THESIS

# GREEN SCHOOLS THAT TEACH: IDENTIFYING ATTRIBUTES OF WHOLE-SCHOOL SUSTAINABILITY

Submitted by

Stephanie Kay Barr

Department of Design and Merchandising

In partial fulfillment of the requirements

For the Degree of Master of Science

Colorado State University

Fort Collins, Colorado

Summer 2011

Master's Committee:

Advisor: Katharine E. Leigh

Kenneth Tremblay
Brian Dunbar

ABSTRACT

GREEN SCHOOLS THAT TEACH: IDENTIFYING ATTRIBUTES OF WHOLE-SCHOOL SUSTAINABILITY

The combination of green school design, green organizational behavior, and aligned educational goals sets the stage for the attributes of green schools to become teaching tools. School facilities, whether functioning well or not, serve as powerful pedagogical 'instruments'. If the power of these attributes as "three-dimensional textbooks" was harnessed the impact on learning for the next generation of students would be limitless.

This research study focused on five LEED certified green schools promoting sustainability through building design, operations, and curriculum. Participating schools were LEED certified and offered a formal environmental education program. The purpose of the study was to explore the combination of attributes leading to success in developing a methodology for best practices resulting in a model for whole-school sustainability. This model can be used as a tool for those seeking to establish whole-school sustainability informing the development of 'green schools that teach' at local, national, and international levels. Participants ($N$ = 77) included school principals and administrators, parents, community members, teachers, and support staff with building professionals responded to an e-survey relevant to sustainability integration: design process approach, organizational behavior, guiding educational philosophies, and the role

of the building and grounds in curriculum. Responses provided an illustration of whole-school sustainability in action.

Shared sustainable values among stakeholders formed a supportive culture informing decisions about facility design and curriculum and guided the whole-school sustainability process. The physical context of participating schools reinforced successful whole-school sustainability through hands-on learning opportunities for students and physical representation of the entity's values. Finally, the alignment of sustainability values within culture, curriculum, and facility operations was found to be critical to the success of whole-school sustainability.

ACKNOWLEDGEMENTS

I am grateful to all who have contributed to this research. My committee with whose support this paper has resulted in a highly professional and personally gratifying project. I would like to thank Katharine Leigh, for her enthusiasm, dedication, and unwavering belief of the value of this work; Brian Dunbar, for his passion for green schools and invaluable professional mentorship; and, Dr. Kenneth Tremblay, for his support, guidance, and commitment to sound research practice.

I thank each school who agreed to participate and be a part of this study. The inspiring success stories shared by members of school staff and project teams created the heart of this research, and truly communicated the value of green schools better than any cost data. This project would not be possible without your dedication to sustainable practices in education.

To my parents, Brent and Alana Barr, thank you for your love, support, and encouragement. I also thank you for your faith and trust in me, and my decision to pursue this graduate experience. To my best friends, I am blessed with such wonderful women in my life. Your support, love, and laughter keep me grounded and remind me what is truly important in life. Thank you to Mallorie Dye, our dreaming and your unceasing encouragement were pivotal in my decision to attend graduate school and my completion of this project. Your strength, spirit, and faith are an inspiration to all who know you.

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# CHAPTER I

# INTRODUCTION

*Learning is the process whereby knowledge is created through the transformation of experience.*

*David Kolb* (1984, p. 41)

The National Center for Educational Statistics (2007) reported nearly 44% of school principals in K-12 facilities were displeased with their school buildings, and perceived deficiencies in these facilities interfering with instruction. In response, school design has begun to change. Changes include greater efficiencies in building designs and greater attention to the needs of teaching pedagogy. Without a change in school design, those responsible for district budgets will continue to find it difficult to operate poor performing buildings with steady increases in utility costs.

Poudre School District (PSD) in Fort Collins, CO is combating this problem by setting and implementing aggressive energy goals in new schools and renovations. Since 1994, PSD has completed 190 energy efficiency projects (Poudre School District, 2011). The ongoing yearly savings from these projects is $561,000 with an accumulated savings of over $2 million (Poudre School District, 2011). Mentioned as one of the greenest school districts in the U. S. (Gutter, 2010), PSD began the transformation toward green school environments by targeting the energy efficiency of their facilities. PSD's

approach has served as a model in terms of project outcome for district-wide transformation to sustainable measures.

As districts replace or renovate facilities, understanding a building's effect on student performance can inform decisions about shaping the learning environment. Project design objectives, used to guide the design of the physical spaces, are only one element in the creation of healthy and productive school environments. Countless other variables should be considered in the design process so that the resulting educational facility cannot only be a model of high performance standards, but also actively engage students in the learning process.

## Power of Design

The built environment frames the quality of life in the U. S.; Americans spend over 90% of their time indoors (The Center for Green Schools, 2010). Interior environments enhance learning and understanding through increased functional support and improved environmental health when specific attention is paid to sustainable principles and specific design attributes. Beyond a functional backdrop enveloping activities, the design of interior learning environments can be harnessed as a tool to manifest and shape teaching and learning values. Facility design is an often untapped and potentially powerful tool in the enhancement of school programs.

> Design can transform the world. It can put right what is wrong in our communities. It can address society's most intractable ills. Properly mobilized, design could make a whopping impact on deep-rooted dilemmas such as the ravages of poverty, the miserable state of the American education system, and the failure of criminal justice. It can do nothing short of move mountains (Farson, 2008).

What if the built environment respected and supported the natural environment as well? “In many ways, the environmental crisis is a design crisis. It is a consequence of how things are made, buildings are constructed, and landscapes are used” (Van Der Ryn, as cited in McLennan, 2004, p. 5)

Aligning educational objectives to encompass sustainability addresses concerns about the future in terms of quality of life and learning. Green building creates a context for students to learn about sustainability. If provided with green schools, a generation of students will have a chance to learn about sustainability, positioned to become environmental activists. Providing green schools for every child *within a generation* is the mission of the U.S. Green Building Council’s Center for Green Schools (USGBC, 2009). This generation of students will be sustainability natives – as a generation experienced in more sustainable lifestyles capable of driving global market transformation (USGBC, 2009).

Though a green school facility is a critical tool in the education of sustainability natives, the facility is one component of a larger and more complex system. Green schools are not achieved through green building alone; all aspects of a school must embrace the same sustainability principles as their building’s design. In essence, a holistic approach must be used to weave sustainability through this complex system.

McLennan in *The Philosophy of Sustainable Design* (2004) defined *holistic thinking* as a primary principle guiding sustainability. “Holistic thinking… attempts to widen the circle of understanding…to comprehend the connections…exist[ing] between all things and more specifically to aspects of the design process and the built environment” (McLennan, 2004, p. 218). The role of sustainability in schools considers

more than the building and site design; curriculum, operations, maintenance, organizational behavior, and community involvement are each of vital importance in the conceptualization of a truly holistic learning environment.

To examine the interrelated dimensions within school environments, Owens (2004) developed the School Climate Model (Figure 1) meshing four primary components: ecology, culture, milieu, and organization. Ecology refers to the physical qualities of the environment, such as site, architecture, equipment, and technology. Culture refers to the values and behaviors of the members of the school community with milieu describing the social patterns and psychosocial dynamics among students (Owens, 2004). Organization encompasses teaching pedagogies and the social hierarchy within schools. Overlaps of these four dimensions demonstrate symbiotic aspects of these relationships, with each component influencing the others. This model remains unique as the only school environment model holistically addressing the student learning experience by including the built environment as a primary factor (Gislason, 2009).


*Figure 1*. Owen's (2004, p. 192) School Climate Model

## The Whole-School Sustainability Movement

A recent movement, Whole-School Sustainability, addresses each aspect of school climates suggested in Owen's model. In this approach, schools incorporate sustainability into all aspects of their *organization*, manifested in school governance, pedagogical approaches, curriculum, resource management, school operations, and grounds (Henderson & Tilbury, 2004). The mission of whole-school sustainability programs is to educate students *for* sustainability, in contrast to earlier environmental education programs whose missions were to educate students *about* sustainability. This subtle difference places emphasis on active engagement. Henderson and Tilbury (2004) conducted an international review of whole-school sustainability programs concluding whole-school approaches to sustainability were vital elements in efforts to move toward sustainable communities (Henderson & Tilbury, 2004).

## The Rise of Green Schools

Studies investigating effects of green building design on occupants have indicated green building occupants experienced fewer rates of absenteeism, lower turnover, and higher productivity (Heschong Mahone Group, 1999; Kats, 2006). In 2007, the USGBC released the LEED for Schools Rating System to focus on school specific factors including indoor air quality, daylight, and acoustics.

> The LEED for Schools Rating System recognizes the unique nature of the design and construction of K-12 schools. Based on the LEED for New Construction rating system, it addresses issues such as classroom acoustics, master planning, mold prevention, and environmental site assessment. By addressing the uniqueness of school spaces and children's health issues, LEED for Schools provides a unique, comprehensive tool for schools that wish to build green, with measurable results. LEED for Schools is the recognized third-party standards for

high-performance schools that are healthy for students, comfortable for teachers, and cost-effective (USGBC, 2010).

In *Greening America's Schools: Costs and Benefits*, Kats (2006) validated green building does not come at high premiums as originally assumed. According to this study, premium for green is typically 2% of total cost of the project. Green school buildings on average are 25-30% more efficient compared to conventional buildings, use less water, produce less waste, are cheaper to maintain, and enhance occupant productivity (Kats, 2003). When a small increase in total project cost is compared to savings of lifetime energy costs, there is potential financial savings equal to ten times the initial investment to construct a green building (Kats, 2003).

Incorporating green design strategies into curriculum has become an important piece in the development of green schools, demonstrated through the development and dissemination of the LEED for Schools Innovation in Design credit focused on utilizing the school facility as a teaching tool. To achieve this credit, a school must develop curriculum utilizing the building and grounds to teach environmental principles to students (USGBC, 2009).

## Purpose of the Study

The apparent untapped potential of green school design and its undefined role within whole-school sustainability invites further investigation. The purpose of the study was to conduct exploratory research on the combination of attributes leading to a success whole-school sustainability program, to develop a methodology and model of best practices. This model can be used as a tool for those seeking to establish whole-school

sustainability informing the development of ‘green schools that teach’ at local, national, and international levels.

**Study Objectives**

The study sought to document and synthesize results of surveys distributed to key contributors to holistic green school development into a best practices guide for future school planning and development. The study collected data about individuals’ experiences with the green school design process and the establishment of a whole-school sustainability program. School administrators at the district and school level, teachers using the facility, the building project team, and parents of children attending the facility were invited to participate in the study. A developed survey instrument sought input on:

a) building design and process;
b) educational culture (leadership, organizational structure, perceptions about sustainability and values); and
c) integration of green building components into curriculum and learning activities.

A small number of leading schools are striving to accomplish whole-school sustainability; however, the process executed to achieve this objective and methodologies that worked well have not been well documented and disseminated. If sustainable environments are the goal of schools in the near future, foundational research is necessary to make sense of the processes leading to successes, measured by integration of the environment with teaching and learning. Using an e-survey to include as many respondents as possible, documenting this knowledge of whole-school sustainability followed by dissemination of processes as best practices can serve as a springboard for future holistic green school development.

## Research Questions

Three research questions frame this investigation of green schools:

> Q1. Were the core constructs of culture, facility, and curriculum evident in the experiences of individuals engaged in whole-school sustainability?
>
> Q2. Is there a sequenced process taken by schools practicing whole-school sustainability?
>
> Q3. What attributes facilitate the smooth execution of the process to achieve whole-school sustainability?

## Terms and Definitions

The following definitions define this research inquiry:

- ***Environmental stewardship*** **|** responsibility for environmental quality shared by all whose actions affect the environment (EPA, 2005).
- ***Education for sustainability*** **|** a transformative learning process … [equipping] students, teachers, and school systems with the new knowledge and ways of thinking … [needed] to achieve economic prosperity and responsible citizenship while restoring the health of the living systems upon which our lives depend" (The Cloud Institute, 2011).
- ***Environmental education*** **|** a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action (UNESCO, 1978).

- ***School facility*** | the physical elements of the school environment; including, school building, technology, grounds and gardens.
- ***Holistic thinking*** **|** a way of thinking widening the circle of understanding in comprehending connections existing between all things; more specifically, to aspects of the design process and the built environment (McLennan, 2004, p. 218);
- ***Innovation in design*** **|** a category under the LEED rating system providing design teams and projects the opportunity to achieve exceptional performance above requirements set by the LEED Green Building Rating System and/or innovative performance in Green Building categories not specifically addressed by the LEED Green Building Rating System (USGBC, 2009).
- ***Integrated design*** **|** design solutions simultaneously addressing and solving several challenges within a single solution embodying the work and requirements of multiple disciplines (McLennan, 2004, p. 222).
- ***LEED*** | Leadership in Energy and Environmental Design, an internationally recognized certification system for green environmental design of facilities and sites providing third-party verification (USGBC, 2011).
- ***Lifecycle cost*** **|** cost to obtain, operate, repair, and decommission (or salvage) a building over a defined period of time (Kwok & Grondzik, 2007).
- ***School environment*** **|** the total space within which children learn, not just architecture and landscape architecture, but inclusive of equipment, furniture, and the context within which the school is located (Dudek, 2000).

- ***Sustainability*** **|** meeting the needs of the present without compromising the ability of future generations to meet their own needs; measured by the triple bottom line: environmental responsibility, economic prosperity, and social equity (Humblet, Owens, & Roy, 2010).
- ***Sustainable design*** **|** a design philosophy seeking to maximize the quality of the built environment while minimizing or eliminating negative impacts to the natural environment (McLennan, 2004, p. 4).
- ***Whole-school sustainability*** **|** the incorporation of sustainability into all aspects of a school organization including: school governance, pedagogical approaches, curriculum, resource management, school operations, and grounds (Henderson & Tilbury, 2004).

## Research Perspective

As a passionate advocate for green schools, I enter into this research project with a belief in the value of green school design and the positive impact this method of building has on occupants. Through my work in the green building industry and my proximity to Poudre School District, a green school district, I have direct observation, experience, and access to successful green school design and operations.

## Delimitations

As of December 2010, 275 K-12 education facilities in the U. S. had received LEED certification. The research design limits investigation to schools certified under the LEED for Schools or LEED for New Construction rating systems between January 2005 and December 2010, to observe current perspectives on green school development. The study will also be limited to schools serving grades pre-kindergarten through eighth.

Of these 267 educational facilities, 141 meet the specific criteria (Appendix A). An important condition for participating schools is that the school also provides environmental education (EE or EfS) as a structured program. Fourteen schools that were LEED certified and delivering a structured environmental program were considered for inclusion to participate in this research study.

# CHAPTER II

# LITERATURE REVIEW

America's schools annually enroll over 55 million students and more than 5 million faculty, staff and administrators. Therefore, over 20% of our population spends at least six hours a day in a school building (The Center for Green Schools, 2010). Rick Fedrizzi, founding chair of the USGBC stated, "Across America, the next generation of leaders walks into classrooms, libraries, dining and lecture halls…compromising their ability to learn, not enhancing it" (Humblet, Owens, & Roy, 2010). A holistic application of sustainability principles in schools has the ability to enhance the quality and effectiveness of the learning environment.

The following review of literature encompasses three components important to whole-school sustainability: facility design, organizational behavior, and educational philosophy (Figure 2). Research on green schools examines the effects of green schools design on occupants, the value of third party certification, and the impact of the integrated design process. Second, the environmental change process and the roles of leadership and organizational structure are examined in reviewing the guiding educational philosophies for experiential learning and environmental education. Finally,

research centered on the ability of a green school to be an instrument for teaching provides an understanding of the ways in which physical properties "teach."

