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“\textbf{The struggle to resolve global warming and today’s other pressing environmental and social challenges reflects, more than anything, a crisis of thought...The most urgent need is for all of us to look inside and decide if our core beliefs and perceptions, and the behaviours that they spawn, match the nature of today’s reality and if we are living up to our most deeply felt values and aspirations.}”

\textit{- Bob Doppelt, The Power of Sustainable Thinking}

During the past several years I have had the pleasure of working with colleagues to oversee the development and initiation of two new curricula for the School of Architecture at the University of Minnesota. The first was launching a Masters of Science in Architecture for Sustainable Design and the second was integrating our environmental technology curriculum into required zero-energy, carbon neutral design studios in the first year of the Masters of Architecture program. Through these efforts and continued experimentation, pilot testing, and reflection there are five areas that I think are critical to the successful integration of ecological literacy and sustainable/environmentally conscious design in architectural education:

\textbf{1. Foster Ecological Intelligence:}
Ecological principles - based on essential precepts and patterns of nature - should be taught as the essential underlying concepts of sustainability and environmentally conscious design education. Perhaps due to time constraints, accreditation requirements, lack of knowledge, or simply the desire to focus on architectural issues, few faculty and students have been adequately exposed to the fundamental concepts of ecology. This lack of exposure limits the ability of students [and many educators] to translate ecological principles into architectural design. The Center for Ecological Literacy in Berkeley, California cites six essential principles as a basis of ecology, including: networks, nested systems, cycles, flows, development, and dynamic balance.\footnote{Center for Ecological Literacy, “Principles of Ecology,” Berkeley CA: Center for Ecoliteracy, http://www.ecoliteracy.org/education/principles_of_ecology.html.} While this is just one articulation of essential ecological principles, students and faculty could learn much from even a simple investigation of how these [or other] ecological principles might inform design thinking at varied scales [the region, city, neighborhood, site, building, room, components] or across design issues [water, energy, emissions, materials, waste, etc.]. As psychologist Daniel Goleman suggests, to meet today’s ecological challenges, we need to foster a new ecological intelligence: “The contemporary expression of ecological intelligence extends the native naturalist’s ability to categorize and recognize patterns to sciences like chemistry, physics, and ecology [among many others], applying the lenses of these disciplines to dynamic systems wherever they operate at any scale, from the molecular to the global. This knowledge about how things and nature work includes recognizing and understanding the countless ways manmade systems interact with natural ones....Only such an all-encompassing sensibility can let us see the interconnections between our actions and their hidden impacts on the planet, our health, and our social systems.”\footnote{Daniel Goleman, “What is Ecological Intelligence?,” http://www.danielgoleman.info/blog/2009/04/20/ecological-intelligence-definition.} As design educators, we might simply start with the first principles of ecology.

\textbf{2. Design Ecological Relationships, not Objects:}
To go beyond the limits of current sustainable design practices, architect Bill Reed envisions a “regenerative trajectory,” which will see a fundamental shift away from designing architectural objects toward instead designing ecological relationships: “Sustainability, as currently practiced, addresses generalized and planetary issues by limiting the intensity of the damage we cause. Regeneration is local in practice, and addresses how we partner and thrive in relationship with...
the unique social-ecological system of each place.”“ While the design of architecture ultimately involves the creation of physical artifacts, it is essential to transform design intentions from the creation of static objects to the design of living systems and ultimately living and responsive architecture. Ecological design frames ecological relationships across diverse scales and issues, including, among others, relationships to place, culture, environmental forces (such as the sun and wind), history, time, materials, and construction (both traditional and innovative). While there are ecological opportunities at all scales of design, Christian Schittich, architect and editor of DETAIL, elaborates on the particular promise of multi-layered and dynamic building envelopes: “…the building skin as a responsive skin, as one component of a sustainable low-energy concept. This begins with simple folding and sliding shutters or with the popular moveable louvers and culminated in multi-layered glass facades equipped with a multitude of devices for shading and glare protection, light deflection, heat- and energy gain. Today, in the face of diminishing raw materials and growing CO2 emissions, this approach is increasingly important. It seems to offer the best of both worlds: contemporary façade design without running the risk of superficial ornamentation…” Ecological design requires a shift from thinking of architecture as a static object to seeing it as a series of dynamic and constantly changing systems functioning in relation to the place, users, seasons, and culture.

