills while introducing a practitioner's perspective in its approach to addressing complex topics (Ledewitz, 1985). The studio classroom is a place where students learn by doing, a venue for hands-on learning that requires an active role engaging with and incorporating distinct components of the curriculum into a comprehensive project (Ochsner, 2000). It provides the venue to focus on learning activities that exemplify an epistemology of "knowing-in-action" (Schön, 1983), ideally transforming the divide between idea generation and application in the design process.

Yet the methods for how learning is accomplished in studio can vary greatly. An emerging call from educators and practitioners in the design disciplines has sought to reevaluate a pedagogy that supports only an individual's autonomous creativity and productivity and instead seeks to conduct studio courses as an open-source experiment in which value is produced through the collaborative processes of research and design in an attempt challenge conventional practice within the fields (Steele, 2004; Milburn and Brown, 2003; Boyer and Mitgang, 1996). This approach aligns with broader transitions within education that are shifting to a more systems-based approach focusing on the recognition of relationships and functional processes of engagement over the need to identify specific and static solutions or responses (Tasker et al., 2011).

While Landscape Architecture programs may already actively incorporate systems-based pedagogy in their design curriculum, the scope of literature available for how this is done is relatively limited (Tasker et al., 2011; Ahern, 2002; Poole et al., 2002; Tamminga et al., 2002). In this paper, we describe our approach to systems-based education through two related courses, a studio and lecture that introduce basic ecological principles and integrate them with the design process in the initial year of Landscape Architecture studies at the University of Washington.

2.1 Systems-Thinking in Design Education

Over the past several decades many of the basic principles and theories upon which the ecological sciences were founded have shifted, instigating an extensive reevaluation of the field. As Kristina Hill describes it, "Recent work in the ecological sciences seeks to envision landscapes as composed of shifting nodes of interaction, driven by dynamic temporal relationships rather than deterministic trends" (2005, p.131). Instead of viewing ecosystems as autonomous, deterministically marching toward an operational equilibrium, ecologists now view them as dynamic, in constant flux, and influenced by contextual conditions in both time and space (Pulliam and Johnson, 2002). These shifts in understanding have forced the design and planning professions to more fully understand and engage with the ecological systems that compose and maintain the sites and regions where work is being accomplished. In many ways the professions have responded by taking a proactive rather than reactive stance, understanding sites as productive, living systems and in some instances generating designs that improve upon ecological functionality, and are adaptive and resilient to shifting conditions (Amidon, 2008).

Following these advancements in practice, design education is also evolving to accommodate a more holistic, systems-thinking approach for understanding landscapes. Physicist and systems theorist Fritjof Capra describes, "…a new way of seeing the world and of thinking—in terms of relationships,

connectedness, and context—that goes against the grain of traditional Western science and education" (2005, p.20). In his proposed framework, he argues for a focus on these intangibles, where "ecosystems or human systems, are characterized by sets, or networks, of relationships" (2005, p.20). His approach urges students and educators to view the landscape systemically, not as parts in isolation but through interactions, and that design must cross scales and embody change.

The core concepts that emerge are that "healthy" systems are adaptive and resilient to changing conditions, and that to understand systems we need to focus less on the physical components and more fully on the relationships and patterns that form cohesion and support function within the system. Walker and Salt (2006) argue that a fundamental tenet for comprehending such an approach to education is to embrace an understanding that people, their ideas and actions, are not distinct from their surroundings, but active agents in system processes. "We all live and operate in social systems that are inextricably linked with the ecological systems in which they are embedded; we exist in within social-ecological systems. […] It is not possible to meaningfully understand the dynamics of one of the domains in isolation from the other." (p.31).

To shift from a theoretical framework to practical approach in design education we argue that systems-thinking in design needs to arise from a synchronization of the concepts, tools, and methodologies currently used in design education. According the Jack Ahern and colleagues (2002) a primary strategy for effectively integrating ecological and systems-based thinking into design curricula is to "show explicitly that ecological concepts apply at all scales and incorporate projects that demonstrate shifting scales of design and planning" (p.382). Systems-thinking in design education becomes focused on 'how' and 'why' something works. Instead of characterizing the design process as a bounded, linear progression, it must be understood as iterative and responsive in a way that blurs boundaries between what may be right and what is most certainly wrong. This ambiguity inheres the design process, where inspiration and creativity coupled with contextual conditions, unanticipated findings, and design objectives drive direction.

What emerges is a pedagogical structure for establishing effective methods in teaching and learning about landscape conditions through a systems-oriented framework that is open, reflective, and responsive, yet directed toward conceptualizing and defining operational perspectives as opposed to static solutions. Kathy Poole and colleagues (2002) argue that to apply this framework within the design studio the focus should be on the functional potential of the design rather than the aesthetic. "The important matter is not that the project "looks" ecological but that it addresses the dynamics of the landscape of which the project is a part—of both the landscape's processes and its forms" (p.420).