## Green School Design

The design of school facilities has remained relatively unchanged in the last 200 years. Our nation's school facilities are built to comply with health, safety, and welfare codes, but inadequately support teaching missions due to the design's poor alignment with pedagogy. Many exhibit poor ventilation and inadequate lighting; and many more are simply too old to adequately maintain (USGBC, 2009). Cost is a major barrier to school districts improving their facilities; the capital required to build and operate a school facility is often daunting. As school facilities continue to degrade, it is more important now than ever before to recognize the opportunity to rebuild sustainably.

The idea that the built environment plays an important role in education is not new; however, understanding ways in which this environment can be enhanced or created is scarce in the research literature. Schools are often an uninspiring series of empty boxes with the primary objective to adequately accommodate a maximum number of students, pushing students through an assembly line of state approved curricula with little room for students to develop a sense of ownership or involvement in their learning environment.

Few have seen the advantages of these design approaches, and fewer still have proposed alternate systems to enhance learning, interaction, communication, and skill development. Taylor (1993, 2009), in *Linking architecture and education: Sustainable design of learning environments,* challenges designers to view a building as a functional art form, motivational center, three-dimensional textbook, and a silent curricula. Taylor (1993, 2009) and Orr (1993) believe the built environment is the physical reflection of

the values of an organization with the ability to convey these values to students. Teachers are directed to achieve competencies for state-mandated testing, requiring students be tied to textbooks, minimizing opportunities for students to learn concepts that are challenging to quantify by multiple-choice examination. Concepts such as community values, social responsibility, and environmental stewardship are not commonly included in state tests. Green building, when designed according to sustainability guidelines, illustrates these learning concepts. This raised a question: "What if the school facility itself was the vehicle helping to convey these values to students?"

**Value of Third Party Certification**

Project certification, the result of a third-party verification process, is a public confirmation of sustainability efforts. Project teams can claim that a building is green, but without third party certification, public trust in this claim is difficult. Third-party certification systems spur change in building practices. Credits for improved acoustic design, air quality testing, and shared-use of facilities, push project teams to consider new approaches. One credit included in two certification systems (LEED for Schools and Collaborative for High Performance Schools) is "School as a Teaching Tool." This credit has helped illustrate the opportunity for architecture and design to be used in pedagogy. With the increased awareness and popularity of the "School as a Teaching Tool" credit, increasing numbers of educators and designers embrace the possibilities and potentials of the physical learning environment and invest in further research and exploration of untapped educational opportunities.

Rating systems help define and integrate the attributes of green building, bring public attention to the movement, and result in improved environmental quality. The cost and health benefits of green building have made it a sensible argument in school design. In December 2010, there were 87 certified projects under the LEED for Schools rating system in the U. S., and 1,043 registered school projects in the process of LEED certification (USGBC, 2010).

Collaborative for High Performance Schools (CHPS) defines green schools as being "healthy, comfortable, energy efficient, materials efficient, water efficient, easy to maintain and operate, commissioned, environmentally responsive to site, a building that teaches, safe and secure, a community resource, stimulating architecture, and adaptable to changing needs" (CHPS, 2004; National Research Council, 2007, p. 24). This definition further supports the belief that schools have a profound impact on their occupants.

**Integrated Design**

In order for a green building to be efficient, cost effective, and equitable, an integrated design process is required. Integrated design solutions simultaneously address and solve several challenges within a single solution embodying the work and requirements of multiple disciplines (McLennan, 2004, p. 222). The results of this type of problem solving are described by Berry (1982) as "Solving for Pattern;" defining a good solution as one that solves more than one problem simultaneously.

For a solution to solve multiple problems, all stakeholders need to engage in the integrated design process. Participation is not limited to the design team (i.e., architects, interior designers, engineers, contractors and consultants), but encompasses community members, teachers, students, parents, and administrators as collaborative partners in the

process. Their voices and concerns are essential to understanding project goals and objectives. Synergies, inefficiencies, and potential problems are more easily identifiable when all disciplines and stakeholders discuss design solutions together.

A staple of integrated processes in sustainable development is the design charrette. "Charrettes are basically intense design brainstorming sessions that look to solve a particular design problem by quickly generating multiple schemes (solutions) through the input of various team members (McLennan, 2004). A common vision and measurable goals, established during the charrette, are used to guide project design solutions. To establish vision and goals relevant to the unique needs of a school project, school stakeholders such as community members, teachers, administration, parents, and students must join design discussions. The Center for Green Schools proposed "by inviting the community to be part of the collaborative process to green the school, as well as including them in on-going sustainability initiatives, a green school can become a source of civic pride" (2010).

A concern of the design industry and clients is this process may be more costly. Although the design team may be required to spend more time in collaborative meetings, potentially increasing design fees, the results of a properly executed integrated design process outweigh up-front costs by clarifying information and requirements at the start rather than at a later stage in the design process producing an even bigger impact in terms of cost. "As a result of the integrated design approach, green schools can be built for the same cost — and in some cases, for even lower costs — than conventional schools" (The Center for Green Schools, 2010).

As mentioned previously, the state of American school facilities is far lower than it should be, and it is widely agreed that improvements can be made. However, we cannot keep designing in the same way we always have and expect different results. "If we want to change the result, we must first change the process that led to the result" (McLennan, 2004, p. 86).

**Cost versus Performance**

A green school is a school building or facility that creates a healthy environment conducive to learning while saving energy, resources and money (The Center for Green Schools, 2010). Green schools are supportive and efficient spaces, which inspire the next generation of leaders to value their environments. Green schools help lower operational costs and reduce waste, while also encouraging the active involvement of occupants in these conservation efforts, teaching them to be responsible stewards (The Center for Green Schools, 2010).

The perception that green building increases costs often dissuades organizations from building green; however, articles such as "Greening America's schools: Costs and benefits by Kats (2006) show that any cost of green building is far outweighed by energy savings and benefits to occupants. These benefits to occupants stem from a healthier indoor environment and result in improved health, performance and attitude.

Disproving the myth that green building is more expensive is the first step to the adoption of green building techniques. Often, simply using the term "green" implies costly, and thus dissuades school boards from adopting these practices. For example, when Poudre School District of Fort Collins, Colorado first decided to build green schools, they opted to use the term "high-performance" to describe the building approach,

instead of green (Franzen, 2009). After proving the cost-effectiveness of their approach, the district embraced the term "green" and has since adopted other green programs (e.g., lunch waste composting and environmental clubs).

A seminal study by Kats (2006) of Capital E illustrated the perception that green building costs more has no basis. His findings showed green schools average a 3% increase in cost, but have a financial return of 20 times that amount (Kats, 2006). Benefits accumulate through lower water and energy use, increased teacher retention and lower health costs (Kats, 2006). An additional benefit, not measurable in dollars, is the increased competitiveness of the school. As parents are provided greater choice and freedom about where to send their children to school, the benefit of green building will become even more valuable.

Research on the healthy indoor environment present in green buildings demonstrates benefits beyond cost effectiveness into the realm of societal responsibility (USGBC, 2009; Kats, 2006). In 2005, the Committee to Review and Assess the Health and Productivity Benefits of Green Schools attempted to synthesize empirical and theoretical studies measuring the relationship between student outcomes and school facility design (National Research Council, 2007). The committee found this a difficult task due to a basic dilemma when researching educational achievement; the variables influencing students' performance are hopelessly vast. Students spend an average of 40-50 hours a week in a school facility; therefore, about 75% of their time is spent in other environments such as their home or neighborhood playground. The validity of measuring the effects of green building on students is questionable. Within a school there are many interrelated systems affecting student performance besides the physical environment

(e.g., curriculum delivery, teacher competencies, socio-demographics, national policies such as the No Child Left Behind Act; National Research Council, 2007).

**User Impact**

Elementary schools have been the primary focus of many studies comparing facility design to student performance (e.g., Edwards, 2006; Heschong Mahone Group, 1999; Kats, 2006). Students of this age primarily remain in the same classroom with the same teacher for the majority of their school day. This allows fewer variables to influence the student, allowing the influence of their physical environment to be explored.

Though research is limited, and the nature of the school environment makes conclusive and comparative findings difficult, studies show a positive relationship exists between specific design variables and student performance (Edwards, 2006; National Research Council, 2007; Tanner, 2008). The most widely studied variables of indoor environmental attributes are daylight and indoor air quality. The presence of daylight has dramatically affected the productivity and performance of building occupants (Heschong Mahone Group, 1999). A landmark study by the Heschong Mahone Group (1999) focused directly on school environments and found a positive and highly significant correlation between student performance and presence of daylight in classrooms. One school's test scores showed students progressed 15% faster in math and 23% faster in reading when their classroom included a large area of windows (Heschong Mahone Group, 1999). Skylights and the presence of operable windows were also found to significantly impact student performance (Heschong Mahone Group, 1999)

An increase in student performance in well-designed or green schools may be attributable to increased student pride in their school facility (Edwards, 2006). This pride may stem from green schools often receiving attention from the media and support from the surrounding community (Edwards, 2006). Community support of a school plays a large role in the school's success with education largely a community endeavor, as the educators at the Reggio Emilia School fervently believe (Edwards, Gandini, & Forman, 1998); green building builds community support. In the corporate world, green pride is at work; in a recent survey, 87% of executives perceived their company's community image improved after participating in green building (Kats, 2006).

In a survey conducted by the National Foundation for Education Research, researchers found students who moved into a newly designed and constructed school reported a 30% increase in feelings of safety, a 34% increase in school pride, and an 11% increase in overall enjoyment of their school experience. A significant decrease in bullying, lower rates of student and teacher absenteeism, and a decrease in staff turnover were also identified (Rudd, Reed, & Smith, 2008). This study did not address the potential of a Hawthorn effect because the survey process was closely tied to the relocation of students to their new school; therefore, it is conceivable that effects were exaggerated. Their findings suggested greater student satisfaction and overall well-being are evident in newly designed and constructed school environments. New or renovated facilities attempting to meet green standards may also benefit from revitalized perceptions of the learning environment.

Governor Caperton of West Virginia recognizes the symbolic importance of a school facility within a community. The state had experienced a steady decline in

educational performance; but, instead of investing dollars in educational programs, the governor decided to invest in *educational facilities* (Meek, 1995). West Virginia's schools were rundown and neglected; communities were not proud of these educational facilities and felt no ownership, thus, they did not value education. The governor reasoned, "If the people were proud of their schools and vested in them, they would value learning, and their children would value learning, too." (Meek, 1995, p. v.). The overall impact of this investment was an increase in community pride in schools and the development of a positive sense of place (Meek, 1995).

Often, improved productivity, performance, and happiness are simply by-products of overall improvement in health. The main contributors to improved health are better day lighting and indoor air quality, making it difficult to analyze whether increased student performance is due to overall building design or these variables alone. When the quality and amount of daylight or fluorescent lighting is compared to student level of stress hormones, levels of daylight in concert with seasonal changes had a profound impact on student health (Kuller & Lindsten, 1992). The implications of these findings suggest designing classrooms without windows may have a harmful effect on hormone patterns, stunt body growth, and increase absenteeism (Kuller & Lindsten, 1992). In addition, students' visual access to the natural environment, whether through windows or indoor plantings, decreased stress and improved cognitive function (Wells, 2000). Improved lighting has a large impact on eyes in terms of improved visibility (Heschong Mahone Group, 1999). This may result in a decrease in eyestrain and headaches, conditions especially true if artificial lighting used in addition to daylight specifies

electric ballasts instead of magnetic ballasts, resulting in decreased amounts of flicker (Heschong Mahone Group, 1999).

Another common health risk in today's buildings is poor indoor air quality. Individuals spend 80-90% of their time indoors (USGBC, 2009); however, poor air quality is often unnoticed by occupants but clearly reflected in the number of sick days and in employee complaints. In schools, poor air quality can have pronounced effects on asthma and allergies, increasing sick days taken by students and teachers (Kats, 2006). Because nearly 25% of our nation's schools are considered below standard, designed with minimum required performance for lowest cost, with air quality and ventilation rarely regulated by the state, these poor air quality conditions will most likely continue in years to come (Kats, 2006).

## Educational Philosophies

Educational philosophies supportive of green school design include education for sustainability (EfS), environment-based education (EE), need for nature, modeling, and experiential learning. Each of these philosophical positions considers nature and the human relationship of people to the built environment.

### Education for Sustainability (EfS)

In a study by Henderson and Tilbury (2004), principles of education for sustainability were found to be of vital importance to whole-school sustainability programs. "Education for Sustainability (EfS) is defined as a transformative learning process … [equipping] students, teachers, and school systems with the new knowledge and ways of thinking … [needed] to achieve economic prosperity and responsible

citizenship while restoring the health of the living systems upon which our lives depend" (The Cloud Institute, 2011). Education for sustainability empowers learners to create a more sustainable future, to improve quality of life, and to be skillful and knowledgeable global citizens (Henderson & Tilbury, 2004).

The curriculum content of Education for Sustainability is viewed as a "whole system" of interdependent, mutually beneficial concepts (Cloud, 2005). Core content areas might include carrying capacity, management of resources, interconnectedness of human and earth systems, principles of citizenship, learning to think creatively, educating for multiple perspectives, and the value of place including ecology, people and culture (Cloud, 2005). The purpose of these content areas is to enable students to be active participants in future sustainable development (The Cloud Institute, 2011). The Cloud Institute refined these core content areas for use as a curriculum framework. Concepts apply to five levels: individual self, classroom, school, operations, and community (The Cloud Institute, 2011). These levels teach students knowledge, skills, attitudes, and habits of mind conducive to sustainability, and provide direction to schools so they might infuse these principles into their culture, curriculum, instruction, and assessment practices (The Cloud Institute, 2011).

**Environment-based Education (EE)**

A pre-curser to Education for Sustainability (EfS) was Environment-based Education (EE). This method emphasizes specialized teaching methods that respond to the place or environment in which the student resides. Culture, community, history, and nature are important aspects of this teaching philosophy. Environment-based education also integrates interdisciplinary subject matter into problem and issue-based learning

experiences. It emphasizes the use of team teaching, learner-centered instruction, constructivist approaches, and self-directed learning (NAAEE & NEETF, 2001). Adoption of these methods has been found to help produce "thoughtful community leaders and participants and people who care about the people, creatures, and places around them" (NAAEE & NEETF, 2001, p. 3).

The foundation of this educational philosophy is the belief that one's interest in the environment develops during childhood, frequently as the result of a significant outdoor experience, the influence of family or teachers, involvement in an organization that respects the environment, or the loss or degradation of a natural space that held personal value (Chawla, 1999). The purpose is to provide these experiences in schools to develop environmentally conscious students.

**Need for Nature**

Nature is increasingly something to "watch, to consume, to wear – to ignore." (Louv, 2005, p. 2). Louv suggested nature is an essential component of a child's world, and a child's mental, physical, and spiritual health is positively affected by their association with nature; in reverse, children are negatively affected by their disassociation with natur; termed by Louv *nature-deficit disorder.* He did not use the term to describe illness, but to illustrate human costs of alienation from nature. Identified effects include diminished use of the senses, attention difficulties, and higher rates of physical and emotional illness (Louv, 2005). Studies have shown educational methods connecting students to the natural environment improve students' overall academic performance (Athman & Monroe, 2004; Lieverman, Hoody, & Lieverman, 2000; NAAEE & NEETF, 2001; NEETF, 2000).

