



Live green, think green: Sustainable school architecture and children's environmental attitudes and behaviors



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ABSTRACT

This study aimed to determine whether the environmental attitudes and behaviors of children attending primary schools designed or adapted for sustainability are different from those of children attending conventional schools. An NEP (Children@school) scale was developed to measure children's environmental attitudes and a GEB (Children@school) scale was developed to measure children's environmental behaviors. Data collected from children aged between 10 and 12 years were analyzed using multivariate analysis of variance (MANOVA). The findings indicate that children attending primary schools designed to engage them with sustainable design had significantly more pro-environmental attitudes and behaviors. Thus, it is suggested that pedagogies for environmental education should be developed that require children to directly engage when learning with sustainable design features such as solar panels, the use of recycled water, natural daylighting, gardens and outdoor classrooms.

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1. Introduction

In the promotion of environmental sustainability in water, energy, and materials consumption, education can play a crucial role in creating an environmentally literate society. The most typical outcome of environmental education (EE) is the enhancement of three spheres of awareness: environmental knowledge, attitudes, and behaviors (Leeming, Dwyer, & Bracken, 1995; Stern, Powell, & Ardoin, 2008). Although there is no consensus on whether pro-environmental attitudes lead to pro-environmental behaviors, there is evidence of compatibility of environmental behavior with environmental attitudes. For instance, Hines, Hungerford and Tomera's meta-analysis of *fifty-one outcome measures on attitude-behavior relationship* (1987) found that individuals with more positive attitudes towards the environment were more likely to participate in ecological behaviors. Strong correlation between pro-environmental concerns and pro-environmental behavioral intentions has also been reported (Manoli, Johnson, & Dunlap, 2007; Pooley & O'Connor, 2000; Shetzer, Stackman, & Moore, 1991).

This paper tests the hypothesis that children attending schools

designed for sustainability will have attitudes and behaviors to the environment that are more pro-environmental than those attending conventionally designed schools. The theoretical basis of this hypothesis underpins Manoli, Johnson and Dunlap's NEP scale (2007) for measuring environmental attitudes and Evans, Brauchle, Haq, Stecker, Wong and Shapiro's GEB scale (2007) for measuring children's environmental behaviors. Namely, that difference in behaviors or attitudes can be explained by underlying values, a world-view or a paradigm. Thus, it is posited that learning spaces designed for sustainability reflect pro-environmental values that can in turn inform pro-environmental values in children. This hypothesis is informed by the idea of "architecture as pedagogy" (Orr (1997, pp. 597–600), as reported by Janda (2011, pp. 15–22)); namely, the belief that we learn from buildings, not just in them.

1.1. Background

Burger and Thompson define learning as "the relationship between stimulus and response" (Berger & Thompson, 1995, p. 49), such that learning happens when new experiences evoke new behaviors and attitudes. Since it has been hypothesized that the developmental process might "be influenced by characteristics of the physical settings" (David & Weinstein, 2013, p. 4), this paper investigates the possible influence on children's attitudes and

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behaviors of school built environments. In particular, it is hypothesized that sustainability features in schools, which both explain and represent the relationship between the built and the natural environments, perform as learning stimuli that inform patterns of attitudes and behaviors towards the natural environment. In other words, design in schools that might be understood and identified as “green,” as thus as pro-environmental, can inform pro-environmental attitudes and behaviors in children. In the following sections the theoretical underpinnings of this hypothesis will be summarized through a discussion of the research on five relationships encompassed by the hypothesis: (1) childhood development and environment, (2) school design and learning, (3) school design and children’s attitudes and behaviors, (4) environmental education, and (5) school architecture as a pedagogic tool for environmental education.

1.2. *Childhood development and environment*

The relationship between childhood development and environment has been considered in different disciplines and from different perspectives (Anaby et al., 2013; Kellert, 2005b). As early as the 1920s, Freeman, Holzinger, and Mitchell suggested that environment can considerably impact the intelligence of children (1928). More recently, a child’s immediate built environment has been identified as a primary medium for learning in young children (David & Weinstein, 2013, p. 4). Research has also highlighted the natural environment as an effective learning arena for children (Dadvand et al., 2015; Hunter & Sonter, 2010; Wilson, 2012), and has discussed the adverse physical, social, and psychological effect of children’s diminishing contact with nature (Kellert, 2005a; Zaradic & Pergams, 2007; Zhang, Goodale, & Chen, 2014). Faber Taylor and Kuo (2009) suggest children’s concentration levels could be improved by integrating natural environments with indoor and outdoor built environments. Bell and Dymont (2008) have also found that “green” school grounds can improve children’s physical, mental, social and spiritual well-being (Bell & Dymont, 2008, p. 2). Built environments that integrate nature are not just seen as beneficial for learning in general, but are, as shall be discussed soon, seen as especially suited for Environmental Education (EE) i.e., learning about the natural environment.

