

Teens, Power Tools, and Green Schools: Education for Sustainability through a University Environmental Design Program and Middle School Partnership

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Accepted for publication in the Journal of *Applied Environmental Education and Communication*, March 29, 2017

Abstract

This paper explores the role of green schools in promoting education for sustainability by reflecting on a university-middle school partnership focused on sustainable design. Undergraduates and middle school students met weekly for a semester to learn about sustainability through simple design projects and activities that focused on sustainability features of the school. Instructor and university student reflections explore the value and challenges in integrating education for sustainability and green schools that teach.

Keywords: education for sustainability, sustainable school design, middle school students, university students, design education

Introduction

In his 1993 article titled “Architecture as Pedagogy,” David Orr considered how schools might be designed to encourage creativity, ecological awareness, and civility. He characterized academic environments as spaces that do little to either promote interest and understanding of the building as part of a larger ecological system or to facilitate learning of any subject matter. More than 20 years later, “green” schools have been designed and built in many corners of the world to reduce environmental impacts and facilitate learning (Barr, 2011; Kellert & Finnegan, 2011; Makovsky, Pedersen, Cameron, & Greenberg, 2009; Taylor, 2009). Ostensibly, these schools can facilitate the understanding of a building’s sustainability features and can improve learning overall (Barr, 2011; Cole, 2014; Uline & Tschannen-Moran, 2008). However, exactly *how* or *if*

this education occurs has received little attention in the academic literature. Two fields have emerged to promote education for “21st Century Schools” or “Schools that Teach.” One is the field of sustainable school design (Barr, 2011; Cole, 2014; Makovsky et al., 2009; Taylor, 2009), and the second is Education for Sustainability (EfS) (Barr, 2011; Cloud, 2014). Sustainable schools create the infrastructure and context for learning while Education for Sustainability promotes whole systems thinking, integrating the built and natural features of a school into learning.

Education for Sustainability draws from the best practices in effective education, such as experiential and inquiry-based learning (Zint, 2013) and seeks to diminish gaps in the current K-12 educational system. Cloud (2014, 3) defines EfS as a

transformative learning process that equips students, teachers, schools, and informal educators with the knowledge and ways of thinking that society needs to achieve economic prosperity and responsible citizenship while restoring the health of living systems.

In her review of recent research on EfS, Cloud (2014) identifies positive educational attributes such as enhanced interest in learning and performance, better alignment with people’s interest in holistic learning, greater recognition of students as part of larger systems, and modeling of actions that promote sustainability.

Green schools provide pedagogical possibilities but to date, little research has focused on the role green schools play in promoting education for sustainability. This paper explores the relationship between green schools and education for sustainability by presenting university design students’ experience in facilitating these connections through a university-middle school partnership.

Linking Green Schools and Sustainability Education

Course Context

The university-middle school partnership that is the focus of this paper is set in a small city of about 100,000 people, and contains a university of approximately 30,000 students. The university and the middle school are public institutions. Approximately 600 students are enrolled in the middle school; 52.4% of students are Caucasian, 39.5% are Latino, 3.3% Mixed Race, 3.1% Asian, 1.5% African American, and 0.2% American Indian. Of the total student body, 40% receive free or reduced lunch, and 25% are English language learners. Approximately 15 university students and 25 middle school students enrolled in the courses that composed the partnership.

In 2007, a campus-community partnership emerged out of a middle school renovation that sought sustainability certification. Since its inception, the partnership has evolved from an initial after-school program facilitated by university partners to a pairing of undergraduate environmental design students with a middle school applied science elective (Derr, Malinin, & Banasiak, 2017). In its most recent iteration, undergraduates and middle school students met once a week for a semester to explore issues of sustainability through simple design projects and an exploration of the sustainability features of the school, such as the green roof or school garden.

Undergraduate environmental design students (hereafter referred to as “designers”) met once a week in the university setting, discussing readings and reflecting on the process of engagement, and once a week at the middle school, where they led middle school students in

hands-on sustainability lessons and design activities. Middle school students (hereafter referred to as “students”) enrolled in an applied science elective that met four days per week.