## Modeling

The goals of EfS and EE encompass understanding complex concepts and behavioral change. This leap from concept to behavioral change is often difficult when school leadership does not model the sustainable behavior they are attempting to teach. Higgs and McMillan investigated the influence of school setting on sustainability behavior and found modeling is a significant influence on student behavior. The most significant are role models (such as teachers), school facilities and operations, school governance, and school culture (Higgs & McMillan, 2006). Learning from a model is observational learning, involving attention to a model, followed by the retention and translation of modeled actions into personal behavior (Pintrich & Schunk, 2002). An observer will be motivated to retain this knowledge and emulate the model if they perceive the modeled acts are valuable (Pintrich & Schunk, 2002). Motivation increases when the model also presents information with enthusiasm and charisma (Perry, 1985; Pintrich & Schunk, 2002).

## Experiential Learning

Researchers in the field of experiential learning have noted how our experience in a place influences our understanding. Kolb (1984) wrote, "Learning is the process whereby knowledge is created through the transformation of experience." Black, in his work on learning in museums, expanded this concept by saying "…a learner's attitudes, values, or behavior may change as a result of a learning experience" (Black, 2005, p. 129). This concept of constructing knowledge through experience is an active theory of learning (Hein, 1998) in stark contrast to the traditionally held theory that learning is transmitted from teacher to student incrementally. Known as didactic transfer, this

learning theory requires students to assimilate information, facts, and relayed experiences in an effort to form knowledge (Hein, 1995) as they experience the world around them.

Younger generations have expressed preferences for experiential, or hands-on, learning methods possibly because of the increase in personal technology and the instant feedback these devices provide (Silberman, 2007). For instance, in video games a player learns by doing, by making mistakes and learning from them, and rewarded with real-time scores. Even though experiential learning is preferred, the use of didactic methods (i.e., the lecture) is still the most common teaching pedagogy. However, recent publications suggest the use of experiential learning techniques is growing (Silberman, 2007).

The process of experiential learning at its most basic is "DO-REVIEW-LEARN-APPLY" (Dennison & Kirk, 1990). As a facilitated, process, learners must be motivated to develop the learning cycle. Motivation occurs when a learner perceives the relevance of the experience and sees ways in which the experience is applicable to their lives (Black, 2005). Therefore, an environment that invites engagement is not enough for a user to engage; they must be facilitated and motivated to engage.

A constructivist teaching approach supports experiential learning. Constructivism offers the most comprehensive theory on how individuals acquire knowledge by interacting with their environment (Joyce, Weil, & Calhoun, 2009). Teachers are urged to not only teach students content, but to teach students how to learn content (Joyce, Weil, & Calhoun, 2009). This allows students to develop their individual learning styles and take ownership of their own knowledge acquisition. Learning is not just basic

acquisition; instead, it is the process of taking in knowledge, dissecting, organizing, and restructuring it. It is an active process centered on the learner, instead of the instructor.

## Organizational Culture

School culture plays a large role in achievement, change and reform, and student learning (Deal & Peterson, 2009). It is able to give meaning to people by tying the organization to values and traditions (Deal & Peterson, 2009). Culture includes aspects such as core norms, tradition, mission, rituals, organization, leadership, roles, curriculum, and programs (Deal & Peterson, 2009). Artifacts, architecture, and routines are symbols, or outward manifestations of cultural values and beliefs. The attributes of these have a profound influence on "place" and the motivations and actions that occur in place (Cross & Thomas, 2007; Deal & Peterson, 2009).

### Leadership

The choice to build a green school illustrates a desire to begin the process for environmental change in an organization's culture or indicative of established environmental values held by the organization. In the former, a shift in organizational behavior (i.e., human behavior in the context of an organization (Owens, 2004, p. 76) and environmental values insure the successful operation of the green school. Occupants need to be supportive and engaged in recycling efforts, energy conservation, and passive systems such as daylighting and ventilation. Green schools are designed to support these measures, but they cannot perform them in place of occupants.

To lead the behavioral shift needed in green schools, a charismatic leader with a personal commitment to change is needed (Schelly, Cross, Franzen, Hall, & Reeve, n.d.). "Charismatic leaders differ from other leaders by their ability to formulate and articulate

an inspirational vision and by behaviors and actions that foster an impression that they and their mission are extraordinary" (Conger, Kanungo, & Menon, 2000, p. 748). Collective identity, empowerment, and heightened group task performance are results of charismatic leadership (Conger, Kanungo, & Menon, 2000). Reverence for a charismatic leader develops in followers when their leader is sensitive to the environment (Conger, Kanungo, & Menon, 2000).

A similar type of leadership empowering and inspiring action is transformative leadership. Transformative leadership inspires increased commitment to organizational goals, builds meaning, and inspires (Ryan, 2002). Leithwood (1994) has identified seven dimensions of transformational leadership in schools. These include "building school vision, establishing school goals, providing intellectual stimulation, offering individualized support, modeling best practices and organizational values, demonstrating high performance expectations, creating a productive school culture, and developing structures to foster participation in school decisions" (Leithwood et al., as cited in Ryan, 2002, p. 992). The governance of green schools should act as a model of social equity (Higgs & McMillan, 2006). This can be accomplished through participatory processes and inclusion of teachers and students in decision-making (Higgs & McMillan, 2006). Allowing students to be active participants in the governance and operation of their school empowers ownership of their education (Higgs & McMillan, 2006).

**Environmentalism and Organizational Culture**

Organizations can engage in three methods of environmentalism. Compliance-based environmentalism spurred by governmental regulations, market-driven environmentalism driven by cost savings accrued through environmental efficiency and

innovation, and value- based environmentalism (Post & Altman, 1994). Two barriers deter organizations from achieving environmental goals: industry barriers and organizational barriers.

> Industry barriers include technical information, capital costs, configuration or current operations, competitive pressures, and industry regulations. Organizational barriers include factors such as employee attitudes, poor communication, past practice and inadequate top management leadership. (Post & Altman, 1994, p. 67)

Industry barriers are the first barrier that must be overcome in the process of environmental change. Location is an industry barrier for schools and educational institutions. If a school is located in an area where building professionals lack knowledge about green building, and city infrastructure that does not consider green approaches to services such as recycling, the community will find it challenging to envision a green school. The building professions are increasing their knowledge and experience in green building, thus this barrier may cease to be an issue. For districts initiating process to attain environmental change, the source of challenging barriers would transition to organizational barriers.

Organizational barriers in green building often include a misunderstanding of the true cost of building green, the perceived lack of tangible benefits, or the combination of political and social value systems. In addition, organizational barriers include the attitudes of staff, poor communication, adversity to change, and poor administrative leadership (Post & Altman, 1994).

## Green Buildings as Teaching Tools

The combination of green school design, a green organizational culture, and curriculum aligned with green practices and methodologies sets the stage for a school to

utilize their facilities and grounds as a teaching tool. School facilities can be used as pedagogical 'instruments' (Dudek, 2000; Taylor, 1993; Taylor, 2009; Orr, 1993; Orr, 1997; Higgs & McMillan, 2006). From first through twelfth grade, children spend over 14,000 hours inside school buildings; therefore, some level of influence is inherent in their physical surroundings (Deal & Peterson, 2009). A building serves as a billboard for the values an organization holds. Its design visually illustrates and manifests specific values an organization place – on its employees, on the work they produce, on their clients, on their community, and on the environment.

**Historic Systems of Communication**

The built environment, inclusive of architecture, interior design, engineering, and landscape architecture, has historically been a tool to communicate values. Buildings communicate functions as well as the intrinsic meaning of those functions. This dualism parallels and is exemplified in linguistics where semantics - the meaning of words, and syntax - the structure and order of words both operate as tools in expressing ideas. As language is a tool to express ideas, the built environment is a tool to express values (Hale, 2000).

The perceived interpretation of buildings is dependent on cultural and historical significance of architectural form (Deal & Peterson, 2009; Hale, 2000). For example, the use of classical Greek forms in Washington, D.C. representing stability, power, and endurance. In Native American cultures, the use of symbols and patterns portrays religious and cultural meaning (Nabokov & Easton, 1989). In essence, cultural history plays a significant role in the process of interpretation allowing familiar forms with

historical significance to communicate cultural ideas. Drawing from and layering these established forms communicates intrinsic meaning.

Meaning, in the larger sense, is both cultural and personal. Circumstances, events, information, and symbols are embedded within meaning and contain unspoken paradigms and value systems (Deal & Peterson, 2009; Starratt, 2003). These elements are a part of both space and place. Space as the natural and man-made environment, and place as the sense of meaning attributed to space (Cresswell, 2004). Place, along with its intrinsic meanings, is the first connection formed when entering a space (Hein, 1995). People imbue places, objects, and forms with different meanings; and their response to these meanings will influence how space is comprehended (Rapoport, 1982). An individual's involvement in a place and ability to personalize space establishes a sense of identity between individual and place (Hale, 2000; Rapoport, 1982).

**Meaning in School Facility Design**

When a school community comprised of students, teachers, faculty, and staff, experience a green school, they do not only experience the physical or natural space, they experience *place* with imbedded meanings and values. The connections, attachments, values, and beliefs within a school are communicated to them (Cresswell, 2004; Dudek, 2000). If sustainability is a guiding philosophy of a space, then sustainability will be an emanating value and constructing the meaning of the place.

As suggested by Hale (2000) and others, architectural forms communicate meaning; however, architectural form is not the only form of communication. The functions that occur within this form in the case of schools encompass curriculum, programs, communication, assessment, personnel, and discipline. The prominence or

special features created by individual school spaces communicates school priorities (Deal & Peterson, 2009). Viewing school features collectively reveals a community's values and purposes (Starratt, 2003). This collective message is understood as "*we.*" It tells students, this is how *we* conduct ourselves. This is what *we* value (Starratt, 2003). Schools are the center of civic communities, thus a primary medium for communicating the values of the community at large. They are essentially a crystalline expression of a community's values (Deal & Peterson, 2009; Orr, 1993). This collective message embraces a larger educational purpose.

As Orr proposes in *Architecture as Pedagogy*, design without thought to pedagogy results in buildings that "show little thought, imagination, sense of place, ecological awareness, and relation to … larger pedagogical intent" (Orr, 1993, p. 226). What lessons are conveyed through the design of America's schools? Does the dilapidated state of a school facility communicate community disregard for children, devaluing learning? Do we accept carelessness that accompanies inefficiency, and adopt callousness to the degradation associated with the production of energy and materials (Orr, 1993, p. 226)? If it is desirable for future generations to be better stewards than their predecessors, they will require environments communicating values of environmental stewardship. To educate for sustainability, the built environment will need to illustrate connectedness and responsibility to the larger world community.

**The Power of an Integrated Approach**

Illustrating the resource and cost savings of building efficiencies, conceptualizing schools as interactive museums inviting and enhancing learning by exploring, discovering and engagement, revealing the building systems for occupants to see the

structure and flows of the building exemplify a building used as a teaching tool (Abrams, 2010). Transparency is a core principle of these design ideas. Designing a "transparent" facility is essential for an effective teaching tool (Higgs & McMillan, 2006). "Sustainable facilities and operations …promote [sustainability education] by modeling sustainable practices, reducing the need to preach to students, creating a context for conversations about sustainability, and providing hands-on opportunities to try sustainable practices, increase[ing] student ownership and stewardship of their environment" (p. 46).

Conservation efforts occurring within a facility can be used as a pedagogical tool (Schelly et al., n.d.). These efforts modeled by organizational leadership and supported by green school design strategies and planning efforts offer practical applications of conservation efforts. Sustainability is increasingly tangible to students when they are involved in the operations of the school (Higgs & McMillan, 2006). Allowing students to contribute in meaningful ways to their school environment results in students connecting knowledge about environmental concerns and environmental action (Higgs & McMillan, 2006; Schelly et al., n.d.). Establishing this connection assists students to apply these concepts to their personal lives (Schelly et al., n.d.).

Classroom lectures, discussions, and experiments increase students' knowledge about the environment; however, these methods alone are inadequate to alter students' attitudes or concerns for the environment (Tung, Huang, & Kawata, 2002; Ramsey, 1993). Schools that combine curriculum *and* environmental activities are more likely to see an increase in environmental behavior (Tung, Huang, & Kawata, 2002) necessary to construct a culture of environmental stewardship in the next generation.

## Summary

Green school design has seen a steady increase in the marketplace, partially attributed to third-party certification systems bringing validity and marketability to school projects. The standards of third party certification systems push green buildings to increase efficiency affecting lower life-cycle costs. Efficiencies are developed through the integrated design process which brings together the project team and user groups. This process establishes common visions and goals, essential to project success and efficient long-term operation. Green design has evidenced increases in productivity, performance, health and wellbeing, and satisfaction (e.g., Heshong Mahone Group 1999; Kats, 2006).

A school's educational philosophies affect student experiences within the physical learning environment. Education for Sustainability (EfS) and Environmental Education (EE) complement the goals of green school design. Teachers and school administration actively embracing these philosophies create models of responsibility and stewardship, teaching students to be active citizens in both their civic communities and the environment. Students learn lessons of sustainability by experiencing curriculum and the built environment transparently demonstrating sustainable values.

School culture consists of elements such as core norms, traditions, mission, rituals, organization, leadership, roles, curriculum, and programs. Leadership plays a large role in how each of these elements manifest. For successful whole-school sustainability, a charismatic or transformative leader to lead the effort, models the philosophy, responsibility, and democracy to be *green.* Organizational barriers may need to be addressed before a charismatic leader can guide the environmental change process.

In schools, architectural design is capable of communicating cultural values to students, as well as larger pedagogical intents. The operation of the facility, and the ability for students to interact with its operation, enhances the school's ability to be an educational tool.

**Conceptual Framework**

Three themes were drawn upon from the review of literature to construct the conceptual framework for the study (see Figure 2). These themes--design, organizational culture, and curriculum--collectively influence the success of a school becoming a teaching tool.

