The Teaching Green Building: Five Theoretical Perspectives

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Abstract

Teaching Green Buildings (TGBs) are designed to educate building users about green building design and often broader themes about the connection between buildings and their surrounding ecosystems. The outcomes of a well-designed TGB range from increasing knowledge to fostering a sense of place to promoting environmental behavior change. To date, however, these buildings have been weakly theorized in scholarship and haphazardly designed in practice. This chapter draws on an interdisciplinary research base to discuss five potential roles for TGBs as: symbol, science museum, 3D textbook, call to action, and place.

1 Introduction

Teaching Green Buildings (TGBs) aspire to educate occupants about sustainability through building design (Cole 2013b). These buildings expand the conceptualization of green building performance — often measured in gallons, kilowatts, and dollars — to social metrics that include inspiring and educating the people who use green buildings. The strategies used in such buildings draw from scholarship across disciplines and are variously passive and active, individual or collective, and formal to informal (Cole 2014). In practice, for example, design features in TGBs range from energy feedback kiosks to indoor plants to greenhouses used in K-12 science curriculum. The design features vary widely depending on the building program

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and users, but the essential goal of the TGB is to create design that supports sustainability education and engagement.

While any green building could be used to teach sustainability, the TGB is designed for hands-on and minds-on learning experiences. A residential building can be a TGB, but the strategy is more common in commercial, institutional, and educational buildings. Green school buildings, from K-12 to Higher Education, are the most common venues for "teaching green" features. Universities in particular have adopted the strategy of green buildings as "living laboratories" to experiment with green campus buildings as an educational resource (König 2013).

While the term "Teaching Green Building" is employed here, others have used the terminology of green buildings as "3-Dimensional Textbooks" (Kong et al. 2014; Nair and Fielding 2005; Taylor 1993) or "Teaching Tools" (United States Green Building Council 2008) or "Third Teachers" (O'Donnell Wicklund Pigozzi Peterson Architects Inc et al. 2010). The multitude of terms, while converging on a similar idea, reveal different philosophical approaches. The 3-D textbook concept, for example, evokes the idea of knowledge collected by experts and conveyed to an audience who is willing to do the "reading," so to speak. Language that treats TGBs as "teaching tools" for sustainability represents a more reductionist approach, conjuring images of a building as a toolbox, or an assemblage of parts that can be used to construct various types of learning experiences. The third teacher concept, which is rooted in the Reggio Emilia approach to education (Edwards et al. 1997), is a systems approach that applies more specifically to school settings. The third teacher framework encourages a conceptualization of green buildings as working in concert with educators and peers to create a total educational experience. The term "Teaching Green Building" attempts to, with an economy of words, back away from specific settings or pedagogical approaches to offer a broad term that is inclusive of a greater number of building types and educational strategies.

The study of TGBs is an interdisciplinary pursuit that sits at the intersections of architectural studies, environmental education, museum studies, environmental psychology, and beyond. Theory across these domains can be used to craft an evidence-based approach to designing and using TGBs in practice (Cole 2014). Evidence base from empirical research in TGBs is in the early stages of development; we still have much to learn about how and if these buildings work. There are, however, some notable research developments across several disciplines. Researchers of social dimensions in green buildings have shown that green school buildings increase academic performance for students (e.g., Mendell and Heath 2005; National Academies Press 2006) and green office buildings offer a range of benefits to employees (e.g., Brown et al. 2010; Heerwagen 2000). Meanwhile, scholars in landscape architecture connect landscape design to environmental education outcomes (Malone and Tranter 2003; Ozguner et al. 2011; Tranter and Malone 2004). Other research has examined institutional and organizational factors within TGBs from the differing disciplines of environmental design (Barr 2011; Day 2009) and education (Henderson 2014). Work by Kong et al. (2014) used a qualitative case study of a TGB in Bali to create a framework for school design patterns. Other work in green schools shows that the building itself is only one predictor of green building knowledge and environmentally friendly behaviors, where personal context (such as eco-friendly behaviors at home) and socio-cultural factors (such as teachers and administrators) also appear to influence outcomes (Cole 2015).

