

# Crystallized Pedagogy: Architecture as a Medium for Sustainability Education

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*ABSTRACT: The notion that human behavior is influenced by environmental conditions is not novel, though this dynamic is often overlooked and underappreciated in the construction of buildings and cities. Particularly in the field of sustainable or green building, focus is directed toward the impact of building-related human behavior on the environment. However, in a reciprocal manner, as humans build we create our own environment which embodies a specific set of ideas, influencing occupants over the lifespan of a building. The lessons locked in mortar and floor plans both limit and encourage certain human behaviors. This educational relationship offers a powerful opportunity for designers to create a crystallized pedagogy that encourages and informs occupants in sustainable patterns of living.*

*Keywords: learning, sustainability, built environment*

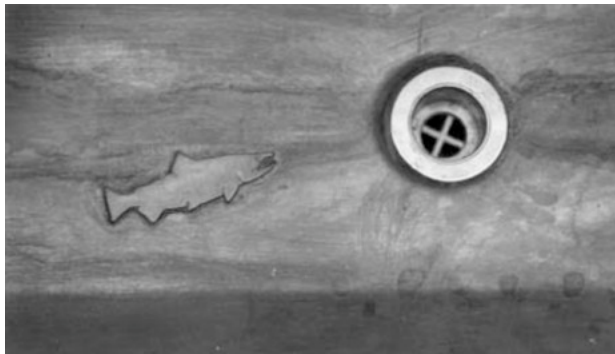


Figure 1: An example of the capacity of the built environment to encourage sustainable behavior. Credit: © Mithun, David Goldberg.

## INTRODUCTION

Research in disciplines from biology to sociology to education suggests our environment shapes the way we think and behave, what we learn, and how we learn it [4, 8, 7]. With the majority of the world's population living in urban areas, buildings and cities *are* the environment for most people [6]. Thus, David Orr asserts "architectural design is unavoidably a kind of crystallized pedagogy that instructs in powerful but subtle ways" [9].

Frequently the instructional or influential role of the built environment is overlooked or underutilized in architectural and urban design. In other instances, the influence exerted and lessons taught by the built environment actively inhibit the development of sustainable behaviors. However, the built environment has the capacity to play an important role in meeting

ecological and social challenges both directly and in support of other learning processes.

This paper explores the behaviors and values various built environments encourage and suggests a framework for understanding the process by which the built environment exerts influence. Using this framework, we examine two case studies in an effort to develop best practices for teaching sustainability with the built environment.

## THE INFLUENCE OF ENVIRONMENT ON HUMAN BEHAVIOR AND LEARNING

"Empirical evidence from diverse sources supports the connection that experiencing natural process and diversity is critical to human material as well as mental well-being," asserts Stephen Kellert in *Building for Life: Understanding the Human-Nature Connection* [4]. Specifically, certain behaviors, such as retail shopping and workplace productivity, have been linked to specific qualities in the built environment, such as the presence of daylight [3, 11]. Thus, both access to natural environments and presence of certain physical properties in the built environment have an impact on human behavior.

The built environment teaches and influences behavior primarily through physical and cultural stimulus. Jacqueline Vischer describes the impact of the physical environment as either a detractor or contributor to human effectiveness [13]. As an example, consider the following images (Figures 2 and 3).



Figure 2: This environment is biologically inappropriate for a panther and could be classified as cruel. Credit: James Burke.



Figure 3: Although this type of environment is common for humans, it may not meet our needs much better, and describes isolation from and control of the environment.

While humans and panthers evolved in similar natural environments, the built environment bears little resemblance to that natural environment. Thus, humans living in the built environment experience physical spaces and stimuli that are different from those to which our species is adapted. Vischer explains that in the extreme, a physical environment can prevent an activity, such as conducting office work while exposed to the rain [13]. More often the built environment does not prevent activities, but instead makes them more difficult, by failing to fully meet human needs. For example, when people work in dreary cubicles with no view to the outside or access to daylight, they are able to continue working, but tend to become relatively unhappy and unmotivated. In these cases, humans manifest this difficulty as stress and decreased efficiency [13].

As well as providing direct physical stimulus, the built environment affects human behavior culturally and socially. For example, educational research indicates that

only with the integration of the built environment into the learning process can the deepest learning occur [12]. David Orr suggests that the built environment conveys lessons on topics ranging from citizenship and ethics to economics and horticulture [9]. Orr coined the term “crystallized pedagogy” to describe the ability of the built environment, such as green buildings, to capture an educational curriculum in the design of a physical environment [9]. For example, at the Adam Joseph Lewis Center for Environmental Studies at Oberlin College, students are able to observe and participate as wastewater from their campus building is purified by living machinery incorporated into the building design.

Some lessons taught by the built environment are intentional, however most are not. As an example, consider a typical suburban neighborhood. In such a neighborhood, it is common for sidewalks not to exist or to run only along one side of the road. Frequently bike paths, bike lanes, or sidewalks end abruptly (see Figure 4). These deficiencies in clean transit connectivity usually go almost unnoticed.