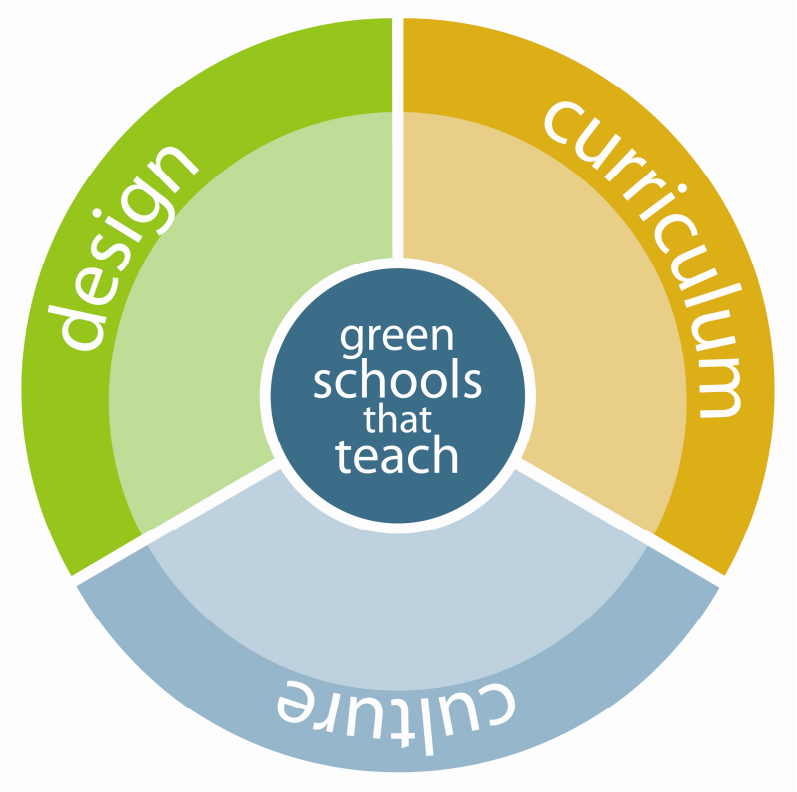


*Figure 2.* Conceptual framework for the study (Barr 2011)

# CHAPTER III

# RESEARCH DESIGN AND METHODOLOGY

This study is a nonexperimental between groups design examining the attributes of whole-school sustainability. The questions posed to participants were framed by appreciative inquiry (AI) theory an "approach to initiating…change…associated with the 'positiveness' movement in psychology; rather than dwelling upon problems..., AI encourages individuals to adopt a positive, constructive approach…" (Dematteo & Reeves, 2011, p. 203). In this manner, questions posed to respondents were 'positive' in nature, seeking to derive responses encompassing the positive impacts of green school design. Data were collected using an e-survey (Appendix B) to allow participants from schools located across the U. S. to access the survey, maintain anonymity, and respond within a reasonable period of time (thirty days). The use of an e-survey also allowed data to be easily transferred and analyzed.

The study population encompassed LEED certified primary grade schools employing sustainable practices and environmentally oriented curricula. Respondents from these schools included administrators, teachers, parents, and technical building professionals. The diversity of respondents added value to the data, providing greater perspective and insight into these learning environments. Using a census of 14 schools

meeting the criteria of LEED certification and formalized environmental curriculum (Table 1), a convenience sample of nine schools was selected[1], based upon the recommendations of two expert consultants in green schools and sustainability. Although use of a convenience sample may limit generalizability, recommendations from these experts narrowed the choice of facilities to those most representative of the inclusion criteria of curriculum and certification level.

## Sampling Frame

The population included 14 school facilities certified under a LEED Rating System between January 2005 and December 2010 and delivering a structured environmental education curriculum (EE or EfS). The USGBC lists LEED certified projects in an online project directory. As of December 2010, there were 265 certified K-12 education facilities in the U. S. Of the 265 educational facilities, 141 were certified under the LEED for Schools or New Construction rating systems between 2005 and 2010, and encompass grades pre-kindergarten through eighth grade. Fourteen schools were determined to be practicing whole-school sustainability (Table 1) by examining the school's website to evaluate mission statements and curriculum descriptions forming the study sampling frame. Of these 14 schools, nine were contacted based on expert guidance, and five consented to participate in the study.

The survey process identified the recruitment steps that were taken (see Figure 3). Principals were originally contacted using a phone script (Appendix C) to ascertain level of interest in study participation. Those principals who were not reached by phone were sent an email containing the information in the phone script. Four questions were

[1] Schools included in the study

included in the phone script: type of school, number of students and faculty/staff, location of school, and project architect. Upon verbal agreement from the principal, a text for a Letter of Cooperation (Appendix D) was sent by e-mail. The principal replied to this email with their consent. The principal acted as gatekeeper, inviting their staff to participate in the study. The Notice to Participants (Appendix E) and a Reminder to Participants (Appendix F) were provided in an email to the principal to assist them in promoting the survey to their staff. These documents included a study description and the URL link to the survey. Not all invited participants may have directly participated in the process of creating the school; however, they may contribute to an understanding of values supportive of whole-school sustainability processes and goals. Participants were not identifiable to the researchers in any portion of the e-survey assuring anonymity.

Table 1. *Schools Certified by LEED and Offering EE or EfS Curriculum*

| **Project Name** | **City** | **State** | **System** | **Level** | **Date** | **Level** |
|---|---|---|---|---|---|---|
| Barnard Environmental Magnet | New Haven | CT | NC 2.1 | Gold | 3/12/2008 | P-8 |
| Bertschi Center* | SEATTLE | WA | NC 2.1 | Gold | 9/16/2008 | P-8 |
| Hilltop Montessori School | Birmingham | AL | NC 2.1 | Certified | 6/19/2008 | P-8 |
| Montessori School of Maui | Makawao | HI | NC 2.1 | Silver | 9/17/2009 | P-8 |
| Prairie Crossing Charter School* | Grayslake | IL | NC 2.1 | Gold | 2/7/2008 | Elementary |
| The Willow School * | GLADSTONE | NJ | NC 2.1 | Platinum | 11/13/2007 | Elementary |
| Evergreen Elementary | California | MD | NC 2.2 | Gold | 10/26/2009 | Elementary |
| Manassas Park Elementary | Manassas | VA | NC 2.2 | Gold | 6/4/2010 | Elementary |
| Pine Jog Elementary* | West Palm Beach | FL | NC 2.2 | Gold | 5/14/2009 | Elementary |
| Second Nature Academy | NASHUA | NH | NC 2.2 | Platinum | 2/25/2010 | Elementary |
| Salmon Creek | Occidental | CA | NC 2.2 | Platinum | 11/19/2009 | Middle School |
| Stamford Environmental Magnet | Stamford | CT | NC 2.2 | Silver | 3/31/2010 | P-8 |
| Windrush School | El Cerrito | CA | NC 2.2 | Platinum | 7/20/2009 | P-8 |
| Learning Gate* | Lutz | FL | Schools 2.0 | Platinum | 6/2/2010 | P-8 |

*schools consenting to participate in study

The cooperation of each school's project architect, identified by the principals, was sought by phone contact. The project architects served as gatekeepers for other

project team members. The architects were informed of the school principal's consent to be involved in this research. Upon the architect's agreement to participate, the same communication procedures were followed. A survey invitation and reminder email were provided, including instructions of forwarding the invitation to other project team members in the fields of architecture, interior design, engineering, commissioning, and sustainability.

The e-survey, including consent and completion directions, was accessible between April 13, 2011 and May 6, 2011. In addition to the first survey invitation, two reminder emails were sent to the gatekeepers (principals and project architects) to encourage their participation and their staff's participation.

## Instrumentation

The principal instrument of this research study was an e-survey (see Appendix B). The survey was cross sectional, collecting respondent's attitudes and insights at a single point in time. The questions included in the survey were based on issues surfacing in literature review, published school surveys, and information from expert professionals in the fields of green school design and research. The phone script (see Appendix C) used with the school's principal or key administrator identified willingness to participate and collected information on the facility demographics.

### E-Survey

The survey consisted of five sections: demographic, school culture, school design, curriculum, building as a teaching tool, and an open-ended comment section. The nature of the study was exploratory; therefore, open-ended questions were the primary question format. The demographic section included questions on staff position, length of time

with the school, experience in their discipline, presence of LEED accreditation, and satisfaction with the LEED process.

Section 2 focused attention on school culture. The questions were closed responses requiring respondents to choose a value on a four-point Likert-like scale with 14 measures. Following the 14 measures, the respondents were asked to provide a brief illustrative example describing a time when a norm/value scored as 1: generally characteristic of their school. This portion of the e-survey was published and disseminated by the Idaho Department of Education and available for use in PDF form on the state's website.

*Sample question with directions:*

**School Culture**
Please rate the degree to which the following norms or values are a consistent feature in your school. (Idaho Department of Education, n.d.).

| | Almost Always Characteristic of our School | Generally Characteristic of Our School | Seldom Characteristic of Our School | Not Characteristic of our School |
|---|---|---|---|---|
| ***Collegiality*** *(Professional collaboration on educational issues)* | ❍ | ❍ | ❍ | ❍ |

In Section 3, information was collected on school curriculum and guiding philosophies to understand the level of influence sustainability had in curriculum using three open-ended questions.

*Sample question*: In what ways does your curriculum promote sustainability?

Section 4 requested information about school design, why green design was chosen for the project, if an integrated design process was employed, and what values were represented in their building. Four open-ended questions and a fill-in matrix comprised the section measures.

*Sample open-ended question:* Why did you design a green school?

Section 5 sought to understand the relationship and influence of the physical building and grounds to the curriculum (i.e., establishing the whole environment as a teaching tool) by asking four open-ended questions.

*Sample open-ended question:* In what ways do you use your green school to teach for sustainability?

At the conclusion of the e-survey, a final, open-ended question provided participants the opportunity to add comments describing their green school in detail and provide possible reasons for their school's success in whole-school sustainability.

All five sections were visible to school staff (group A) and community members and parents (group B); design and building professionals (group C) were asked to complete sections 1, 4, and 5. These participants were not anticipated to provide insight into school culture or curriculum. Table 2 indicates the sections provided to each participant group.

**Response Rate**

A valid response rate could not be calculated with the use of gatekeepers pre-empting how people were invited, who was invited, and when the invitation was sent to potential participants.

Table 2. *Participants Responding to Survey Sections*

| Section | Participant | Rationale |
|---|---|---|
| All sections | A: School staff | Potential for perspectives on all areas |
| All sections | B: Parents and community members | Potential for perspectives on all areas |
| 1, 4, 5 | C: Design and building professionals | No information likely on culture and curriculum |

## Approach to Data Analysis

The survey provider generated an excel file for numeric responses; narrative paragraphs were provided for open-ended responses. The researcher reviewed the number of survey participants and corresponding position/discipline for indications of response representation.

Coding began with open-ended responses using the three constructs in the study as a starting point: culture, design, and curriculum followed by inductive data analysis. During this process, patterns, categories, and themes were constructed from the "bottom up" (Creswell, 2009) examining the data in a holistic manner rather than in segments.

After developing coding guidelines, narrative responses were re-read for thick descriptions to understand the context of responses. Specific focus was on understanding the meaning study participants' held regarding whole-school sustainability (Creswell, 2009). Finally, results were synthesized and common themes presented using graphs, tables, and descriptive text. The findings were presented in a manner applicable to both the fields of education and green building.

Different types of analyses were conducted to gain deep understanding of the data, represent the data, and interpret the larger meaning of the data (Creswell, 2009). The online survey used both Likert scale responses to items and open-ended responses. The open-ended responses were analysed using the process illustrated in Figure 3. The first step in this process was to organize and prepare data exported from the survey provider; all open-ended responses were transcribed and coded to allow tallying and comparison (p. 188). The entire data set was read to gain a sense of overall meaning, depth, and credibility of the data (Creswell, 2009). Open coding was used for the first

round of coding. Within NVivo, a qualitative analysis program, the responses to each question were read with codes developed based on response contents. Once each response was coded in this manner, the codes were grouped according to similarity of content. This resulted in four thematic "chunks" or top-level nodes. The first three themes aligned with the initial study constructs developed in the literature review: building design, culture, and curriculum. The fourth theme identified "personal qualities."

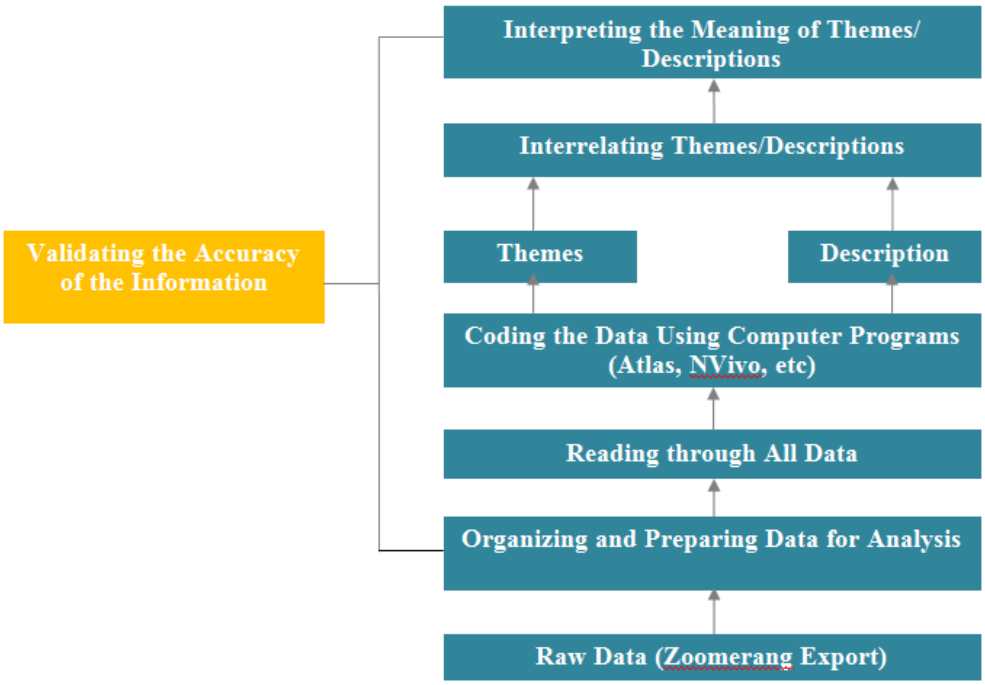


*Figure 3*. Qualitative data analysis approach (Creswell, 2009, p. 185)[2]

In addition to these codes, a fifth thematic repository was created to track representative narrative from participants. Reading through the responses to a particular question provided opportunity to identify profound, descriptive responses. This collection of statements was used in writing the analysis and study summary.

[2] From *Research Design* (p. 185), by J. W. Creswell, 2009, Thousand Oaks, CA: Sage. Copyright 2009 by Sage Publications. Adapted with permission.

Codes within each of these four themes were reviewed for interrelationships. A matrix query was constructed to compare the commonality of codes applied to individual references. This coding query is included in the code book (see Appendix J). Majority relationships were summarized and important outlier relationships noted. The process of identifying interrelating themes created the foundation for data interpretation and synthesis.

During the analysis process, a journal tracked memos, early insights, and mapping of code relationships. After the identification of interrelated themes, code maps were developed using mapping software to examine relationships of sub-categories to create a picture of interrelationships among factors affecting whole-school sustainability.

## Reliability, Validity and Credibility

The study, explorative in nature, used a mixed design aligned with an interpretive framework to identify the meaning of holistic green schools from the perspective of those engaged in teaching, working or creating these environments, to construct a phenomenological perspective. An e-survey collected perceptions rather than face-to-face information collection, as would be traditionally used to capture participants' views. The schools were geographically distant and therefore an e-survey afforded opportunity for distant schools to participate; open-ended responses invited deeper insights to be revealed. Chizawsky, Estabrooks, and Sales (2011) found electronic surveys to be effective in collecting data, receiving a higher response rate among staffs whose schedules are impacted by user demands; nursing staffs, like teachers also "work" with few opportunities for breaks and little time to complete paper and pencil surveys.

Chizawsky et al. (2011) achieved a higher response rate well above their anticipated 50% rate of 84%, compared to paper surveys (16%).

**Reliability**

Reliability was achieved by expert review of the instrumentation by two LEED Accredited Professionals, with the final survey checked for comprehension and understanding. The pattern of response to the survey questions indicated similar perspectives across the five participating schools.

**Validity**

Internal validity was achieved by the research design; data collected responded richly to the questions posed. External validity was confirmed by inclusion of participants having experienced holistic school approaches to learning; that is, the curriculum, facility, and mission are expected to align with sustainable practices and evidence a consensus across each participant group. Queries across five different whole school environments were also anticipated to reinforce similarities in meaning. Using different sources of information (open-ended, Likert-like scales, web information, LEED Standards) triangulated the findings.