Despite a growing body of empirical scholarship, we have yet to establish a strong theoretical foundation for the Teaching Green Building. This chapter is among the first efforts to untangle the variety of terms and philosophical approaches across disciplines to illustrate how TGBs can work to achieve a multitude of outcomes. The sections to come introduce five unique ways to conceptualize TGBs as: a symbol of sustainability, a science museum for informal education, a textbook for formal education, a place with which users form an emotional bond, and a call to action for greener practices (Table 1). These theoretical perspectives draw from a range of disciplines or sub-disciplines. Given the interest in *buildings* that *teach sustainability*, the disciplines of Architecture and Environmental Education (EE) are the foundation of this framework.

The five perspectives in Table 1 largely trace environmental literacy scholarship that outlines four key outcomes for EE: knowledge, affective dispositions, skills, and action (e.g., Marcinkowski 2010; UNESCO 1976). For knowledge, environ-

Table 1 Five theoretical perspectives for the teaching green building

The Teaching Green Building as…	Description	Outcome	Sample discipline(s)
Symbol	Green building designed as a symbol of sustainability and culture change	Architectural meaning	Architecture
Science museum	Presence of engagement opportunities to learn about the green building (e.g., signage, displays, or kiosks)	Informal or free-choice learning	Museum studies
3-D Textbook	Green building integrated into educational programming	Formal learning	Environmental education
Place	Green building designed for human-place bonding with intent to connect occupants to the building and/or surrounding ecosystem (e.g., biophilic design)	Place-making	Architecture; environmental psychology; environmental education; sociology
Call to action	Green Building offers opportunities to engage in pro-environmental behaviors and offers behavioral feedback	Behavior change	Conservation psychology; environmental psychology; environmental education; design studies

Source Author

mental educators distinguish between informal learning (Science Museum) and formal learning (3-D Textbook) (e.g., Eshach 2007). Affective dispositions include desirable outcomes such as environmental sensitivity, attitudes about nature, and a having sense of personal responsibility to care for nature, which are summarized here under human-place bonding (Place). Finally, environmental educators generally see environmental skills and action as the ultimate goal of EE (e.g., Hines et al. 1987) (Call to Action). Architectural scholarship further enhances TGB theory by expanding our understanding of the symbolic potential of TGBs. Together, these five viewpoints provide a palette of metaphors for the Teaching Green Building that can be employed in the design process singularly or in complement to each other. Given the vast nature of each body of literature below, the themes are condensed here and bounded by their application to the theorization of TGBs.

2 Symbol

One basic role of a green building is to stand as a symbol of culture change. Sustainability is an abstract, aspirational concept. In this way, it shares a slippery quality common to terms such as art, beauty, and justice. Despite the airy intangibility of sustainability as a societal goal, it is nonetheless made concrete in the world we create for ourselves. Each tangible artifact in the built environment is part of the ongoing narrative of our society's relationship to its surrounding ecology. Unfortunately, in the modern city, the vast majority of buildings today are telling the wrong story about the situation of humans on the planet. Put another way, "the advent of cheap and readily available oil let the modern building work in spite of nature rather than with it" (Sawin et al. 2007). The result is the non-distinct modern building that communicates that locality is unimportant, disconnection is normal, and precious resources need not be conserved (Orr 2002).

Can building design help us to discover our "ecological address," as Vickers and Matthews (2002) so aptly put it? While the first task of a green building, arguably, is to lighten the building's ecological footprint within the surrounding environs, there is also a potentially important role for buildings in culture change. Another major task of a green building could be to shock and delight, decrease apathy, and re-sensitize people to the possibilities of a new relationship to nature through built form. Seibold-Bultman (2007) writes about the need for tangible manifestations of sustainability, or images and objects that bring abstract ideas into focus. These visualizations of sustainability are not simply created to educate, but must be designed to engage and inspire. Not all green buildings are designed to "look" green; however, TGBs, with the intent to educate users, may benefit from architectural design that outwardly communicates green intent. Designers of TGBs are thus involved in the construction of architectural meaning and increasingly helping to visualize what sustainability looks like in a given time and place. Their design choices affect the nuanced ways in which buildings are understood and interpreted by users or the public.