This paper provides reflections from the second year the author taught the university course. In her role as university instructor, the author used jottings and short field notes (Emerson, Fretz, Shaw, 2011) during the semester to record the emergent themes presented here. This article presents instructor and student reflections as a field note reflecting on the teaching possibilities and challenges of green schools.

Undergraduate Curriculum

Learning objectives for the undergraduate course included understanding the relationship between green schools and sustainability education and developing a personal philosophy of the role of environmental design in shaping learning environments for children. The undergraduate curriculum examined a number of frameworks to aid students’ development of their own philosophy about learning environments that foster sustainability. They began with *The Third Teacher* (O’Donnell Wicklund Pigozzi & Peterson, & Bruce Mau, 2010) and reflected on their own educational history. Designers created timelines that reflected and critiqued the social, cultural, physical and intellectual contexts of their education, drawing from *The Third Teacher’s* framing. Designers also watched the film *If You Build It* (Story Into Action, 2013) and contrasted the high school design studio in rural North Carolina with more traditional educational contexts. Additional readings provided context for thinking about model green schools, student motivation for learning and being interested in science, design thinking in educational contexts (e.g., IDEO, 2012), and models of participation in and outside of school settings. Designers regularly wrote papers in which they critically reflected on reading materials

and their experiences in the classroom. An important context of this course was that most of the students had never worked directly with young people, or any client, in which design and learning were collaborative and co-constructed.

Middle School Applied Science Class

The applied science objectives were for students to learn about systems in the context of sustainability. Students began the semester learning about systems in general, then moved into water systems, living systems, and sustainability systems. Depending on the iteration of the course, other systems, such as transportation or energy, were also included within the course. The water, living, and sustainability systems intersected best with the timing and content of the undergraduate course and were the focus of the paired class.

Middle School-University Paired Class

Collaborative lessons were organized into modules to address the water, living, and sustainable learning systems. The first module was a small scale “terraqua” column, adapted from the *Bottle Biology* curriculum (Ingram, 1993), in which designer/student teams used 2-liter bottles to develop small scale systems that would house and connect an aquatic and terrestrial ecosystem (Figure 1). The emphasis was on how to move the water from one part of the column to other sufficiently to sustain plant life.



Figure 1. An Example of a Completed Terraqua Systems

Building on lessons from the terraqua columns, design teams then developed larger scale terraqua systems using repurposed materials. This four-week design module included a field trip via city bus to a local recycled materials center. In this module, all students worked on the same “problem” (how to build a large scale terraqua system) but worked in small teams to develop their own specific design goals and approaches.

For the final five-week design module, designers selected topics that would facilitate learning about “green” school design and that were focused on the middle school building. At this time, groups diverged in their methods and approaches. The group “Code Name: Green

Roof” used video to interview students to establish their baseline knowledge about the green roof, developed a physical model of a green roof, and developed an interpretive poster about the roof. The Garden Group installed tipi structures as trellises and created mosaic tiles to create a more inviting space in two underutilized areas of the garden. The Wildlife Group inventoried existing schoolyard habitat, used the Co-Design process (King et al. 1989) to visualize changes to the garden, solicited input from classmates about their design ideas, and developed a final wildlife habitat plan.

Designer and Instructor Reflections

Reflections from the designers and instructor are presented within the context of Education for Sustainability and Pedagogical Green Schools because these most aligned with the overall purposes of the course as well as university students’ perspectives. Reflections are presented in the order of their emergence in the semester – designers were most focused on aspects of Education for Sustainability, such as group cohesion and engaging methods, early in the semester and became more critical of the school as a pedagogical tool as the semester progressed. Students’ reflections connect to Cloud’s (2014) EfS goals for enhanced interest in learning and performance, better alignment with people’s interest in holistic learning, greater recognition of students as part of larger systems, and modeling of actions that promote sustainability.