**Credibility**

Consistency in coding was established by defining specific meaning for each code to avoid drift in meaning (Creswell, 2009). These definitions were included in a code book to increase the trustworthiness and credibility of codes (see Appendix J). Codes were checked by experts, including research advisors and green school design professionals. Reviewers periodically examined coding and approach to data analysis to confirm emerging themes and to insure consistency and validity. The conclusions drawn

from the quantitative and qualitative analyses sought to identify major contributors to the process of creating green schools.

# CHAPTER IV

# DATA ANALYSIS AND FINDINGS

Data were collected through an e-survey with each school principal serving as a gatekeeper. Invitations to participate in the study were channeled through the principal to staff, administrators, and community members. Project architects also served as gatekeepers, inviting their project team members to participate. Open coding developed potential themes with subsequent interrelationships identified. Proposed model components of building design, curriculum, and culture were used as a template to interpret the codes into meaningful relationships offering insights into the process of whole-school development.

## Participant Profile

The principals of five schools consented to participate in the study with responses to the survey questionnaire collected from each of the schools responding to questions focused on administration, curriculum, and creation of the facility. The schools, identified as teaching a formalized environmental education curriculum, with a building certified as green through the LEED rating systems, were distributed geographically and by type (see Table 3 and Figure 9).

Table 3. *Summary of Participating Schools*

| School | State | Location Type | Grades | Type | # Students |
|---|---|---|---|---|---|
| **1. The Willow School** | New Jersey | suburban | P-8 | Private | 127 |
| **2. Pine Jog Elementary School** | Florida | suburban | K-5 | Public | 860 |
| **3. Learning Gate Community School** | Florida | suburban | K-8 | Charter | 600 |
| **3. Prairie Crossing Charter School** | Illinois | suburban | K-8 | Charter | 390 |
| **5. Bertchi School** | Washington | urban | P-5 | Private | 233 |

## School Profiles

**The Willow School.** The art facility at The Willow School campus in Gladstone, New Jersey, was certified Platinum under LEED for New Construction version 2.1 in November 2007. This private school serves 127 students, in grades P-8, employs 40 faculty members and 11 support staff. The area surrounding The Willow School is suburban, located southwest of the New York City metropolitan area. The architectural firm of Farewell Mills Galsch ***(***Princeton, NJ***)*** developed the main classroom building, with the campus master plan and new art facility was designed by Hone + Associates ***(***Lambertville, NJ***)***.

The Willow School is located on a 34-acre site in the country. The campus includes a historic home and barn, both original to the site. Site design includes natural meadows, butterfly gardens, water harvesting, and hedgerows. Recent renovations to the barn resulted in a LEED platinum art facility designed by Hone + Associates. The school completed the 13,500 square foot classroom facility in 2003. The design and materials of

this building complements the surrounding natural environment. Details about the building are included on The Willow School website:

> The overall building includes the latest in environmentally sensitive and energy-efficient design. Clerestories provide passive-solar heating, supplemented by geothermal heating and cooling systems. Rainwater runoff and grey water are recycled to maintain the surrounding plantings, and the remaining wastes are processed in the environmental methods available. Our overall goal is to teach in a building that not only houses the students but also serves as a model to study responsible living. (The Willow School, 2011)

*Figure 4.* The Willow School[3]

**Pine Jog Elementary.** Pine Jog Elementary, serving West Palm Beach, Florida was certified Gold under LEED for New Construction v2.2 in May of 2009. This public

[3] Retrieved from http://www.willowschool.org/

school serves 860 students in grades K-5. The architect for the project was Zyscovich Architects with offices in several Florida cities.

Pine Jog Elementary School is adjacent to the Florida Atlantic University Pine Jog Environmental Education Center. The school was the result of collaboration between the School District of Palm Beach County and Florida Atlantic University. The site includes a 150-acre nature preserve with numerous amenities. The website of Zyscovich Architects describes the project:

> The partnership provides ongoing environmental stewardship of the Pine Jog Nature Preserve. The site education curriculum utilizes the entire preserve with designed learning places in and around the structures that bring the outdoors inside and vice versa. These opportunities include butterfly gardens, water re-use demonstration areas, understanding solar paths and energy through the creation of an interactive sun dial area and "Solar Plaza", mitigation/ restoration areas for older students to create themselves, and biological life cycle study areas of slash pines, gopher tortoises, native grasses, insects, lizards, and other native amphibians. (Zyscovich Architects, 2011)

This school was represented in a large percentage of survey responses (52%) and was perhaps influenced by a timely site visit during the survey release by a member of Colorado State University's Institute for the Built Environment, potentially promoting this research study and influencing the response rate.

*Figure 5.* Pine Jog Elementary School[4]

**Learning Gate Community School.** Newly designed modular classroom buildings on the Learning Gate Community School campus, in Lutz, Florida, were certified Platinum under the newly released LEED for Schools 2.0 in June 2010. This charter school serves 600 students, in grades P-8, employs 42 faculty members, with 12 support staff. Learning Gate is located in a suburban area, north of Tampa and the architects for the project were Carlson Studio Architecture (Sarasota, FL).

The Learning Gate campus is located on a 30-acre forested site, which includes wetlands, ponds, and gardens. Architecture follows the traditional Florida bungalow style. The modular classroom buildings each hold two classrooms connected by covered porches and breezeways. Separation of buildings requires students to travel outside to reach their destination, aligning the school's mission to incorporate an indoor/outdoor learning experience.

[4] Retrieved from http://www.zyscovich.com/

*Figure 6*. Learning Gate Community School[5]

**Prairie Crossing Charter School.** The Comstock building on the campus of Prairie Crossing Charter School, located in Grayslake, Illinois, was certified Gold under LEED for New Construction 2.1 in February 2008. This public charter school serves 390 students, grades K-8 and employs 40 faculty members and 11 support staff. The area surrounding Prairie Crossing is suburban and located north of Chicago. The architect for the project was Serena Sturm Architects (Chicago, IL).

The campus of Prairie Crossing Charter School includes five buildings housing administrative offices, classrooms, and support spaces. The LEED Gold Comstock building was the first LEED certified school building in Illinois. The building utilized local, renewable, and recycled building materials, operable windows, natural ventilation, and high-efficiency interior lighting supporting daylighting strategies (Prairie Crossing Charter School, 2011). The design of the school improves efficiency of energy and resources use through the incorporation of a geoexchange system, on-site renewable

[5] Retrieved from http://www.learninggate.org/

energy, high-efficiency lighting, low-flush toilets and water cisterns that collect rainwater for irrigation (Prairie Crossing Charter School, 2011).

The campus is located in a community with a history of conservation activism, surrounded by native prairie lands, lakes, ponds, and wetlands. Other features include an organic learning farm and outdoor classrooms (Prairie Crossing Charter School, 2011).

*Figure 7.* Prairie Crossing Charter School[6]

**Bertschi School.** The Bertschi Center on the Bertschi School campus, located in Seattle, Washington, was certified LEED Gold under LEED for New Construction 2.1 in September 2008. This private school serves 234 students, grades P-5, employs 48 faculty and staff, and is located in the Seattle metro area. The architect for the Bertschi Center was KMD Architects (Seattle, WA).

> The Bertschi Center, which is the first Gold LEED certified elementary classroom building in Washington State, is a real life example of sustainable building technology. Students have the opportunity to interact with this real-life sustainable environment as they go to classes in the Bertschi Center. (Bertschi School, 2011)

[6] Retrieved from http://prairiecrossingcharterschool.org/

Notable features of the design of the Bertschi Center include a touchscreen monitoring system, exposed green building systems, rainwater collection, solar panels, a green roof, and materials from rapidly renewable sources or containing recycled content (Bertschi School, 2011). The campus of the Bertschi School is located in an urban neighborhood and since the site does not include natural habitats, community parks and gardens are utilized in the school's outdoor learning program (Bertschi School, 2011).

This school was a late addition to the study; contact was established in the final week of data collection for the study. The survey close date had been extended once prior to this school's inclusion; the decision was made to adhere to the initial extended close date of May 6, limiting response time for participants from this school. More responses may have been gained if the school had received additional time to complete the survey.

*Figure 8.* Bertschi School[7]

[7] Retrieved from http://www.bertschi.org/


*Figure 9*. Participating schools by geographic locations

**Response Distribution**

There were 77 responses to the e-survey ($N$ = 77). Figure 10 shows responses by school and respondent position classification. In total, responses from Pine Jog Elementary represented over half of the responses, $n$ = 40 (52%), Learning Gate Community School, $n$ = 12 (16%), The Willow School, $n$ = 11 (14%), Prairie Crossing Charter School, $n$ = 9 (12%), and Bertschi School, $n$ = 5 (6%). School employees represented a majority of responses, $n$ = 53 (73%). Parent and community members comprised 7% of respondents, $n$ = 5. Building professionals represented 21% of the responses, $n$ = 14.

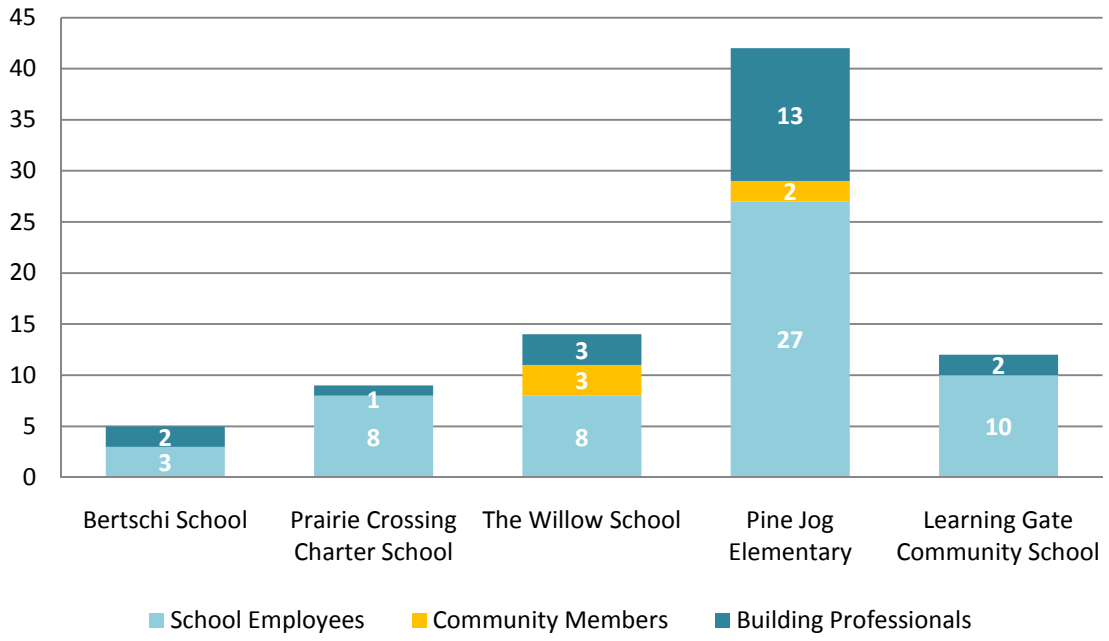


*Figure 10.* Response distribution by school and type of participant

School employees and building professionals were asked to define their position within the school or on the project team. Figures 11 and 12 summarize the distribution of respondents by position. A majority of respondents, classified as School Employees, were full time instructors (66%). School administrators, support staff, and part-time instructors were represented by the remaining responses. The "other" category encompassed individuals involved in the school's facilities operations. For the purposes of the study, these individuals were considered support staff. Of respondents classified as building professionals, sustainability consultants and architects were represented by 9 and 6 responses, respectively. Several respondents identified dual roles as architect and sustainability consultant. Contractors were represented by 5 responses, with the remaining four responses from an electrical engineer, mechanical engineer, interior designer, and landscape architect.

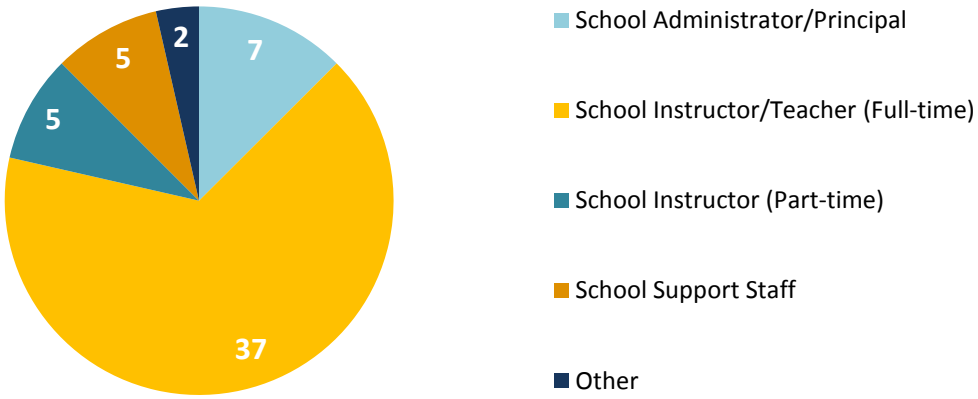


*Figure 11.* School employees by position within school.

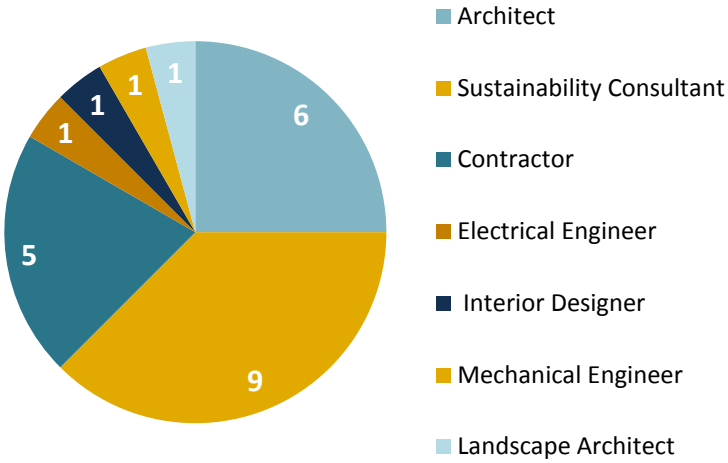


*Figure 12.* Building professional by position within project team

## Data Analysis

Sixty codes were developed from the data (see Appendix J for codebook), independent of *a priori* concepts; these codes were organized into four constructs aligning with the conceptual model (refer to Figure 2). The four constructs were culture, curriculum, facility, and personal attributes. Codes within each construct appeared to offer foundation, methods, and observed impacts. *Foundation* considered the rationale

for implementing a green curriculum within a green school. *Methods* addressed processes or steps for implementation. *Outcome* identified the impact on users, the environment, and surrounding community. Table 4 displays the organization of these codes into themes and categories.

Table 4. *Data Analysis Approach to Theme, Foundation, Method, and Outcome*

| Theme | Foundation | Method | Outcome |
|---|---|---|---|
| Culture | • Values<br>• Priority for student engagement & health<br>• Financial & environmental stewardship<br>• High expectations | • Buy-in<br>• Collaboration<br>• Administrative commitment | • Job satisfaction (faculty and staff)<br>• Awareness<br>• Enthusiasm |
| Facility | • Innovative building design opportunity | • Integrated design process<br>• Indoor/outdoor connection<br>• Exposed systems<br>• Grounds and gardens<br>• Facility operations<br>• Monitoring systems | • Model of high performance<br>• Economic savings<br>• District & community building standards |
| Curriculum | • Constructivist philosophy<br>• Use sustainability principles<br>• Connection to nature | • Project-based experiences<br>• Subject matter integration<br>• Guided exploration<br>• Student directed activities | • Connection to place |
| Student Attributes | -- | -- | • Empowerment<br>• Curriculum guides<br>• Active members of society<br>• Joy of learning<br>• Student as problem solver<br>• Connection to place |

The following discussion highlights respondents' perceptions of these themes and serves as the foundation for the development of the planning and implementation process model exploring the interrelationships found within the data.