Architectural semiotics is an area of architectural research that began in the mid-20th Century and is a discourse that provides potential insight into architectural meaning in the TGB. This area of research built on earlier foundational work by structural linguist Ferdinand de Saussure, and offered a framework for analyzing architectural meaning by identifying signs present in architectural environments (e.g., Eco 1997; Hattenhauer 1984; Jencks 1980). Fully explicating this theory is more complicated than what can be accomplished in this short chapter. However, there are a few notable contributions the semiotics discourse can make to the theorization of TGBs. One such contribution is the distinction between denotation (what is taken at face value) and connotation (what is implied) (Eco 1997).

It is the functioning of a green building (e.g., energy efficiency, water conservation, environmentally friendly materials, etc.) that at once denotes environmental performance and connotes social change. Understood in this way, green buildings have a dual role of physically conserving resources while also becoming beacons for an ethic of environmental care. Umberto Eco (1997) suggested that architecture can be a challenge for semiotic analysis, and notes that "most architectural objects do not communicate (and are not designed to communicate), but function" (p. 174). He goes on to note that the *function* is part of the *communication*, and this is a particularly relevant point for green buildings where environmental performance is the defining function. Green buildings in general denote and connote environmental stewardship; Teaching Green Buildings, with goals to both function and communicate, amplify the possibilities that symbolic meaning will be crafted by designers and understood by users.

If we understand green buildings as having an interpretable message, then we can further acknowledge that architectural "language" varies enormously across different green buildings. As Guy and Farmer (2001) suggest, there is no one logic to green building design. In fact, they propose six competing logics of green building design as: eco-technic, eco-centric, eco-aesthetic, eco-cultural, eco-medical, and eco-social (p. 141). These logics suggest that green buildings are designed and built with differing motivations that range from high technology to low technology where emphasis is variously placed on individual health, the community, and/or ecosystems. The more clarity a design team has about the emphasis of a green building project — the building's overarching narrative – the better that emphasis can be celebrated and communicated to building users. The next challenge, of course, is effective communication. Research by Cranz et al. (2013) cautions that, even with the best intentions, green designers may fail to communicate sustainability. We might begin by recognizing that "architects and nonarchitects do not necessarily share aesthetic sensibilities—and architects often misjudge the opinions of the public" (Cranz et al. 2013, p. 829). Architects can attempt to bridge the gap by working harder to design in a way that is meaningful to the public and, when necessary, translate architectural meaningful to the building user.

3 Science Museum

Where the symbolic reading of a green building is a passive type of engagement, a green building can also be designed for users to actively engage with its features. A metaphor for this approach is the science museum, where users engage in learning experiences at a series of vignettes. The progression through learning experiences in a science museum is often orchestrated to variously engage the mind and senses. This approach aligns well with the "toolbox" or "teaching tool" philosophy of TGB design where we imagine the TGB as a collection of displays each designed to reveal different aspects of the building's design.

The type of learning that happens in science museums is commonly termed informal or free-choice learning, and is characterized by initiative on the part of the learner (J. H. Falk et al. 2009). Falk and colleagues offer a sizable body of work built on decades of empirical evidence that is summarized in the "Contextual Model for Learning in Museums" (J. Falk et al. 2007; J. Falk and Storksdieck 2005; J. H. Falk and Dierking 2000). This framework outlines three major contexts that affect informal learning: physical, personal, and sociocultural. The relationship of these contexts to the Teaching Green Building is examined elsewhere (Cole 2014) and summarized in Table 2. The Contextual Model for Learning, developed through research in informal learning environments like museums, informs the pursuit of TGBs by expanding the horizon beyond the physical environment. This model highlights the importance of the unique individuals and social settings that affect free-choice learning experiences.

Taking a science museum approach to designing a TGB, if undertaken intentionally at the beginning of the design process, would encourage the design team to curate learning experiences across the building to consider the total educational experience. In contrast, some TGBs are designed in an ad hoc way with a sign added here or a kiosk installed there, with the hope that people notice and engage with these features. If TGB design increasingly reflects decades of research on informal learning venues, then designers will additionally consider (1) the total orchestration of learning

Table 2 Teaching Green Buildings and the Contextual Model of Learning

Contextual model for learning	Application to teaching green buildings
Physical context	The given features (signs, kiosks, displays, etc.) within at TGB that are designed to engage visitors/users in free-choice learning experiences
Personal context	The prior knowledge, experiences, and interests of individuals that affect the ways in which they engage with a green building
Socio-cultural context	The culture of sustainability communicated at the organizational or institutional level, social norms among building users, the presence of knowledgeable others who share insights about the green building's features

Source Adapted from Falk et al. (2007)

across the space, (2) the intellectual and emotional starting point of the individual building users, and (3) the culture of sustainability among the user groups within the building. A deeper understanding of the physical, personal, and socio-cultural contexts can increase the chances that a TGB is a successful venue for free-choice learning.