Approaches and Methods that Support Education for Sustainability

From the beginning, designers reflected on the importance of teamwork in fostering collaboration and better alignment with people’s interests, which they viewed as an important aspect of Education for Sustainability. As the designers entered the second module, they discussed challenges, frustrations, and a desire to more effectively reach the middle school

students who demonstrated diverse learning styles and interests. In their final reports for the large scale terraqua systems, designers found different ways to understand their students. One group identified their team members by names such as “The Imagineer,” who has aspirations to one day become an architect, like his grandfather; “The Artist,” who helped the group effectively communicate their ideas and bring them to fruition; and “The Negotiator,” who brought problem solving and negotiation tactics, jokes and laughter to the team. By focusing on students’ strengths, designers were able to identify roles that students willingly assumed, thus fostering teamwork, a smoother working process, and greater contributions to the design process as a whole.

As the semester progressed, designers began to apply ideas of Design Thinking (IDEO, 2012) because they realized they needed a way to make “design thinking” visible to the middle school students. To do this, designers developed an interactive poster on which students would identify project specific details and locate them within the framework (Figure 2). At this point in the semester, many designers began to identify with Hayward’s (2012, 15) writing that “children learn about democracy ‘by doing’ democracy, through regular and meaningful opportunities to participate in real life decision making in their school and community” and with the idea that Education for Sustainability needs to encompass more than just facts about green buildings or ecological systems. One student reflected, “If I were to change the social environment of schools, I would make it more of a community setting where kids are frequently given the option to alter their physical environments or to choose what their school stands behind and works towards.” The Design Thinking poster was a means to engage children more actively in decision making about the systems they were constructing.

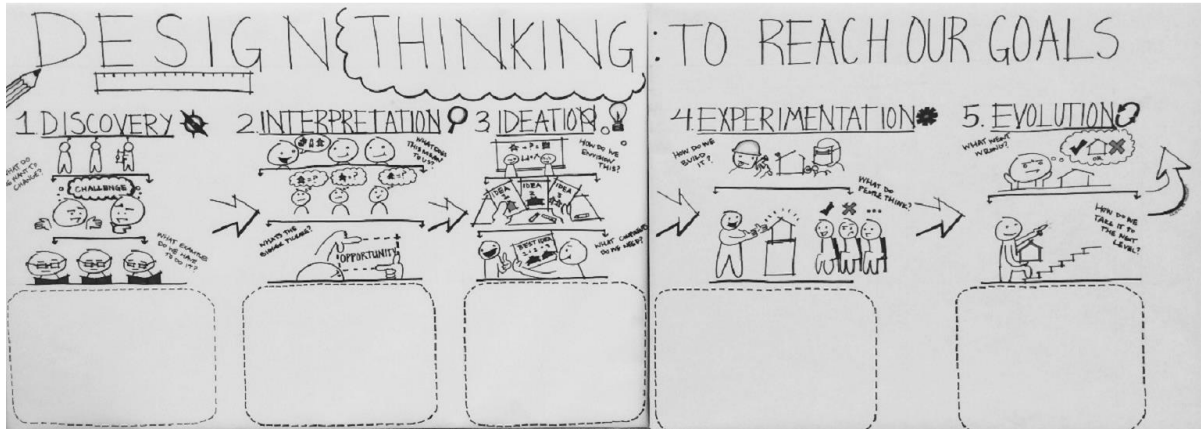


Figure 2. Design Thinking Process board as used by designer/student teams. Credit: Joshua Zinnecker and Annika Northland

Undergraduates' self-reported benefits from the course include a greater understanding of participation and working in team settings. The benefits designers describe for themselves and perceive in their middle school counterparts are similar to those from community engaged design studios. It is the dance of working together that Palleroni (2008, 278) describes thus:

As students and community venture into unknown territory, each is awkward in the face of the other's experience. Each makes mistakes, and it is through the common humiliation and appreciation of one another's talents we experience on the site that we actually become a tighter and better group at building. If there is one thing I have learned, it is that you have to go out there and listen. As Freire said, 'in the act of listening, you hear yourself as well.'