In early design education, visions, values, and a philosophical perspective prioritize a conceptual understanding of design process alongside a formalized design solution. We have sought to apply such a systems-thinking approach to introducing students to the general topic of ecologically-based design. Similar to the distinctions between ecological restoration and restoration ecology, we define ecological design through a skills-based, practice orientation that responds to contemporary ecological conditions while improving upon the capacity for those systems to respond dynamically to changes over time (Rottle and Yocom, 2011). Design ecology is the research that assists in determining the performance capacity of ecological design proposals and a pedagogical framework for engaging students in an inquisitive and query based approach to learning that requires them to conceptually understand socio-ecological systems to a depth that enables the assessment of site conditions and the generation of alternative solutions for improving the process.

3 CASE STUDY

The first year of the three-year program in Landscape Architecture at the University of Washington is framed upon a foundational approach to design education that introduces undergraduate and graduate students to the type, breadth, and quality of work done by landscape architectural professionals, as well as the tools necessary to become a viable candidate for employment within the field upon graduation. Split into three terms (10 – 11 week Quarter system) the first introduces students to basic design concepts, design process, and focuses on developing technical representation skills by hand. The second term builds on the first introducing contextual and systems thinking into design by addressing highly urban conditions. The related technical skills introduced include basic digital research and representation programs commonly used in the field. The third term that we focus on in this case study, seeks to build upon and integrate the concepts, processes, and skills taught in the previous two quarters.

The curriculum in this term centers upon two classes; a lecture/seminar and studio course. To facilitate this integration, the faculty member teaching the lecture course also co-teaches the studio. The courses operate syncretically, and the content and approaches build from those used by faculty who previously taught these courses. The lecture/seminar provides students with a basic understanding of ecological processes such as the hydrological cycle and trophic structure using precedents to clarify how these operational systems have been either mimicked or restored by professional projects within the field. Closely linked, the concurrent studio course actively utilizes these concepts through problem-based activities for design and pushes students to seek new and innovative (for them) approaches, and to succinctly and effectively represent their ideas.

To reduce student anxiety about the informational depth and contextual complexity of applying systems-thinking to site design, the courses are taught using a narrative-development framework. As described by Potteiger and Purinton (1998) a narrative framework provides a good opportunity to collect, structure, and present complex information about a topic. “Narrative refers to both the story, what is told, and the means of telling, implying both product and process, form and formation, structure and structuration” (p.3). They argue that landscape is an effective medium for relaying narratives. “Landscape not only locates or serves as background setting for stories, but is itself a changing, eventful figure and process that engenders stories” (p.3-4). By establishing a narrative approach in the design process that gives structure and focus enables the students to build design content and identify effective modes of communication. Individually the frames of the narrative provide opportunities to reduce design ambiguities and develop the detail of designs so that when combined, a structured narrative that is spatially grounded and temporally relevant is developed.

3.1 Ecological Design and Planning – Seminar | Lecture

This discussion-based lecture course provides much of the content described in the narrative-development framework by introducing students (both landscape architecture and non-majors) to the basic principles of ecology and explores their relevance to the design process in landscape architecture. The course is loosely organized into three phases and proactively coordinated with studio progression while focusing on the dynamics and resilience of system relationships, temporal cycles and flows, and spatial hierarchy. Each process is explored in depth explicitly examining changes over time and the influence of human actions on its functionality. As the foundation is set greater complexity is introduced, evaluating the intentions and actions of specific design opportunities focused on improving or reestablishing the performance of the particular process. The final aspect of the class explores specific design actions, successful and not, to build a greater understanding of the capacity for design to be reflective and adaptive, responsive to shifting conditions and changing perspectives.

While formal lectures are provided, the majority of the class time is spent discussing the topics and the assigned readings. Over the term 4 - 5 practitioners and researchers are asked to join the class for a session to present their work and expertise. The invited discussants shift each year depending on the need and focus of the studio project, but the range of expertise spans from climate change science to environmental psychology to civil engineering and hydrology. The class also goes on several fieldtrips to designed sites that employ the ecological design processes we are discussing in the classroom. However, the most appreciated fieldtrip seems to be a visit to the Botany Greenhouse at the University of Washington. The tour focuses on the structural adaptations of plants to respond to often harsh environmental conditions. After the tour the students are asked to use one or more of the adaptations they have learned about to improve upon some aspect of their lives. The biomimetic innovations range from raincatching backpacks to solar-powered bicycles and beyond (Figure 1), however; the important learning objective from this assignment is that the students are able to translate and relay complex information into an effective narrative.