4 3-Dimensional Textbook

Inspired by the term "textbook" as a curricular artifact, the 3-Dimensional (3D) textbook approach to TGBs integrates formal learning experiences. The emphasis on formal education makes the 3D textbook approach most readily pertinent to the design of green school buildings and environmental education centers, where formal education already takes place (Kong et al. 2014; Nair and Fielding 2005; Taylor 1993). This is the approach taken by universities employing the "living laboratory" idea in campus buildings, where the building becomes woven into curricular opportunities. The Environmental Studies building at Oberlin College, for example presents an excellent model of a green building deeply tied to undergraduate coursework (Orr 2006) (See Fig. 3).

Like the science museum approach, 3D textbook implies the involvement of a content expert who is crafting an educational experience. Just as a textbook may be assigned to the course, a building can be assigned and aligned with formal education. This viewpoint will encourage strategies that go beyond kiosks and signage on the walls (a museum approach) to strategies that are more deeply intertwined with the social dynamics of the people in a space (an educational programming approach).

Green Building Literacy is the term used to describe the multi-faceted outcomes of successful green building education (Cole 2015). Green Building Literacy involves a mixture of knowledge, affect, and behaviors that relate to green building design (Cole, in review). In terms of green building knowledge, the focus of a 3D textbook approach, the formal lessons that could be taught using a green building are vast in number. One starting point for defining "green building knowledge" domains is to consult the metrics used in architectural practice that define green building. Dominant green building rating systems in North America include Leadership in Energy and Environmental Design (LEED) (United States Green Building Council 2008) and the Living Building Challenge (International Living Future Institute 2016) Knowledge domains drawn from these frameworks include:

- Green infrastructure
- Sustainable Landscapes
- Energy and Atmosphere
- Water
- Materials and Resources

- Indoor Environmental Quality
- Economic Impacts
- Beauty and Inspiration
- Local and Healthy Food Systems

Many green buildings address all or most of these categories in their own unique ways. These categories can help to organize the "chapter headings" of the Teaching Green Building as 3D textbook. A TGB that supports formal green building curriculum will increasingly connect environmental lesson plans to the categories above to strengthen the connection between the built environment and educational programming.

5 Place

Place theory — with its emphases on symbolic meaning, actions, and social and physical contexts — is one theoretical domain that has the potential to weave together the diverse approaches to TGBs. Key outcomes of the previous theoretical approaches included awareness and education; the focus here is on the outcome of sense of place, or connectedness to place, which can be engendered through TGB design.

"Sense of place" can be conceptualized as a combination of meanings, attachment, and satisfaction a person has toward a place (Stedman 2003). Within this framework, Stedman (2003) emphasizes "place attachment" as the factor that has the most depth and complexity. Place attachment is a term used widely to describe human-place bonding (Hernandez et al. 2013; Lewicka 2011) and, pertinent to the design of TGBs, is a phenomena of interest to environmental educators, environmental psychologists, and environmental designers alike.

Theorizing place has a long tradition in the areas of architecture and environmental psychology. Interestingly, place theory in other disciplines, such as sociology, has deemphasized the role of the built environment and focused more on social processes (Stedman 2003). However, scholars generally agree that place attachment is alternatively socially-based and physically-based (Scannell and Gifford 2010), meaning that the built environment can play a critical role. Of the many potential theoretical frameworks of place, Canter's (1977) Model of Place integrates the built environment and provides a tri-partite framework for understanding 'place' at the intersection of the physical environment, the meanings that environment has for users, and the activities accomplished in that place (Fig. 1). TGBs are designed to communicate and engage. A thoughtfully designed TGB could have symbolic importance to users while affording a variety of opportunities to learn about sustainability and make a difference through participating in pro-environmental activities. In this way, the Fig. 1 framework integrates the many roles of the TGB as a symbol and venue for learning and action.