While the scale is different between middle school students' terraqua systems and architecture students' buildings, the process of coming together, making mistakes, and appreciating each other's talents is the same. As one designer wrote, the benefit of participatory design was the

“intermingling” of middle school and university students, so that each could understand the other: “In middle school, I had no idea what it really meant to be in college besides that it was four more years of school. And before this class, I had no idea what middle school looked like in 2015.” This student reflected on how different the educational context was just seven years after she had experienced it herself, with students having a much greater exposure to sustainability issues than she would have imagined.

Education for Sustainability recognizes students as a part of a larger system (Cloud 2014). While the design modules primarily emphasized the bio-physical environment, designers repeatedly emphasized the importance of the social environment and community that was fostered through the lessons. The partnership transformed university students in that they learned the value of understanding people as individuals and what students can bring to the community as a component of sustainability.

Designers also reflected on methods to effectively engage middle school students, who often were pre-occupied with social dynamics more than learning about sustainable systems. When design modules required the use of tools, the middle school students came alive and were focused and engaged. Designers reflected that frequently middle school students are not trusted with such responsibility; however, when given the opportunities, middle school students rose to the expectations held for them and acted with care and interest. Designers also reflected on the importance of active learning and the challenges of holding middle school students’ attention without it: “when the use of power tools is on the horizon, it is hard to motivate eighth grade students to actively discuss the ‘design thinking’ process.” Over time, designers were able to see the benefits of times where the process was as engaging as power tools, and times that allowed reflection and discussion about the process, such as using the design thinking framework for

discussion of what they were learning (Figure 2). This mixing of reflection and action allowed both middle school and university students to engage in conversations that improved the process and outcomes of design.

Learning about sustainability is not just about learning facts, it is a process of learning to work with others, to solve problems, and to think critically about how to approach the world (Hayward 2012). When given the chance, middle school students showed a variety of interests in learning. One designer reflected that: “The balance of rationality and creativity was very productive and fun in that it challenged our entire group to solve the problem of how things would physically come together and work.” Another thought that: “Without the unique and ‘open’ structure of the science class, many of these opportunities would have been missed.” Because this course was focused on designing and building, issues of sustainability came in through the back door. Questions such as “How can we do this with fewer materials?” or “How can we sustain plants without adding nutrients?” emerged organically from the process and projects. Designers found that effective means of “doing democracy” allowed for creativity, critical thinking, group decision-making, and learning through research and doing.

Green Schools as Pedagogical Tools

When designers read about exemplary green schools (e.g., Makovsky et al., 2009), they wondered why the middle school they worked with had not done more to integrate the sustainable features of the school into the curriculum. While the initial designs and development of after-school programs or applied science courses were, in fact, designed for student learning *about the building*, to the undergraduate designers, the school-curriculum integration appeared to be a lost opportunity. The designers believed that the students could be more connected to their

school community if the buildings' sustainability features were more interactive and designed for learning.

Students frequently mentioned that one of the places within the school they liked the most was the applied science classroom itself, which had live turtles, fish, and art made from recycled materials. While Green Schools are often designed to promote connections to nature, the undergraduate design students reflected that the particular design features of this middle school were not successful in sustaining student or teacher interest. Students are not allowed to access the green roof and can only view it through windows; many students view the geothermal system as a weedy lot but do not know how it functions; and the garden is small and too structured to allow much dynamic interaction with nature. What the designers saw, in comparison to other schools (as they appeared in course reading materials), was a lost opportunity for architecture to serve a positive pedagogical role.