**Culture**

School culture was examined to determine commonalities and differences among the cultures of schools practicing whole-school sustainability. Questions were designed to measure school climate and to determine if values or guiding principles exist among schools, and the influence these values and principles have on curriculum and facility operations.

Figure 13 shows responses to questions centering on school climate. The attributes included in the school climate survey were identified as positive attributes of any school culture (Idaho Department of Education, n.d.). All attributes were rated positively by over 88% of respondents illustrating the school climates of participating schools as generally positive. Attributes rated *almost always* by 30 or more respondents were:

- *collegiality* (professional collaboration on educational issues);
- *experimentation* (interest in exploring new, not yet proven techniques);
- *high expectations* (a persuasive push for high performance for students and teachers);
- *reaching out to the knowledge base* (use of research, workshops, and experts in the community); and
- *caring, celebration, and humor,* and *traditions* (rituals and events that celebrate and support core school values).

These attributes were highly consistent in the work life of the school by respondents.

The option was given to provide a narrative example of how one or more of these attributes manifest in their school culture. These statements were captured in the narratives by developing themes derived during data analysis.

Qualitative analysis of open-ended questions revealed the following cultural attributes held by representatives from participating schools.

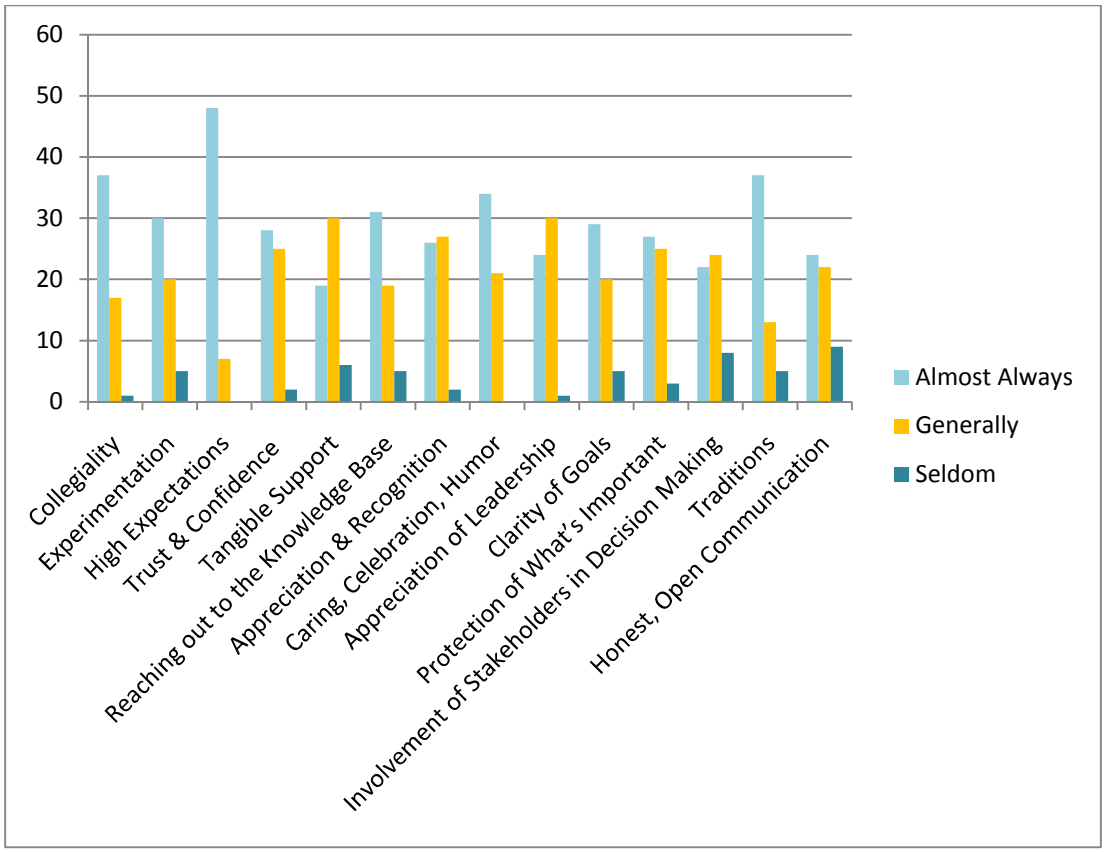


*Figure 13.* Responses to attributes of school climate

**Values.** The choice to practice sustainability was indicated by responses to a commitment to values. Values are beliefs or ideas, shared by members of a community; participants described values as virtues, ethics, conservation, integrity, respect, responsibility, and interdependence. A community member from The Willow School described some values guiding their school program:

> *…compassion - keeping the needs of all community participants and the natural world front and center; and thoughtfulness - careful planning has been required at each stage and no new work has been taken on without investigation and deliberation.*

Respondents suggested sustainability was the right choice, and the only choice, when viewed through the lens of their values. Respondents indicated a responsibility and accountability to the environment, towards students, and towards community as creating the best possible learning environment. An administrator at The Willow School commented:

> *…this [sustainable] focus came from a very real commitment to values and was not imposed from above. It grew organically from within.*

Respondents spoke of values as playing a major role in the choice to build a green school. Community members from Willow School shared:

> *[our green schools] are well built and clear examples of the integrity of the planners and builders.*

> *The design of each of the buildings shows respect for the building site, respect for the daily users of the building, respect for the resources and respect for the gifts of the natural world.*

> *Students are taught everyday about the importance of ethical behavior in all of their activities. At a point in the early development of the school, it became clear that those who valued ethical behavior among people also should appreciate and value an ethical relationship with the natural world. The integration of this ethical approach to the natural world meant that a sustainable approach to all school activities was the best and perhaps only way to truly walk that talk.*

Included in values is a focus on the future. Forward thinking was discussed in two contexts: the future of students, and the future of the environment. Respondents noted that producing conscious, empowered members of society, who valued the

environment, and would ensure the health and longevity of the earth. A teacher from Learning Gate wrote:

> *Because as a school and as an individual there is a belief that teaching sustainability to the future decision makers of the world is the best way to create a healthy and ongoing environment and Earth.*

**Priority for student engagement and health.** Creating a healthy learning environment where students could engage directly in nature was noted as a guiding principle of each school. Responses cited the building's indoor environmental quality and access to outdoor spaces as direct contributions to the health and well-being of students. As a building professional involved with the Pine Jog School, and an administrator of The Willow School commented, respectively:

> *… to provide the children the best education possible in a healthy, productive environment.*

> *…children learn better in a healthy environment that has significant natural daylight and natural outdoor air ventilation.*

The priority for student engagement in building design was mentioned by these building professionals from Pine Jog and Bertschi Schools, respectively:

> *[building and site] tools where the students engage directly to the facility on a daily basis [are valuable].*

> *Being able to provide a school with a building that is continually teaching the students about sustainability was an opportunity that couldn't be passed by. The kids that are learning science in the new green building will grow up thinking that things like net zero energy and water are not only attainable, but normal!*

**Financial and environmental stewardship.** Acting as good stewards of funds in the initial design of the school facility, and in continued operations was cited as an important responsibility of school leadership. A building operating at the highest

efficiency lessens negative impacts on operational budgets. Economic savings were perceived to benefit staff, students, and the community at large. A building professional and community member from Pine Jog stated, respectively:

> *…the School District expressed an interest in developing an energy, material and resource efficient building.*

> *We wanted the healthiest indoor environment possible, maximum use of resources, and payback on energy savings.*

Stewardship, expressed as resource efficiency, was described by this member of the Learning Gate support staff:

> *[we] designed a green school…to make better use of our resources.*

**Buy-in and commitment.** Evident in responses was a strong commitment to the goals and mission of the school. Responses displayed passion about the school, its potential, and its effect on its students and community. A support staff member at Leaning Gate shared this commitment:

> *The students and staff of Learning Gate truly live and breathe the sustainability practices necessary to return our world to a healthy and viable planet.*

**Collaboration.** As illustrated in Figure 13, each school's commitment to sustainability was practiced within a highly collaborative culture. Results displayed high levels of collegiality, or collaboration on educational issues. Responses noted a shared vision for the classroom and a collaboration to develop innovative, creative, and inspiring lessons. A teacher at The Willow School noted:

> *We all work together exploring the constructivist approach to learning and support each other towards a common goal.*

Diverse resources contributing to school curriculum were identified. References to resource knowledge base included community members, higher education institutions, the building's project team, environmental education curriculum providers, and online sources. Reaching out to the knowledge base was also highly rated in the school climate survey, illustrated in Figure 8.

A commitment to collaboration and reaching out to resources in order to support the school's knowledge base appeared to create a setting that invited innovation. A teacher at Learning Gate noted this desire of administrators, the high expectations held for themselves, their school facility, and their staff to be innovative:

> *Teachers have nearly total freedom to innovate and try new lessons/activities. Leadership encourages "out of the box" ideas and projects.*

**Administrative commitment.** Responses identified the importance of top-level support, specifically in school development, outlining school philosophy, and facility procurement. This commitment sets the foundation for innovative building design allowing stakeholder buy-in to flourish. A building professional at Pine Jog and a teacher from Learning Gate stated, respectively:

> *The principal…had a great vision for the school from the beginning. I believe the principal is a driving force for what happens in a green school building after it is built.*

> *Our principal is a visionary. She is not afraid to dream big and has the means to find people who share her ideas. She delegates responsibility to reach her goal.*

**High expectations.** High expectations were held by respondents for students, staff, and the facility. This was expressed throughout narrative responses displayed in the results of the school climate survey illustrated in Figure 8. The universal application of high expectations appeared to be an essential component of each school's desire to be a

model for their students and community. A teacher at Prairie Crossing Charter School stated:

> *We promote a good message of self-advocacy, self-determination, and high expectations in all areas.*

**Job satisfaction.** Positive job satisfaction appeared to be shared by respondents. Satisfaction was often noted in conjunction with an enthusiasm for the school's mission and an alignment with personal values. A teacher at Pine Jog shared:

> *It is a pleasure and a privilege to work at this school and know we make a difference in the environment.*

**Facility and Site**

Survey questions uncovered commonalities regarding the facilities and site. Commonalities included the approach design process, inclusion of specific site features, integrating structural design to benefit learning, building design emphasized as a teaching tool, rationale for building green, and favorable outcomes of the green building process.

**Modeling high performance.** Designing and operating a school facility, embodying the highest level of performance, was mentioned as a goal by school staff and project team members. This goal initiated a desire to position the school as a model for the school district and at large and global communities. Leadership expressed a responsibility to model high performance behavior by designing an innovative and high performing building. An administrator from the Bertschi School and a community member from The Willow School respectively shared:

> *[We designed a green school] to set a standard for the importance of green practices for the students and families within our community at large.*

> *…[we designed a green school] to model what we teach.*

**Integrated design process.** The design process was described as integrated and involved school administration, support staff, maintenance and facilities staff, teachers, parents and guardians, community members, sustainability consultants, and students. Collaborating with these stakeholders early in the design process appeared to help establish shared buy-in and vision, and created an environment conducive to innovative solutions.

School stakeholders such as teachers shared perspectives on how the building could be used to achieve curriculum objectives resulting in the project team incorporating program-based components in the design enhancing delivery of the curriculum. A teacher from The Willow School affirmed:

> *As a teacher, it is very beneficial in being able to participate in the planning process of the new Wellness Center. We get to put in our opinions about the practical aspects of the building such as space needed for what we do…*

An administrator and sustainability consultant from The Willow School declared, respectively:

> *Teachers provided perspective on the program needs and what it will be like to actually "live" in the new space.*

> *Teachers ensure that we consider the functions of the buildings, the flow of students throughout, and can tell us what does not work about current buildings*

The importance of the principal's involvement in the integrated design process was noted by this building professional from Pine Jog:

> *[The principal's] vision for this new school was vital during the design to ensure the new curriculum was enhanced by the building systems and infrastructure.*

Student involvement in the design process was described as providing insight, vision, and enthusiasm to the project. A building professional at Bertschi School shared:

*Students were the most valuable contributors in terms of providing the ideas that made the building both functional and designed by and for them.*

The process of designing the school was referenced as pivotal to school culture. The principles of integrated design established a method, or best practices, for the school cultural environment. The importance of this process was described by a community member at The Willow School:

*The school uses the process of design, construction, and operation of the created campus environment as an ongoing source for developing the capacity for ecological thinking in students, faculty, and the community.*

**Innovative building design.** Cutting-edge, high performance building design appeared to create a context for cutting-edge, high performance activities to occur within the participating schools. The architectural design of the schools was identified as being efficient as well as inspiring. The desire to test innovative, new models of school design and curriculum development was mentioned by respondents. This interest in exploring new, not yet proven techniques was revealed in the high rate of experimentation reported in the school climate survey (see Figure 8). A community member from The Willow School and a teacher from Learning Gate shared:

*The spaces in which the children learn are living examples of innovative, sustainable design and school practices*

*[The design of our school is] on the cutting edge.*

**Indoor/outdoor connection in building design.** The integrated, project-based curriculum of the five participating schools made use of the surrounding natural environment as a significant component of curriculum. The design of the school buildings reflected commitment to indoor/outdoor integration. Drawing the outdoors inside often occurred through natural ventilation, large windows, breezeways, outdoor

classrooms, and site features that were easily accessible from classrooms. A building professional at Pine Jog and a teacher from The Willow School described the indoor/outdoor connection in building design, respectively:

> *The Design of the school flows with the preserve with trails leading through it. The architecture allows for outdoor interaction with windows, outdoor hallways, archways that pull the breeze through.*

> *Because sustainability ideas are so embedded in the buildings themselves, such as conservation of water (using rainwater to flush toilets), planting indigenous plants, tall & wide windows to make one feel he/she is sitting outside in nature, etc. one can't help but think about sustainability.*

A teacher from Prairie Crossing noted:

> *I particularly like the windows, openness, and sunlight that allow us to grow inside as the garden outside.*

Community members from Willow School perceived:

> *…children learn better in a healthy environment that has significant natural daylight and natural outdoor air ventilation.*

> *[the design of our school represents] sense of place, history; connectedness among people and with nature.*

**Exposed systems.** A primary method of engaging students in the operation of their built environment was making the building systems visible and accessible. Revealing processes such as rainwater capture and its subsequent use in flushing toilets allowed students to follow the process, see inputs and consequences, and be actively engaged in the operations of their school. Exposed systems at Learning Gate were described by this support staff member and teacher, respectively:

> *I love the cistern bladder system. It is a visually impactful learning tool.*

> *I use this as a show and teach my Kindergartners. We examine the rain barrels and water flow and how it can be recycled to use inside the building. They can visually follow the rain containment process and see how much water is actually collected in rain barrels.*

Descriptive signage was used to assist students and teachers in understanding exposed systems. Transparent openings revealing wall components, mechanical rooms, and water systems, or the labeling of native planting and recycled materials conveyed basic information to inform learning. Using this basic learning tool, teachers then provided expanded explanation facilitating guided exploration by students.