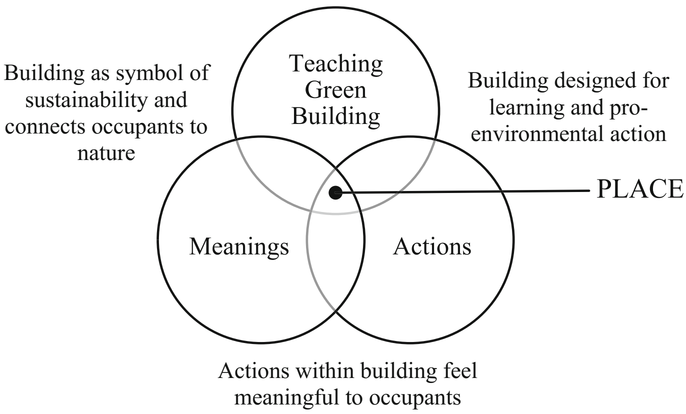


Fig. 1 The teaching green building and Canter's model of place. (*Source* Adapted from Canter (1977))

Human-place bonding in natural environments is also a long-standing research agenda for environmental educators. Educators are particularly interested in how connection or disconnection to nature affects environmental education (EE) outcomes like knowledge, attitudes, and sensitivity toward the environment (e.g., Chawla 1998; Louv 2008; Sobel 2008). Environmental educators also study connections between 'sense of place' and pro-environmental behaviors (Kudryavtsev et al. 2011). Environmental educators have additionally explored the importance of place-based learning, or the ability to deepen learning through hands-on experience in one's own ecosystem (e.g., Gruenewald 2003; Somerville and Green 2011). TGBs are well positioned to provide complex place-based learning experiences that explore the relationship between built and natural worlds. Further, while EE research has largely focused on place theory in outdoor environments, a rich potential exists to connect what we know about the importance of human-nature connections to building design. Green buildings, more than conventional buildings, are often celebrated for the integration of nature into the built environment.

A recent movement toward biophilic design centers on integrating nature into the built environment. Biohphilic design is an extension of the "biophilia hypothesis" proposed by E.O. Wilson (1984) that defines biophilia as the innate human connection to nature. Since the time Wilson's work arose out of conservation biology, scholars of the built environment have begun a major sub-area of scholarship on biophilic design. In efforts to inform practice, scholars have created robust frameworks that outline the precise architectural features and geometries that trigger a biophilic response (e.g., Kellert 2011; Ryan et al. 2014). Biophilic design considerations are vast and range from lighting and materials to organic shapes, interior plants, window views, and well beyond. Other researchers have focused on evaluating the benefits of biophilic design, examining a great variety of psychological and physiological outcomes such as stress reduction, increased wellbeing, faster healing in hospitals, and more [for a review of the literature see Söderlund and

Newman (2015)]. Pertinent to the "teaching" aspect of Teaching Green Buildings, human-nature connection has also been related to school design and enhanced learning outcomes (e.g., Malinin and Parnell 2012).

In summary, human-place bonding is an important aspiration for TGB design. TGBs already have rich potential to foster sense of place for occupants given the overlay of environmental meanings and actions associated with the building (Fig. 1). A well designed TGB will additionally connect the occupants to nature through approaches such as biophilic design. A biophilic TGB will offer myriad psychological and physiological benefits to occupants while also providing an inspired venue for environmental education.

6 Call to Action

A green building can further be a "call to action" for environmental stewardship. The former approaches address broad educational goals where the building occupant, or learner, is ideally constructing a foundation for *content knowledge* on green building design (e.g., what is a solar panel?) The "call to action" approach to Teaching Green Buildings, rooted in theories of environmental behavior change, involves *procedural knowledge*, or a type of learning that is rooted in taking action (e.g., how do I compost this apple core?) Research in conservation psychology and environmental psychology, along with design studies and environmental education, can all inform this approach.