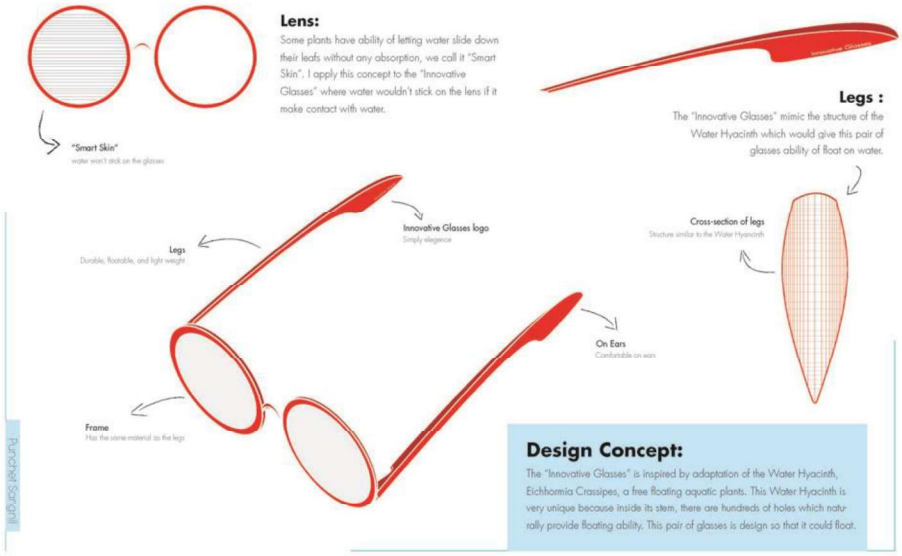

Figure 1. Biomimetic Design Innovations (student: Punchet Sangil)

3.2 Natural Processes in Design - Studio

This studio focuses on the discovery and integration of natural processes in an urban context, emphasizing the intertwined relationships of human use and ecological systems. As students have practiced a site-based design process in the preceding two studios, we shift the initial focus of studio projects towards systems and temporal change that ultimately inform the culminating site design project. This approach is intended to engage students in making explicit the systems and processes that a site plan typically doesn't embody. Students are challenged, as they feel they don't know enough about particular species or processes, as well as how to visually communicate their findings. As such, the initial exercises expand students' repertoire of analytic, conceptual, and representation skills.

As noted in Section 3.0, the sequence of studio projects employ students in narration, asking them to discover and convey a hierarchy of themes and relationships. The first project, introduced with a field trip to the site that will serve for their final design work, engages students in identifying their own experiential and perceptual connections with the site. A list of experiential phenomena is provided as prompts, for students to discover and articulate, and they must identify other phenomena they find meaningful. Students are tasked with creating a two-dimensional composition that expresses a selection of these phenomena, and subsequently, a three-dimensional piece that conveys the relationships among three phenomena. In contrast, the second project tasks students to work in small groups, finding and expressing data at a watershed level using GIS as well as a field trip to sites within the watershed. This project asks students to identify themes of analysis and express their relationships spatially and across three time periods. The project is introduced with presentations by landscape architecture professionals, who provide examples of how such analysis is used in practice. The third project has been revised as a brief design charrette, bringing students back to the site and to expressing concepts as physical form. The subsequent project engages students in discovering and conveying relationships again, that of two species who may be found at the site (Figure 2).

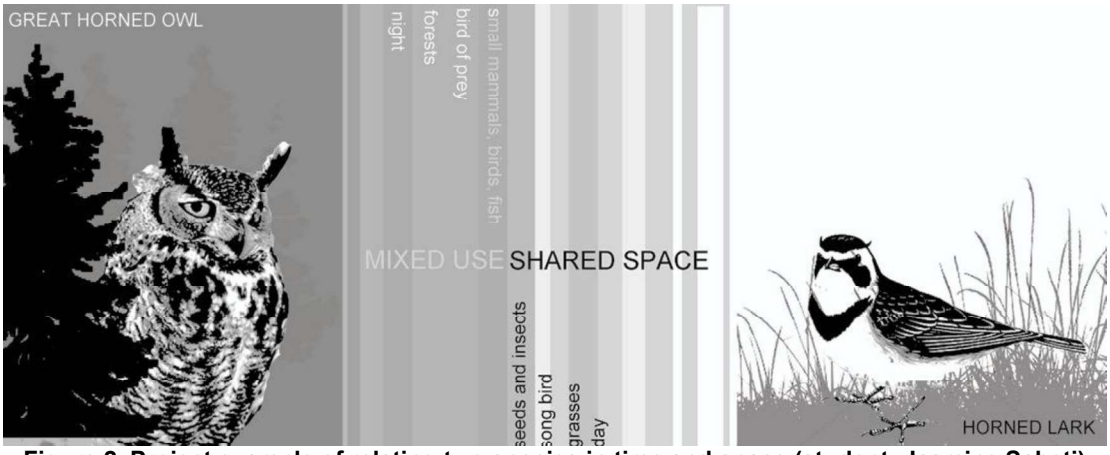

Figure 2. Project example of relating two species in time and space (student: Jasmine Sabeti)