**Monitoring systems.** Building elements that change, such as cisterns, sundials, and automated interior lighting, have greater interest for students than static elements. Monitoring systems of water and electricity allowed changes in these elements to be visible by students, and for them to see their personal impact on the use of a variety of elements (i.e., energy conservation, daylighting, recycling, water re-use). A contractor at Pine Jog described their monitoring system:

> *Next to these windows, there are touch screens for the children to interact with. These touch screens show the students what is "green" in their school. It displays how much electricity their photovoltaics are producing, how much water they are using, etc. These touch screens really promote learning about the school.*

Monitoring systems were easily incorporated into project-based learning activities, allowing the building to operate as a living laboratory for student experiments.

**Grounds and gardens.** The natural environment surrounding a green school was a primary component of building and site design, and integrated into curricula. The attributes of the school's grounds were used to teach about "place" and give students the opportunity to practice conservation. The grounds of The Willow School were described by this community member:

> *The several acre school yard is fantastic since it is large enough that all groups are able to find their own special spot, diverse enough to expose the children to many aspects of nature - bushes, trees, a stream, birds, squirrels, garden - and has enough building blocks to provide endless opportunities to engage in civil engineering projects - forts, bridges, stores, etc...*

The design of the outdoor spaces allowed students and teachers freedom to explore the attributes of their place, and invited autonomy to alter or preserve the space.

**Facility operations.** School operations, including recycling, composting, and resource use, were an integral part of school culture. Expectations were evident that students actively engage in these processes and be responsible for their success. The design of the school facility improved student access to these processes by providing the infrastructure for recycling in each classroom and facilities to compost lunch waste. The operational cycles (such as the process of composting food then using this compost in school gardens) were visible to students, allowing active engagement in the process. The recycling program at Pine Jog was described by this teacher:

> *We take a serious school wide approach to teaching our students how to implement recycling through daily awareness and practice. At our school, we collect and recycle everything - children's food packaging, classroom supply containers, plastic, cans, paper, school clothes, and shoes.*

**Economic savings.** High performing school facilities were believed to be models for future school design and laboratories for innovative solutions to integrated building design. Economic savings of these high-performing facilities, as observed by a school's monitoring systems, positively affected district and school operating budgets. Data from the monitoring systems were displayed on interactive touch screens and used in the classroom. Data were used to inform future building projects and made available to the

community at large. The importance of this dissemination was noted by a building professional at Pine Jog:

> *Building energy performance data is available in real time and stored for later use and analysis by the [School] District, [Florida Atlantic] University, and others who may be interested.*

**District and community building standards.** The success of the high performance building design of participating schools and the positive impact the facilities have on occupants and culture, resulted in facilities becoming models for districts and surrounding communities. A building professional at Pine Jog stated:

> *This focus [green school design standards] has been extended to other projects in the district and led to greening the design guidelines for all new construction.*

Beyond modeling responsible building, respondents desired to "practice what they preach." Sustainability as a fundamental component of each school's educational program was a required component of how the school operated. A community member from The Willow School stated:

> *The integration of this ethical approach to the natural world meant that a sustainable approach to all school activities was the best and perhaps only way to truly walk that talk.*

## Curriculum

Respondents provided information about their curriculum, including the philosophical foundations for curriculum development and guiding principles or theories, methods, and outcomes of the curriculum planning process. Responses provided a perspective on common attributes of curriculums.

**Constructivist approach.** The programs of participating schools were founded on the principles of constructivism involving active, project-based learning for students to

acquire learning skills and construct their own knowledge. A teacher at The Willow School remarked:

> *We all work together exploring the constructivist approach to learning…*

The importance of student engagement in a constructivist approach was described as essential and valuable to the learning process. A Willow School teacher stated:

> *[Engagement] is essential – it's the whole point.*

A member of Learning Gate's support staff and Pine Jog's project team shared, respectively:

> *Absolutely, [student engagement is valuable] … You have to have the students' and teachers' buy in for it to be effective and engaging students in the exploration is a valuable way to strengthen that learning.*

> *…hands on learning really engages the children into learning about the environment.*

**Use of sustainability principles in curriculum.** Principles of sustainability were found to be used in the curriculum development of participating schools. Respondents cited topics such as systems-thinking, long-term thinking, environmental stewardship, and ethical decision-making as contributing to curriculum development. The inclusion of environmental stewardship was noted by this teacher from Pine Jog:

> *We try to include the idea that we are all environmental stewards throughout the curriculum on an everyday basis. We each have a responsibility to do our part.*

Principles of sustainability appeared to be a catalyst for higher level, integrated thinking – thinking skills which respondents noted as critical to student development. Parents and teachers (Pine Jog and Willow School), respectively related to the importance of sustainability's role in the curriculum:

> *It [sustainability] lies at the core of curriculum because there is an understanding and appreciation for the fact that it is integral in so many ways and in so many forms...from science and math to language arts and history.*

> *The big ideas of sustainability such as systems thinking, long-term thinking, interdependence, etc. are woven into the essential questions in all subject areas.*

Using sustainability as a guide for curriculum development required faculty to use an integrated approach. Faculty committed to working collaboratively to span their respective subject areas, weaving topics together through project-based activities. A teacher from Willow School stated:

> *We use a systems thinking approach; nothing is studied in isolation; multiple perspectives are an essential component…*

**Connection to nature in curriculum.** Respondents cited a connection to nature as important to student learning, often describing outdoor activities that get students out of indoor classrooms. This connection to nature in curriculum used unique natural elements of the school's surrounding environment (e.g., sunlight, wind, water, plants, and animals) to connect students to the school's "place." This connection to nature was described by a teacher from Pine Jog and community member from The Willow School, respectively:

> *..the love of plants and animals, the need for exercise and sunshine daily, and the peaceful aspect of nature for renewing oneself [are foundation of our school]; we are interrelated with our environment.*

> *I think that it is important to make this connection with nature to better understand the changes which are constantly taking place… and learn to positively interact with the outdoors under all circumstances.*

**Project-based experiences.** Respondents described their school's curriculum as utilizing the school building and grounds in project-based activities. The green facility

and conservation efforts on-site were believed to be dynamic learning tools, and used by teachers and by students in independent studies. A teacher from Learning Gate commented:

> *Students form projects based on the green technology and designs found on campus. By using our campus for learning students interact with the green designs and understand what makes our buildings special and different.*

Descriptions of project-based activities frequently required a high level of student interaction with the environment. Respondents felt these projects taught students to use higher-order thinking to solve problem challenges.

**Subject matter integration.** Respondents described project-based learning activities as incorporating a variety of subjects, reporting students were often asked to conduct experiments to investigate topics in science and social studies, while also learning skills in English, reading or speech. Faculty collaboration was attributed to contributing to their ability to integrate subject matter. A teacher at Pine Jog summarized:

> *We write, read, and experience sustainability through many lessons and activities.*

**Guided exploration.** Respondents described the use of guided exploration using integrated, project-based activities. They noted questions posed to students facilitated exploration, allowing students to search and find answers independently. A Pine Jog building professional remarked:

> *…whenever we can engage a student to ask "why" and to see their questions explained and answered fuels the human mind to gain further knowledge.*

The design of participating schools was described as encouraging engagement and exploration to explore *why*. Student exploration of space was described as a goal of the facility design. A Prairie Crossing building professional stated:

> *Green methodologies and techniques were packaged in a contextual architecture having a minor edge to invite exploration without alienation.*

**Student directed activities.** Participating schools described the level of student engagement as expanded by granting of roles and responsibilities to students to assist in school operations. Cited roles included assisting with the collection and sorting of recycling, leading tours of the school, tracking building energy and water use, and planting and caring for the school garden. A teacher at Prairie Crossing described the expectations placed on students when stating:

> *We directly teach about sustainability and … we have expectations that require the students to have actions that assist in creating a sustainable process, such as waste free lunches.*

A teacher at Learning Gate remarked on this responsibility:

> *A Kindergarten student can begin to take responsibility at this early age to protect and preserve our natural resources.*

A building professional at Pine Jog commented on the value of student involvement in building tours:

> *Students take an active part in being tour guides to identify to others the 'green' features of the facility and site.*

Respondents described learning activities guided by students allowing students to participate in the development of curriculum, to choose topics for research projects, and to perform research in greater depth beyond requirements. A teacher at Prairie Crossing confirmed student involvement:

*The students are encouraged to guide the curriculum…*

Self-directed learning was performed in conjunction with activism activities, as described by a member of The Willow School support staff:

> *…we have students that are trying to create a greener atmosphere because of what they have learned from being on the school's grounds.*

**Student Attributes**

When discussing school culture, curriculum, or the facility, respondents noted specific qualities of students that were observed as resulting from the whole-school sustainability program.

**Empowerment.** Respondents described students as empowered individuals knowledgeable and proud of their space(s), leading to increased knowledge, and evidence of sharing knowledge with others. A building professional from Bertschi School remarked on student empowerment:

> *The more the students are engaged in both the design process and the proper functioning of the building, the more ownership they feel for the space, and the more they know and then learn about how the building works.*

Students were described as empowered to change their environment outside of school, specifically in their home environment, as noted by a teacher at Learning Gate.

> *They are making this thinking THE WAY TO THINK! They are teaching their parents and grandparents.*

**Students as active members of society.** Respondents described their school programs as preparing students to be active members of society, positively affecting their communities and environment. An administrator from Bertschi School shared:

> *Our students are learning how to live their future lives, and this principle [sustainability] will be critical to the success of their future society.*

**Joy of learning.** The culture of participating schools was described as fun, joyful, and exciting. *Caring, celebration, and hum*or was also rated highly by respondents in the school culture survey (refer to Figure 8). Respondents indicated a desire to develop students as life-long learners, sustained by the joy of learning. A community member from Willow School responded:

> *We wanted to start a school that … combined academic excellence with the joy and wonder of learning.*

**Student as problem solver.** The use of sustainability principles, integrated topics, and systems thinking requiring higher-order thought and discernment supports the deeper development of students' problem solving skills. An administrator for Learning Gate, and a teacher from Willow School stated, respectively:

> *Our students are taught from a very young age that just learning about a problem is just the first step. Figuring out how to solve, and then implement change is the ultimate reward.*

> *Children are asked to be problem solvers. They are asked to look at a problem, whether personal or not, and come up with solutions.*

**Student connection to place.** The process of engaging students with their surrounding environment was described as helping form a connection to place. "Place" includes the physical and natural space, as well as the history and culture of the surrounding community. An administrator at The Willow School described their program when responding:

> *We have a strong service-learning program in which each grade has an ongoing tie to the local community that is based on one aspect of sustainability. Students are taught to use the concepts of sustainability as a filter to consider when making a decision.*

Schools were described as playing important roles within their communities. Faculty used service-learning projects and other outreach and engagement activities to connect students to their place and to strengthen the school to community relationship. A teacher from The Willow School stated:

*They [students] feel very connected to our place.*

**Awareness.** Increased awareness of the environment and environmental issues was noted as an objective of the participating school's educational programs focused on environmental education. Deepening the level of student awareness was believed to influence students outside their school environment and throughout their lives.

A community member at Pine Jog described the importance of awareness:

> *[Our program] promotes deeper understanding of simple concepts (like how human activity influences the water cycle) and a lasting appreciation for environmental issues in the staff and students.*

Respondents referenced the importance of "living" by the sustainability principles they taught, and noted the impact of being surrounded by an innovative, high-performing, naturally diverse environment. Awareness was also discussed emphasizing the development of interest and curiosity in students. A student's curiosity was described by a parent of a Pine Jog student:

> *As the mother of a 1st grader at the school, I know from hearing what he now notices, comments about, finds interesting, that the experience at his school has piqued an interest in him about the built environment that he probably would not have had coming from a traditional school.*

**Enthusiasm.** Student enthusiasm for their school was described by participants and demonstrated by connectedness to the school's accomplishments. Students developed enthusiasm through their involvement in the school's facility, culture, and

curriculum. As stated by a building professional at Pine Jog, students understand the importance of all they are accomplishing, and are enthusiastic about their success.

> *[Students have responded] very positively [to their green environment]. They know they are in a special school and they are very proud of what they do and what they have accomplished. Learning is fun and they have a sense that what they do is important. Their work has connected them to the community and they derive a positive sense of self-esteem (sic) from being at Pine Jog.*

## Complexity of Whole-School Sustainability

The construct attributes identified in the findings of this study are components of a complex system and do not stand in isolation, as evidenced by the responses from groups representing participating schools. Relationships among attributes appear vital to the success of an educational experience focused on whole-school sustainability. Influential relationships described by respondents are shown in Figure 14, visually mapping major components considered in whole-school sustainability development.

The map is composed of the three major constructs critical to whole-school sustainability: culture, facility, and curriculum. Each construct encompasses the three categories developed during coding and is discussed in terms of its foundation, method, and outcome (see Table 4). The following discussion examines the relationships within and across culture, facility, and curriculum to construct an understanding of interrelationships of attributes created when whole-school sustainability is the intended target.

### Cultural Attributes

Values shaped the foundation within the culture component, informing all system attributes. Values held by stakeholders were diverse and personal. Two that appeared most critical included *priority for student engagement and health* and *financial and*

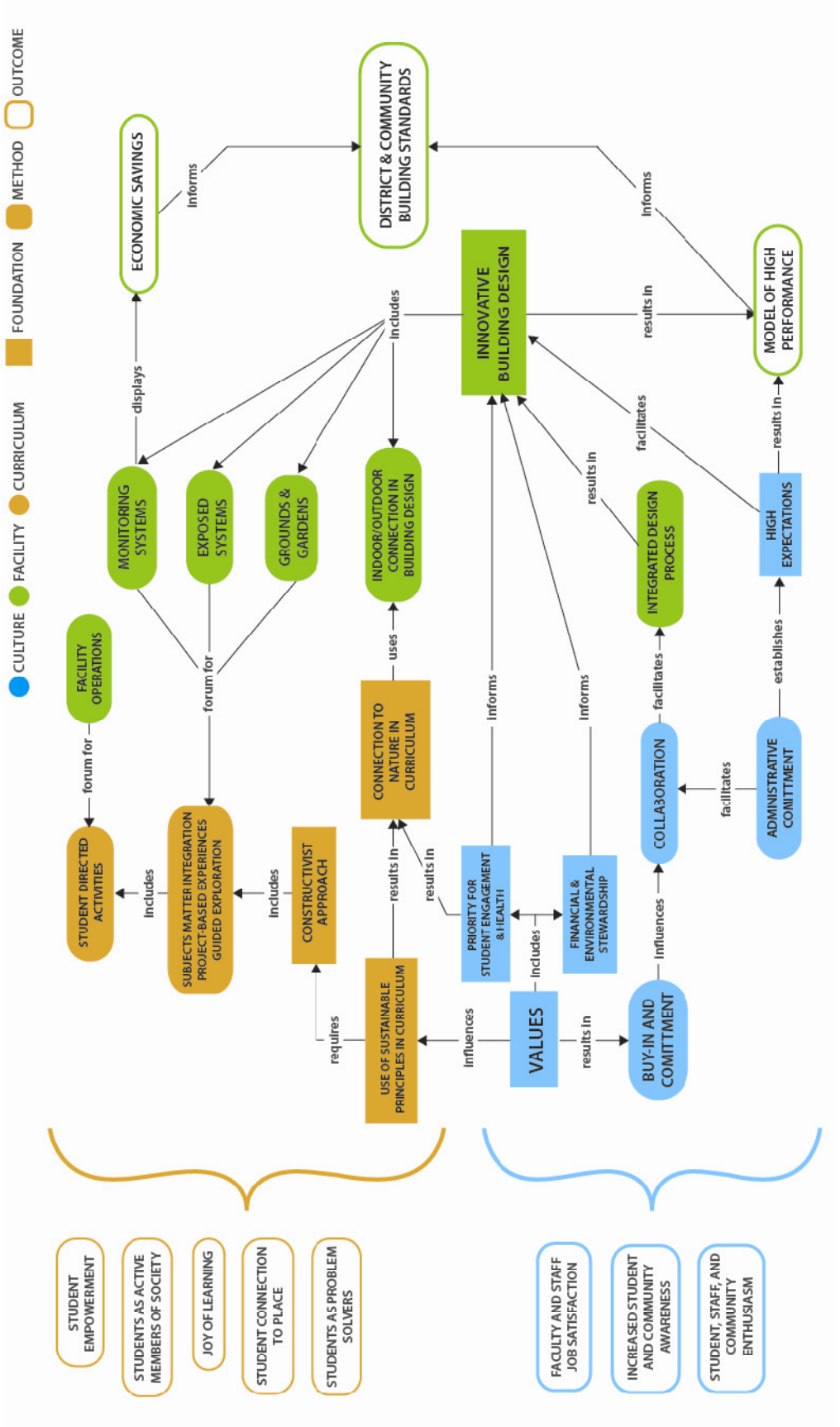


*Figure 14.* Relationship map

*environmental stewardship*. A second relationship surfaced suggesting common values resulting in *buy-in and commitment* among school stakeholders. Stakeholder buy-in resulting from shared values influences the *collaboration* of these stakeholders. Working toward a common goal, guided by the foundation of shared values allows successful stakeholder collaboration. *Administrative commitment* by the school's principal, superintendent, or founder is essential to facilitate collaboration within a school's culture. This top down commitment is pivotal in establishing *high expectations* for the facility, staff, and students.