If promoting behavior change is the goal within a TGB, then a rich and interdisciplinary knowledge base can illuminate pathways to pro-environmental behavior change. To begin, various sub-disciplines within psychology have long-running research agendas to unpack the psychological dimensions of behavior change. Over the decades, research in both conservation psychology and environmental education examines the array of variables shown over time as predictors of environmentally responsible behaviors (e.g., Azjen 1991; Bamberg and Möser 2007; Hines et al. 1987; Hungerford and Volk 1990; Stern 2000). Literature in the field of environmental psychology is similarly dense with empirical studies on the environment-behavior connection, with a sub-area of focus on environmental stewardship (e.g., De Young 1993, 2000; Kaplan and Kaplan 2009).

Across the substantial literature base on theories of behavior change, a key takeaway is that behaviors are multiply determined. There are many variables and many different pathways to a given behavioral outcome. Models of behavior change across disciplines essentially converge on knowledge, attitudes, skills, social settings, and behavioral willingness as key factors predicting behavioral decisions (e.g., Azjen 1991; Hines et al. 1987; Hungerford and Volk, 1990; Stern 2000). Fewer theories incorporate the physical environment. The models that address the physical environment frame it as a behavior setting (Kaplan 1991), a component of "perceived behavioral control" (Azjen 1991), or vaguely as a "situational factor" (Hines et al. 1987).

Given that the physical environment does not figure prominently in models of behavior change, designers who wish to promote behavior change through architectural design do not have a single, widely-accepted framework. There is, however, a growing body of literature in the area of "Design for Sustainable Behavior" and an ever-increasing number of empirical studies that point to evidence-based strategies.

Design for Sustainable Behavior (DfSB) is a growing area of scholarship in product design that could lend insights to architectural design. Lilley and Wilson (2013) present an overview of the research to date that elucidates approaches to DfSB that variously put the power of decision-making in the hands of the user, on one hand, and behaviors determined by the product on the other. An important question arises for designers of Teaching Green Buildings: what are best practices for promoting environmental actions within a green building? Basic strategies include informing occupants of behavioral options, persuading occupants to participate, and, on another extreme, actually determining their behavior through building design (Fig. 2). Table 3 uses the axis of influence framework to illustrate various strategies to promote recycling in a TGB.

While installing static signage to inform building users of behavioral options is a basic strategy, using dynamic behavioral feedback systems could increase the levels of occupant behavior change. Real-time feedback, for example, has been a long-standing research agenda in the area of energy conservation behaviors since the 1970s [for reviews of the literature see Darby (2001) and (2006)]. Darby (2001) outlines multiple types of energy feedback for homeowners, where the most applicable to architectural design is "direct feedback," which includes smart meters and feedback digital displays that could be visibly placed in the architectural environment. Across 21 studies, direct feedback yielded 5–20% energy savings and was the most promising form of feedback across all types examined (Darby 2001). A study in Oberlin College dormitories has similarly demonstrated the promise of energy feedback to significantly reduce energy consumption, where high resolution feedback reduced energy consumption by 55% compared to 31% in dormitories with low-resolution feedback (Petersen et al. 2007). Most research in this area points to the importance of feedback for behavior change, but authors commonly stress that feedback shouldn't be used alone but in conjunction with other behavior change interventions (such as information campaigns, incentives, and evoking social norms).

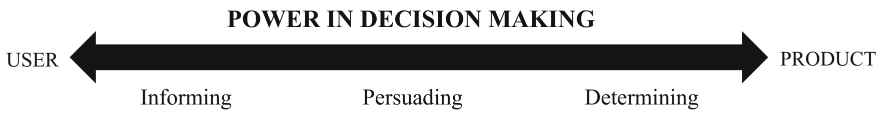


Fig. 2 The design for sustainable behavior axis of influence. (*Source* Adapted from (Lilley & Wilson (2013) and Zachrisson & Boks (2012))

Table 3 Various strategies to promote recycling behavior in TGBs using the axis of influence framework

DfSB axis of influence	Teaching green building sample strategies to encourage recycling
Informing	Signage next to recycling bins informing occupants about where and how to recycle
Persuading	Recycling bins playfully designed with signage that informs and persuades occupants to recycle. Trash cans labeled as “landfill”
Determining	Large recycling bins strategically located throughout space and with fewer and smaller trash cans available