Other schools allow access to and interaction with features such as green roofs or constructed wetlands. For example, at Sidwell Friends School in Washington, D.C., students participate in a BioBlitz in which they identify all the species they can find on the school grounds (Hardenbergh, 2012). Working with the U.S. Geological Survey, Sidwell students found the greatest concentration and diversity of bees in the constructed wetland and green roof of the school. In this way, the building facilitated learning in interactive ways that support engaged learning. Upon learning about Sidwell Friends School, the designers regretfully reflected that they might never know the bee species attracted to the green roof, because there is no way to access or survey it. In contrast, designers in this partnership struggled to find ways to integrate student learning with building features. A field trip to the local recycled materials center was far more engaging for students, as it awakened their imaginations to possibilities;

whereas the fixed and closed nature of their own school facilities incited very little interest among the middle school students.

Similarly, the designers described frustration in the design and placement of the school garden. They felt the garden was “shoved in a corner” and did not invite students to interact, experience or wonder. While both designers and students expressed a desire for “biophilic” schools that connect students with nature (Beatley, 2011), barriers in accessing and taking ownership of some of the amenities generated frustration and feelings of disempowerment among the designers. This led designers to plan wildlife habitat or to redesign some of the school spaces that were more accessible than the green roof and to make “seed bombs” of wildflowers and clay that they threw into the mix of plants growing over the geothermal system. From existing literature, it appears that many more schools have been successful at linking education to green school grounds (e.g., Ito et al., 2010; Rigolon, Derr, & Chawla, 2015; Smith, 2011; Wake, 2007) than to the building itself. While examples of linkages to building function and education are emerging (e.g., Ghent, Trauth-Nare, & Haines, 2014; Gough, 2005; Taylor, 2009), more work could be done to deepen and integrate “architecture as pedagogy” (Orr, 1993). These lessons can best be applied in the design phase of green schools, before features are installed and changes are difficult. However, the designer/student teams did develop a number of recommendations, such as altering some of the landscape elements to create more diversity and green infrastructure, or adding amenities to the school garden that generate more interest and opportunities for sustainability education.

Conclusion

This field note reflects on a university-middle school partnership and its potential to link education for sustainability and green schools that teach. As green schools emerge in many parts of the world, there is great potential for crafting partnerships where children and university students might learn sustainability through school buildings. While the partnership described here paired university design students with middle school students, the approach and methods could also be employed by students in other educational contexts and settings. Many other disciplines also have employed the design thinking process, from businesses to education. In addition, the partnership described in this paper required very few resources – in fact, each design project used reclaimed or recycled materials as much as possible, with a budget of approximately \$150 to 200 US for the semester. Similarly, while this partnership was established over eight years, changes in faculty have resulted in a loss of much institutional history. Both the university and school teachers demonstrated an openness to experimentation and adaptation that was far more critical in facilitating learning than any particular institutional arrangement.

The paired course arrangement created a framework in which designers continually adapted their curricula to meet the evolving needs and interests of the middle school students, thus *meeting the needs of diverse learners*. Some of the most engaging activities, such as building the terraqua systems, allowed students to apply sustainability thinking “through the back door,” thus *identifying engaging methods for process-driven learning through sustainable design activities*. Students may have shown more immediate interest in power tools, but they also expressed pride in projects that allowed them to better understand, communicate about, and advance the mission of a “green school.” Green schools could do more to support the integration

of sustainability features into their curricula *by carefully identifying ways the building can foster and support interactive learning*. Cloud (2014) suggests that Education for Sustainability needs to align student interests with learning and to foster responsible citizenship through transformative education. Designer observations suggest that education which recognizes diversity, identifies engaging (and sometimes unconventional) methods, and connects to the school building itself, can help to achieve this transformation.

More systematic research of this approach could help advance green schools as spaces for teaching and learning: a mixed methods approach that measures changes in knowledge with changes in perceptions and attitudes toward sustainability would be particularly valuable in demonstrating the impacts on student learning for all levels of education (in this case, both middle school and university). Similarly, comparative cases that evaluate specific features of green schools and the variations in how design of such schools fosters or limits learning and teaching would further help to lessen the gaps in Architecture as Pedagogy and Education for Sustainability.

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