Figure 4: In suburban environments, clean and public transit systems routinely lack connectivity, which reinforces a cultural dependency on automobile transit. Credit: The Fiona Project.

Imagine what would happen if roads similarly lacked connectivity and ended abruptly. Some critics argue that automobiles offer more convenience and shorter transit times than other transit [2]. This is certainly true in an environment that values and prioritizes automobiles over other forms of transit. In built environments that are not dominated by the automobile, such as New York City or Amsterdam, residents learn to use a variety of transit options.

This example illustrates the role the physical environment can play in shaping human behavior. Developing an awareness of the capacity of the built environment to serve as a teaching tool is the first step enabling designers to use the built environment to teach sustainable behavior.

## THE BUILT ENVIRONMENT AS AN INTENTIONAL TEACHING TOOL

There are many examples of architects, governments, companies, and artists using the built environment to convey messages and influence learning. Several are presented here as an illustration.

A sinister example of the intentional use of architectural influence on human behavior is Nazi architecture. Historian Barbara Miller Lane typifies this use saying that “underlying and running as a thread through Nazi architecture and Nazi propaganda was again the promise of a new kind of community, which Nazi writers spoke of as a *Volksgemeinschaft*, ‘people’s community,’ or perhaps, ‘racial community’” [5]. The degree to which this community excluded individual diversity and embraced pervasive centralized authority is expressed in the strong symmetries, stark open spaces, and heavy tectonics present in Nazi architecture (Figure 5). Excellent examples include Albert Speer’s Party Congress Grounds and the 1936 Olympic Stadium in Berlin.



Figure 5: Nazi architecture conveyed the party’s agenda with the use of space and architectural expression. Credit: IAKS.

In democratic societies civic buildings frequently employ Greek and Roman architectural expression as a means to convey cultural values of power, authority, and timelessness. The modern commercial environment actively employs both physical and cultural devices to promote buying. Marketers use logos and graphics on storefronts and interiors as means to teach brand loyalty to customers, while stores with natural light yield higher retail sales [3]. Grocery stores place popular items in the back of the store to encourage incidental purchases. These examples illustrate the types of learning resulting from physical and cultural stimulus in the built environment.

## THE MECHANICS OF CRYSTALLIZED PEDAGOGY

Drawing from a review of research dealing with ways in which humans learn from and are influenced by their environments, the following framework for

understanding the modes of this teaching and influence in the built environment can be derived:

### 1. Demonstration

In this capacity, the built environment functions like a museum. Using signs and exhibitions, buildings explain curriculum to occupants. This mode is most common and is the most frequently used intentionally. The demonstration mode works on a cognitive level, employs the language of symbols, and appeals primarily to achievement-based motivation.

### 2. Experience

This mode classifies the learning that occurs with direct experience, such as on a field trip. Beyond observation, this experience is a kinesthetic and emotional process during which learning occurs with stimulus from all senses. Examples of this mode include seeing daylight and feeling cooling breezes in a passive building or smelling blossoms and feeling foliage in a courtyard garden (Figure 6). This mode appeals primarily to motivation by affiliation.



Figure 6: Sitting beside and working in these buildings at the IslandWood School, these people learn primarily with the second mode: experience. They directly experience passive and green building strategies, such as daylighting, natural ventilation, and rainwater catchment. Credit: Roger Williams.

### 3. Involvement

The involvement mode is engaged when individuals become active participants in the built environment, such as when taking care of a garden or operating a window to cool a room. Individuals gain a deep understanding of curricula through the process of experimentation, observing causal relationships and testing hypotheses. This mode appeals to motivation by influence and encompasses learning by both conscious and subconscious processes.

These three modes of learning from the built environment are, to some extent, independent. Effective learning can occur using only a single mode. However, the deepest and most effective learning occurs when all three modes are integrated.

The modes possess a hierarchical quality. While demonstration is typically the easiest to implement, learning tends to be limited to simpler ideas and teaching tends to be less effective. In Bloom's Taxonomy of Educational Objectives this corresponds to the description of lower level "knowledge and comprehension" skills in the cognitive domain [1]. The third mode, involvement, tends to be more challenging to implement, often requiring education programs to extend beyond the physical limits of the built environment. Because involvement mode learning includes synthesis and evaluation skills, the designer has less control of content, as subjectivity is an inherent aspect of the engaged learning paradigm. However, learning through involvement has the capacity to deeply teach the complex and interdependent ideas associated with sustainability [12].

### **USING THE BUILT ENVIRONMENT TO TEACH SUSTAINABILITY**

For built environments to effectively crystallize a sustainable pedagogy, they must both embody sustainable ideals and integrate the modes of teaching. Such an environment ceases to be an associated collection of components designed to serve the end uses of occupants. Instead it begins to function much like an interdependent ecosystem that includes the occupant. With the inclusion of the individual into the functioning of the built environment, the character of learning shifts. Rather than learning about external systems or relationships, occupants begin learning about themselves, their behavioral tendencies, and their relationships to the social and biological world.