3. Bring Ecological Theories Into Practice:
Theoretical lenses such as deep ecology, eco-feminism, systems theory, biomimicry, bioregionalism, and environmental justice can be invaluable in providing a deeper understanding for sustainable design education. The integration of theories from outside the design professions is also helpful in extending our design aspirations and visions. Ecological theories can bring fresh and often overlooked perspectives to design. For example, deep ecology can transform an anthropocentric view to a biocentric perspective (design for all life). Shifting from a focus on the parts to an integration of the whole reflects an understanding of living processes as found in system’s theory. Architect and educator Kate Nesbitt, explains in Theorizing a New Agenda for Architecture, “…theory is a discourse that describes the practice and production of architecture and identifies challenges to it…It poses alternative solutions based on observations of the current state of the discipline, or offers new thought paradigms for approaching the issues. Its speculative, anticipatory, and catalytic nature distinguishes theoretical activity from history and criticism…Theory deals with architecture’s aspirations as much as its accomplishments.” Stepping outside the traditional theoretical structures of architecture can provide a transformative perspective that inspires and extends ecological design thinking.

4. Balance Qualitative and Quantitative Considerations:
While qualitative and quantitative analyses are rightfully introduced in the earliest phases of design education, there is also a need to balance and integrate varied design methods, processes, and means of assessment. Given the urgency of current ecological problems, there is a great desire to quantify and verify the potential ecological benefits of design decisions, whether through reductions in CO2 and greenhouse gas emissions, energy consumption, or the elimination of waste. Design guidelines and rating systems have proliferated, in response to the need for verifiable ecological performance. Unfortunately, as we bring the newest computer tools and quantitative assessment methods to the design process, we may displace traditional tools and methods that have an important role to play. Faculty should be cautious to balance both poetic and pragmatic design considerations, tools, and assessment methods from the earliest to the most advanced levels of the design studio. To deepen critical thinking and ecological design skills, the appropriate design tools and methods should be incrementally introduced and tailored to appropriate design levels.

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5. **Extend Partnerships and Classroom Boundaries:**
   The complexity of ecological design education requires new teaching partnerships and alliances. No single person has the knowledge and expertise needed to teach or practice the full range of disciplines encompassed by ecological design. Reconfiguring courses for collaborative teaching, whether through internal co-teaching or as interdisciplinary collaborations, may require overcoming deeply entrenched structures and modes of operation at the University level. Seemingly simple considerations of workload, classroom scheduling, tuition, etc. can be significant hurdles. Additional funding for new faculty, extra course preparation, learning new tools, restructuring courses, pilot testing, and on-going evaluations and student feedback may be necessary. Support and buy-in from administrators and colleagues are necessities. In addition to extending our partnerships, the boundaries of the classroom can and should reach out to the community as well as the built and natural environments. Architectural educators can learn from other ecological educators, as David Orr, Professor of Environmental Studies and Politics at Oberlin College suggests: “A revolution in education is underway and it is starting in the most unlikely places. The revolutionaries are not professional educators from famous universities, rather they are elementary school students, a growing number of intrepid teachers, and a handful of facilitators from widely diverse backgrounds. The goal of the revolution is the re-connection of young people with their own habitats and communities. The classroom is the ecology of the surrounding community, not the confining four walls of the traditional school. The pedagogy of the revolution is simply a process of organized engagement with living systems and the lives of people who live by the grace of those systems.” By extending the boundaries of the classroom into our communities, we can model collaborative design processes while allowing students to observe the environmental forces, rhythms and moods of place, and other bioregional factors that shape and inform ecological design thinking.

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