Source Adapted from Lilley & Wilson (2013) and Zachrisson & Boks (2012))

The Bullitt Center in Seattle, which is arguably the most sustainable modern commercial building in the world, offers a potent example of DfSB. This building meets the stringent guidelines of the Living Building Challenge and was designed to engage visitors with its green features. The website and building signage *inform* building users about the various features. Even more compelling is the “irresistible stair” that was designed to *persuade* visitors to save energy and make a healthy choice by taking the stairs (Bullitt Foundation 2016). There some evidence for this strategy. For example, Zacharias and Ling (2014) showed that architecturally separating the stair and the escalator in shopping malls increased stair usage by 95%.

The examples thus far demonstrate single architectural features that promote environmental behavior change and are variously overt and covert. TGBs may be designed to have isolated features, but they can also be designed to impart a holistic sense of greenness. Researchers Wu et al. (2016), for example, were interested to learn if an overall atmosphere of sustainability, what they termed “building atmospherics,” related to recycling behavior. In comparing a green campus building to a conventional one, they found that research participants did indeed recycle more often. Interestingly, they also found that as recycling behavior went up in the green building, so did recycling errors (Wu et al. 2016).

In examining this spectrum from informing to determining, a key question emerges for the designer of a TGB. If increasing pro-environmental behaviors within the building is a design goal, will this goal be accomplished deterministically (through coercion or persuasion) or more gently by “nudging” the building occupant, to use a term popularized by Thaler and Sunstein (2008)? Ethical questions emerge with deterministic approaches (Lilley and Wilson 2013), but psychological questions also arise. A deterministic space (e.g., a building where it is difficult to find a trash can) could evoke psychological reactance for building users who become irritated by the design. Further, a space that provides extrinsic motivation to conduct a behavior, or behavior motivated by external forces, will likely fail to help building users develop their own internal reasons (or intrinsic motivations) to perform eco-friendly behaviors. It is the difference, for example, between conducting a behavior because it is convenient or expected versus doing it because one believes it is the right thing to do. Research shows us that when external motivators are removed, the behavior typically returns to baseline (e.g., Abrahamse et al. 2005; Clary and Snyder, 1999; Lepper et al. 1973). The presence of intrinsic motivation, on the other hand, would be more likely translate across time and settings. Research in conservation psychology presents a strong case for considering both extrinsic and intrinsic motivations (De Young 2000; Kaplan 2000), where scholarship indicates that extrinsic motivations alone may be challenged to promote long-lasting behavior change.

In summary, occupant behavior change is most likely to occur at the intersection of factors such as green building design, organizational policy, educational efforts and culture change. This complexity may explain in part why some scholars believe that green building design should be less sensitive to occupant behavior, meaning that buildings should perform efficiently with or without conscientious occupants (e.g., Karjalainen 2016). But no building can be designed to completely override user behavior, and such a building would fail to engage its users in the environmental story of the building, which is one of the main goals of a TGB. Designers of TGBs will ideally achieve a delicate balance between delivering an efficient building and one that additionally serves as a meaningful “call to action” for occupants.

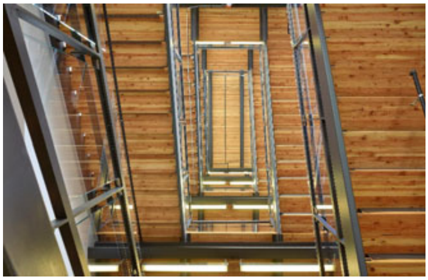
7 Implications for Practice

A key goal of this chapter is to elucidate multiple strategies for the design of TGBs to support increasingly intentional approaches. While any one of the five strategies could be the dominant approach to designing a TGB, these strategies can also be used together to provide rich and layered sustainability education. Figure 3 shows images that are representative of each perspective from five different TGBs in the United States. The five perspectives build upon one another in a sequence that moves from creating sustainability awareness through design (Symbol), to helping people learn about sustainability (Science Museum and 3D Textbook) to fostering connections between people and place (Place) to inspiring action (Call to Action) (Fig. 4). While these outcomes could certainly shuffle in order or be diagrammed in a less linear way, they are shown in sequence here to emphasize that the ultimate goal of environmental education is action. Our climate will not stabilize itself, our water, soil, and air will not magically resist pollution, and species will not be saved from extinction unless we — individually and collectively — act. Green buildings can begin by shocking and delighting but must ultimately do a better job of protecting our environment. Teaching Green Buildings go beyond typical green buildings to invite users to take part in the meaningful work of environmental protection.