The last third of the term operates as a more traditional design process, of thematic site and program analysis, conceptual and schematic design. But the systems and relationships identified through the preceding projects serve as a grounding and guide for students to integrate, improve, and express ecological processes with human activities. Expression of changes envisioned on the site across time are part of the presentation requirements, which challenges students to consider what time frame is most relevant and appropriate to highlight. The considerations of narrative structure, hierarchy, and dynamic relationships that have been touchstones across the term serve as reminders for the content and the representation of their work (Figure 3).

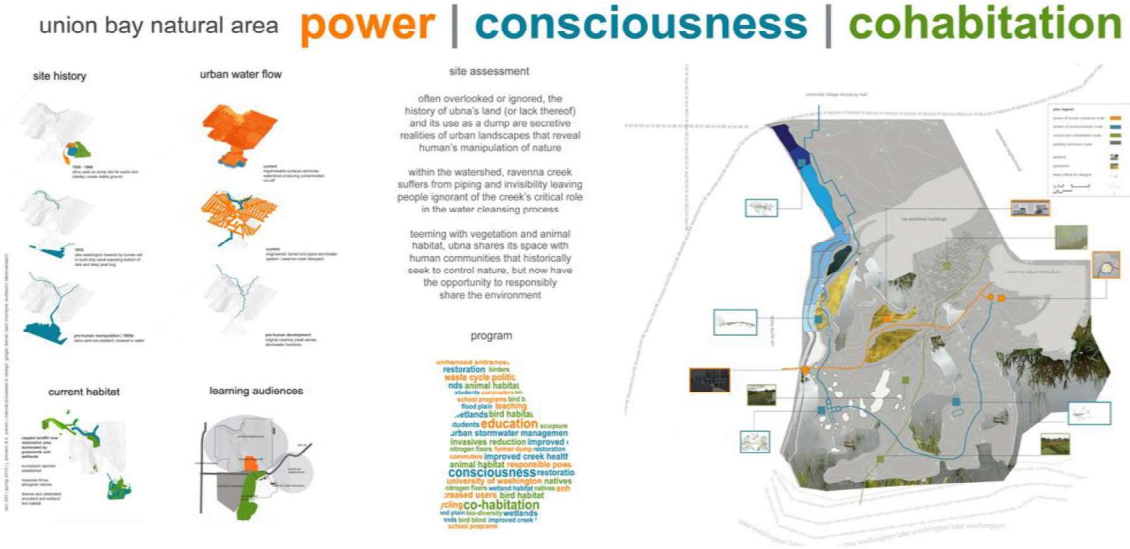

Figure 3. Systems synthesis board for conceptual framework (students: Ginger Daniel, Sam McIntyre, Wuttiporn Taksinvarajarn)

4 DISCUSSION

In our experience, in four years of explicitly utilizing a systems-thinking framework in early design education its effectiveness has had mixed results. Through reviews of student work and student formal and informal conversations with students we find: 1) they have difficulty in understanding and translating core ecological concepts and their spatial relevance; 2) incorporating the temporal qualities of biophysical processes into early design education adds a level of complexity that taxes students' form-making process; and, (3) a linear approach to narrative representation of design proposals doesn't capture or express the multidimensional interactions inherent in ecological systems and in the design process.

Some of these challenges may be rooted in the students' exposure to new content and ways of thinking must be understood and creatively translated through design, when the design process itself is still a relatively new set of practices. The range of project types and shifting focus may be difficult to synthesize and enable a sense of confidence in giving form while envisioning change.

Further, questions emerge regarding the utility of engaging the students across such a broad foundation so early in the program. Greater merit may be gained from focusing on a more defined, deeper, exploration of a particular system. Additionally, while this is their third term, students' graphic skills must span both hand and digital realms, to explore, test, and ultimately communicate their design intentions. And their facility with software that could convey more dynamic, shifting, or alternative representations may still be developing. The pedagogy of this term's courses may best be seen as part of a system of future studios and coursework, where design processes and content deepen and enrich students' understandings of design ecology and their capacities for ecological design.

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