1.3. *School design and learning*

Studies have asserted the direct impact on student learning of the environmental characteristics of school buildings (Clark, 2002; Dudek, 2000; Higgins, Hall, Wall, Woolner, & McCaughey, 2005). These characteristics include thermal comfort, lighting, natural ventilation, air quality, and acoustics. It is believed that architecturally well-designed schools contribute to greater levels of engagement with learning activities (Moore, Lackney, Wisconsin Univ, & Urban, 1994). Schneider (2002) suggests that school design should be seen as an opportunity to enhance educational outcomes by creating better learning environments (Schneider, 2002).

It is also claimed that schools designed sustainably – i.e., designed for more sustainable resource consumption through, for instance, passive design (using the climate ahead of fossil fuels to maintain a thermal comfort) – can positively impact educational performance by providing better environmental conditions (Edwards, 2006).

1.4. *School design and children’s attitudes and behaviors*

For many decades, there has been research into the impact of the built environment on human behaviors and attitudes.

Numerous studies have found spatially informed patterns of behavior in different places, such as: children’s psychiatric hospitals (Rivlin & Wolfe, 1972), libraries (Eastman & Harper, 1971), workplaces (Heerwagen, Kampschroer, Powell, & Loftness, 2004; Penn, Desyllas, & Vaughan, 1999), and places with unique physical characteristics such as buildings without windows (Küller & Lindsten, 1992). Russell believes that “architecture is the formulation of sets of rules for different behaviors in a building” (2004, p. 2); suggesting that architectural design can play a significant role in deterring or encouraging attitudes and behaviors. It has been theorized that environmental experiences in childhood endure into adulthood, and thus that the design of buildings can have both a direct and long-term symbolic impact on children (David & Weinstein, 1987). School design can encourage and facilitate, hinder and inhibit behaviors at school, and the architectural symbolism of schools can have a profound wider impact on children and their behaviors in and outside of school (Proshansky & Wolfe, 1974).

Weinstein (1977) found statistically significant differences in students’ behavior due changes in spatial design, where students were encouraged to move into locations that had previously been avoided, and the frequency of specific behaviors was altered. A study by the Carnegie foundation (1988) asserts that students’ attitudes toward education are a direct reflection of their learning environment (Carnegie Foundation for the Advancement of Teaching, 1988). Younge (2001) also states that the school built environment is central, not marginal, to student’s behavior and performance.

Although conventional wisdom on the design of educational facilities suggests a relationship between physical environments and school occupants’ attitudes, behaviors and achievements, this relationship is recognized as difficult to statistically demonstrate (Earthman, 1998, p. 5), and thus requires further investigation.

1.5. *Environmental education*

Environmental education is seen as playing a key role in attaining sustainable development (defined as a balance between human’s present and future needs) and in creating an environmentally literate society able and motivated to influence decision making (Goldman, Yavetz, & Pe’er, 2006, p. 4). Education is seen as a prerequisite for changing individual’s attitudes towards the environment and equipping them with the knowledge to make meaningful environmental changes (Hungerford & Volk, 1990).

The recent emergence of environmental consciousness has promoted environmental education globally (Nikel & Reid, 2006). Such programs, as categorized by Lucas (1972), refer to one or more of three classes: “Education about the environment - facts, concepts, principals; Education for the environment - attitude and skills directed to conservation; Education in the environment - forms of outdoor education” (Lucas, 1972, p. 136). Thus, “learning about the environment supports environmental understanding and knowledge; learning for the environment is directed toward environmental stewardship and action; learning in the environment encourages interactions and experiences in the environment” (Malone & Tranter, 2003). Malone and Tranter (2003) posit that all three dimensions should be accessible through schooling to provide a comprehensive approach to children’s environmental learning.

Although teaching via the curriculum is the primary method for EE, other less directly observable and more implicit methods such as learning through participation (hands on experiences) or learning through “knowing eye” (visual literacy) have also been developed. Taylor and Enggass believe that once we start to ‘read’ an environment, we have cultivated a knowing eye (2009). The

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