Probably the most important property of an environment of sustainable pedagogy is the capacity of the environment to internalize externalities. Externalities, or unseen unintended consequences of behaviors, generate many environmental problems. For instance, the act of wasting water in a desert city may have few direct consequences for an individual other than a small increase in a utility bill. However, in aggregate, the demand for water in desert regions often severely impacts natural riparian ecosystems.

One example of a built environment that begins to internalize externalities is passive, net-zero, and off-grid buildings. While systems in these types of buildings should be designed to meet the reasonable needs of occupants, if occupants do not properly engage with building operation, they may face consequences. Occupants in a naturally ventilated building may be uncomfortable if they fail to open and close windows properly. Thus they learn to note weather and operational patterns to successfully maintain thermal comfort.

Occupants in an off-grid building may run out of electricity if it is wasted. Thus they learn to monitor battery charge levels and to modify behavior if weather prevents electricity generation. While it may not be reasonable or realistic for the entirety of the built environment to be off-grid and passive, to internalize externalities the built environment must provide the individual both control and feedback.

The presence of complexity and biological diversity also appears to be critically important to effective learning in the built environment [4, 7]. Sustainability education fundamentally involves the development of an understanding and appreciation of interconnectedness and interdependency. Without a complex and biologically diverse learning environment, individuals cannot often learn about sustainability through experience or involvement. Thus, ideas learned only through demonstration do not often translate into action or behavioral changes [12].

An environment of sustainable pedagogy must also directly incentivize and facilitate sustainable behaviors. This may seem obvious, but is frequently overlooked. Individuals must be able to implement the lessons they learn from an environment within it. The most effective built environment must teach, enable, *and* encourage sustainable behavior.

In aggregate, the learning in an environment of sustainable pedagogy may be able to support the development of sustainable social norms and cultural values. A built environment designed to address ecological problems by internalizing externalities and including biological diversity, may have the potential to significantly shift human behavior toward sustainability.

### **CASE STUDIES**

The following two projects demonstrate the framework we have proposed for understanding crystallized pedagogy in the built environment.

#### ***The Desert Living Center***

Located inside the City of Las Vegas, Nevada, the Desert Living Center is an interpretive facility dedicated to educating school groups and the general public about ways to protect the desert environment and the global community. The Living Center adeptly combines built structures with plant and animal habitat to create a rich learning environment (Figure 7).





Figure 7: The Desert Living Center uses demonstration and experience to teach sustainable living skills. The facility integrates buildings and exhibits into the biologically diverse Springs Preserve. Credit: Erik Bonnett.

The built environment at the Desert Living Center facilitates learning primarily with signs, diagrams, and exhibits. Many of these demonstration strategies work to make visitors aware of elements of the built environment to facilitate learning by experience. Note the schematic diagram applied to the side of a cooling tower in Figure 8. The diagram demonstrates the cooling and humidification of air as it passes through the tower. In addition, the tower is located beside the entrance to the building. Visitors see the diagram as they enter the building and immediately experience to cool flow of air coming from the tower.



Figure 8: This downdraft cooling tower and pictorial diagram demonstrate a green building strategy and facilitate the visitor's experiential learning. Credit: Erik Bonnett.

### ***The IslandWood School***

Located on Bainbridge Island, Washington, the IslandWood School offers programs for children, graduate students, teachers, families, and adults to inspire lifelong environmental and community stewardship. The school facilities employ all three modes of teaching to convey curriculum and to support other educational programming (Figure 9).



Figure 9: The IslandWood School is a learning environment crafted to facilitate learning through demonstration, experience, and involvement. Credit: © Mithun, Richard Franko.

The IslandWood School campus includes numerous sustainability strategies ranging from daylighting and natural ventilation to composting toilets and photovoltaic arrays. Many strategies are highlighted and explained with signage. However, the deepest learning occurs as a result of the integration of sustainability strategies into a comprehensive learning environment nestled inside the temperate rainforest. At IslandWood, lessons in ecology or the relationship of humans to the natural environment may involve activities in the greenhouse or living machine. Figure 10 captures a lesson about birds – in a tree house!



Figure 10: During a lesson, a child experiences a bird's perspective on the forest's canopy while inside a tree house. Credit: Kelli Breeton-Fairall, IslandWood

## CONCLUSION

“The ‘art of the eye’ has certainly produced imposing and thought-provoking structures, ...but it has left the body and the other senses, as well as our memories and dreams, homeless.” - Juhani Pallasmaa [10]

The built environment has been and can be used intentionally and unintentionally to influence human behavior. Therein, green building offers an opportunity to use buildings and cities to teach lessons about sustainability. We suggest that learning from the built environment occurs through the modes of demonstration, experience, and involvement. Learning can occur in each mode independently, but is most effective when the modes are integrated. When the built environment engages individuals in learning, occupants may become participants in building operation. Rather than being blindly served by the built environment, individuals begin to understand the interconnected systems and start to play an integral role in the environment's functioning. This co-dependent dynamic internalizes the effects of individual behaviors, which previously had been perceived as externalities. Thus, a built environment that conveys a pedagogy of sustainability has the opportunity to link individual actions and larger social and ecological issues. The resulting changes in individual behavior may have the capacity to play a significant role in addressing contemporary issues of sustainability.

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