Symbol: Amidst traditional campus buildings at Oberlin College, the Environmental Studies building stands out as a visible symbol of sustainability on campus. *Source* Author

Science Museum: This display offers real-time feedback on the building's energy performance in the lobby of Redding School of the Arts. *Source* Author

3D Textbook: The greenhouse at Greenhills School is integrated into the high school biology curriculum. *Source* Author



Call to Action: The "irresistible stairs at the Bullitt Center encourages occupants to take the stairs instead of the elevator. *Source* Ben Benschneider

Place: The campus of the Willow School has a LEED gold building, a LEED platinum building, a renovated historic building, and a relocated barn, all connected by native landscaping. The whole campus, indoors and out, is used as a living laboratory for K-8 education. The use of natural materials and indoor/out connections is designed intentionally to foster human-place bonding. *Source* Author

Fig. 3 Five perspectives from awareness to action

8 Implications for Research

While few studies have been conducted specifically within Teaching Green Buildings, research across disciplines — such as the research summarized above — points to the promise of buildings designed to engage, teach, and support environmental action for building occupants. This outline of five theoretical

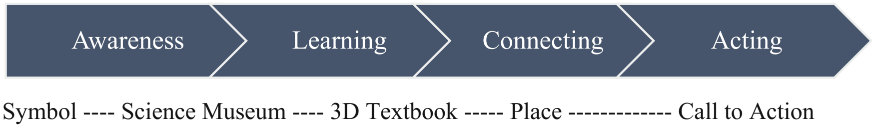


Fig. 4 The five perspectives in exemplar teaching green buildings

perspectives shows that these special settings could be studied from a variety of disciplinary lenses and for an array of occupant outcomes.

Methods for exploring outcomes in TGBs are similarly diverse. For example, TGB studies to date have employed ethnography to study institutional factors (Henderson 2014), survey research with school administrators to illuminate school culture (Barr 2011), qualitative case analysis of a green school in Bali (Kong et al. 2014), survey research with students in a range of TGBs (Cole 2015), and Photovoice interviews with middle school students to discover environmental education outcomes (Cole 2013a). The overwhelming majority of this research is conducted in schools, and also in unique private and charter schools that have access to excellent green facilities. We know much less about TGBs in places like public schools, civic spaces, and office buildings.

The evidence base for what works in TGBs is yet in the early stages. However, there is a wealth of empirical knowledge from across disciplines that can inform design approaches. That is to say, specific strategies within TGBs can be evidence-based. For example, based on literature reviewed previously, we know that interactive energy feedback enhances energy conservation behaviors, building atmospherics can inspire greater recycling participation, and biophilic design features are linked to a wide range of beneficial psychological outcomes. What is yet missing is an integrative framework to inform the theory and practice of TGB design. The work here intends to make a provisional step in this direction.

9 Conclusion

As implied by the name, the fundamental goal of a "Teaching Green Building" is education. Reviewing theory across disciplines, however, reveals expansive possibilities for these buildings that extends well beyond imparting knowledge. TGBs are an interdisciplinary pursuit, and there is no one way to frame a successful TGB. The purpose of this review of theoretical perspectives is to uncover the multiplicity of lenses that can be used to frame the diverse possibilities for what a TGB is and does. What unites these various approaches is the emphasis on social impacts. The possibilities for social impact range from symbolic meaning to formal/informal environmental education to place-making and environmental behavior change. These impacts are not monolithic but have multiple, potentially overlapping dimensions. For example, design that supports sustainable behaviors has possible overlaps with informal learning outcomes and also sense of place if a building user feels that their actions within a building matter. The perspectives outlined thus present complementary ways of viewing a single setting. The frameworks presented here further offer tools for scholars interested in studying — and practitioners wishing to build — Teaching Green Buildings. At the intersection of these various approaches lie exciting possibilities for making positive change through built form.

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