Three outcomes related to the creation of a positive school environment. The first, *job satisfaction* directly related to the culture of the school, specifically in the values guiding the organization and manifested in the facility design and curriculum. The second, increased *student, staff, and community awareness* stemmed from the programmatic delivery of whole-school sustainability. The third outcome was identified as *student, staff, and community enthusiasm*; participants loved their school!

**Facility Attributes**

*Innovative building design* is informed by goals to achieve financial and environmental stewardship and a priority for student engagement and health. An *integrated design process* is facilitated by collaboration and necessary for the facility to result in an innovative building design. Further, high expectations held by administration further facilitated innovative building design. These four attributes – integrated design, high expectations, goals for financial and environmental stewardship, and the priority for student engagement and health – set the context for the planning and design of a green school facility.

Innovative building design as outlined above includes *gardens and grounds*, *exposed systems*, and *monitoring systems*. These building design attributes serve as a forum for constructivist curriculum – subject matter integration, project-based experience, and guided exploration. Innovative building design also includes *indoor/outdoor connections*, which in turn are used by teachers to establish a connection to nature in the curriculum.

The *facility operations* of a green school provide a forum for student directed activities included in the constructivist approach to learning allowing students direct engagement in the operation of their school building and grounds.

Innovative building design and high expectations result in a *model of high performance*. The success of this model informs *district and community building standards*. These standards are informed by *economic savings* displayed directly by the school building's monitoring system.

**Curriculum Attributes**

The *use of sustainable principles* in curriculum, influenced by shared values requires a *constructivist approach* to learning. A constructivist approach includes *subject matter integration, project-based experiences*, and *guided exploration*; this educational philosophy meets the challenges of sustainability curricula by encompassing experiential learning. The priority for student engagement and health, and use of sustainable principles in curriculum also results in a *connection to nature in the curriculum*. Connection to nature allows students to experience sustainable principles first-hand, using the indoor/outdoor connection in building design to achieve student health and engagement.

Student empowerment was described in relationship to student directed activities. This quality was directly tied to the enthusiasm of students as reported by respondents, which also identified the student's joy of learning.

The integrated, project-based activities required students to become *problem solvers*. Students are taught integrated thinking to find sustainable solutions to complex problems. Integrated, project-based activities centering on the school's unique location also appeared to develop students' *connection to place*, including the environmental, cultural, historical, and community components of that place.

The combination of these outcomes was noted by respondents as goals in developing students to be *active members of society*, influencing the family unit, their surrounding community, their environment, and the world.

## Summary

The respondents from the five schools contributed their perspectives, successes, and opinions on their school's curriculum, culture, and building design. The analysis of these statements revealed specific components of the whole-school environment. The relationships between these components were analyzed and a map was developed, signifying each component's significance and influence. The development of a relationship map signifies that components must be viewed collectively, that the integrated nature of components through their relationships, is as important as the components themselves. Integration is the operative word with curriculum, facility, and culture indisputably linked.

# CHAPTER V

# SUMMARY AND CONCLUSIONS

The achievements and lessons learned from these green schools can potentially influence standards of future building projects. In April, 2011, the Director of the USGBC Center for Green Schools, in an interview with Grist Magazine stated "What we're missing are the roll-up studies of a green super-school: a collection of environmental, education, architectural, and operational best practices" (Gutter, 2011). This study takes a giant step toward developing a well-rounded understanding of the holistic green school in terms of attributes, relationships, processes and the identification of outcomes.

## Study Findings

Previous investigations of school climate rarely consider the school facility as a component of climate (Gislason, 2009). Though the school climate model developed by Owens (2004) included the built environment, the influence of this component was minor in comparison to the influence demonstrated in the findings of this study.

A green school's building and grounds essentially provide the context for whole-school sustainability. The process of designing a green school facility helps to establish or enhance a collaborative culture within the school. Through this process, qualities like

integrative systems thinking, collaboration, and the consideration of diverse perspectives. Green facilities and grounds also provide a forum for practicing sustainable actions, deepening occupants' understanding of how to live as environmental stewards. The practice of environmental stewardship compulsory of this sustainable context initiates conversations about sustainability, and builds shared understanding and ownership of the school's mission and potential.

Aside from the sustainable context established with a green facility, the physical attributes of the building and grounds are dynamic teaching tools. However, the potential of these teaching tools is only met when curriculum and culture are aligned to the same principles and values guiding the design of the building and grounds. Alignment is achieved when the school entity shares common values. Values are the crux of any whole-school sustainability program. As Deal and Peterson (2009) noted architecture, operations, and curriculum are simply manifestations of shared values and beliefs.

## Response to the Research Questions

The research questions guiding this study created a forum for synthesizing attributes of schools practicing whole-school sustainability effectively.

### Q1. Were the core constructs of culture, facility, and curriculum evident in the experiences of individuals engaged in whole-school sustainability?

Based on the literature review three core constructs were used to elicit responses from study participants. The depth of responses reinforced an understanding of construct attributes found among the participants in sharing their perceptions and experiences in schools embracing whole school sustainability forming the core components of green school development. Key attributes constructed the *foundation rationale* for a process to achieve whole-school sustainability and included shared values, facility opportunity and

constructivist philosophy as essential to the process. Foundation rationale revealed *methods* key to achieving *outcomes*: administrative commitment, indoor-outdoor connection, project-based and student directed activities. Participants shared their observations of outcomes focusing consistently on innovation, positive environment, high performance, connection to place, and empowerment.

Outcomes revealed in the data, comprised of observations by respondents of student attributes, resulted from the integrated influence of culture, facility, and curriculum. In addition to empowerment, joy of learning, connection to place, problem solving skills, and active members of society were noted as positive attributes demonstrated within these school environments.

**Q2. Is there a sequenced process with identifiable steps taken by schools practicing whole-school sustainability?**

Specific characteristics identified by respondents suggested a sequence of steps as a part of their experience in creating their school and as above (Question 1), incorporated attributes from each of the three constructs. For example, from a cultural perspective, the establishment of shared values provided the foundation for cohesive and consistent administrative support producing innovation within a positive environment. From a facility perspective, the opportunity to incorporate the facility as a teaching tool required certain flexibilities and considerations, as prerequisites to creating indoor-outdoor connections and establishing connection to place. Achieving high performance affecting the facility, users and the community at large required an approach to facility design addressing facility opportunity. From a curricular perspective, simply offering education about the environment does not provide the enriched learning without buy in to a constructivist philosophy supporting project-based, student directed activities ensconced

in an integrated environmental education program fully embracing the culture, facility and curriculum, producing student empowered educational experiences.

Outcomes cannot be produced without a strong foundation incorporating methods of implementation, affirming the need for a process to achieve desired results in educational planning. The responses of participants engaged in whole-school sustainability reinforced the idea of a process of sequenced of steps based on the integration of culture, facility, and curriculum (Refer to Figures 14 and 15).

**Q3. What attributes facilitate the smooth execution of the process to achieve whole-school sustainability?**

In addition to critical core components, the findings revealed *process facilitators* making a difference in the ease of which groups or organizations might construct their process to achieve a school emulating whole-school sustainability (Figure 15). Four components act as process facilitators: high expectations by those engaged in the process, accessibility to resources needed to achieve the process objectives, integration and collaboration among stakeholders, and buy-in and commitment of stakeholders. An integrated, collaborative process, embracing the process of designing a green school, gaining buy-in and allowing collaboration of all stakeholders, influences the integrative, collaborative nature of school culture indefinitely. In a sense, the green school is the foundation, the glue, and the context for whole-school sustainability programs.

Collaboration spurs increased collegiality on educational issues, needed for an integrated program. The school must also hold high expectations for the building design, the curriculum program, staff, and students. High expectations continue to guide the design and daily operations of the school.

## A Process Model for Whole-School Sustainability

The attributes identified in the relationship map were refined in developing a process model comprised of core components and process facilitators. The model in Figure 10 represents critical components of whole-school sustainability programs serving as a guide to groups and organizations encompassing educators, building professionals and green school advocates who desire to implement whole-school sustainability.

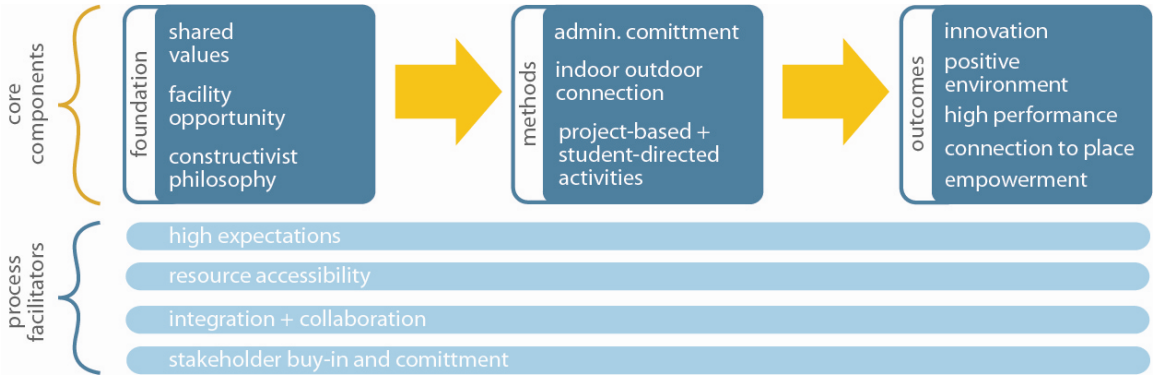


*Figure 15.* Process model of whole-school sustainability

The core components and process facilitators in the whole-school sustainability process are fundamental; however, this process will be unique to each school that attempts to practice whole-school sustainability. This uniqueness is a result of the ever-changing attributes of place; including the unique aspects of the surrounding community and natural environment, influences the manifestation of whole-school sustainability and results in a whole-school sustainability program unique to each school.

Since whole-school sustainability develops to include attributes of place, it cannot be a simple three-step process ending in the achievement of whole-school sustainability. The process must continue to evolve to include attributes of place and the ever-changing needs of students, faculty and staff, and community.

Some may ask which of the core components, facility, curriculum, or culture, must be established first in the process of whole-school sustainability. The answer is values. A foundation of values influences each core construct guiding decisions about facility and curriculum. With a foundation of sustainable values embedded in school culture, sustainable building design and operations, and sustainability curriculum will be natural by-products.

## Study Limitations

This study employed a gatekeeper model to protect the privacy of survey respondents; however, this approach relies on the availability and support of a single person to reach and gain the support of participants. If the principal was not enthusiastic about the study, staff members may not have been encouraged to respond to the survey. This limitation also applies to the building professionals contacted to participate. If enthusiasm for the study was not exhibited, the number of respondents may have been influenced negatively. The greater the response by school employees and building professionals a school provided, the greater the enthusiasm may have been demonstrated by the gatekeeper. Further, building professionals work on billable hours; and 20 minutes of non-billable work may not have been possible given their workweek if the value of this study was not adequately communicated or understood.

Timing may also acted as a limitation. School employees rarely are provided with free time and late spring is an especially busy time. Participating schools were in the midst of spring break or state testing during the time the survey was open; the close date of the survey was extended one week to better accommodate school schedules.

There are certainly differences in application between new schools vs. existing schools and public vs. charter vs. private schools; however, the focus of this study considered participating schools as a group and did not examine differences between the schools.

Finally, contact information was challenging to obtain, to identify the school principal and the project team contact. When contact information was obtained, it was difficult to reach and speak directly to the individual. Messages left with secretaries and voicemails were often the outcome of contact attempts, delaying response of the school or building professional.

## Implications

The holistic green school is a complex entity. The commonalities among participating schools form best practices applicable to schools seeking to achieve whole-school sustainability. Every school is unique, formed with different structures and orientations, set in different communities, surrounded by unique natural environments, and operated by diverse staff and administration. Best practices outlined in this study may not apply to all those wishing to pursue whole-school sustainability.

Furthermore, the "uniqueness" of a school should be celebrated. The special features of their facility, surrounding environment, and community should be embraced in order to form a strong connection to place. Therefore, it is expected that these distinctions would result in a unique process. The process developed in this study is a guide, a starting point to begin conversations and implement changes in schools wishing to establish whole-school sustainability.

The sample for this study consisted of schools founded on principles of sustainability. None of the participating schools were once conventional schools transforming to focus on whole-school sustainability. The results of this study, in general, targeted application to all schools, no matter their classification, location, or founding principles. Therefore, schools transitioning to whole-school sustainability will face challenges that participant schools may not have experienced.

## Recommendations for Future Studies

A targeted study, involving members of whole-school sustainability programs, evaluating values held by participants would define the influence of values on the success of a whole-school sustainability program. This evaluation would develop definitions of the words used by participants when addressing their values. Future study might also embrace the integration of climate and culture in school settings.

Student perceptions gained from direct interviews or focus groups would be valuable in understanding the impact of the school program. In this study, student perceptions were provided through observations made by adults involved in the school. Hearing student perceptions directly would add depth to the understanding of how whole-school sustainability programs affect students.

The application of the whole-school sustainability process, compared between schools of different types (public, private, charter) should be conducted in order to identify differences in the successful application of this process. As well, the identification of the unique barriers faced by public, private, and charter schools should be evaluated. This identification will provide greater assistance to schools pursuing whole-school sustainability.

Though the evaluation of whole-school sustainability programs on student academic performance would be valuable, it is difficult to isolate variables that are responsible for student performance.

## Conclusion

School facilities require change to meet the learning needs critical to the 21st century. This change requires the integration of design thinking with learning and invites creativity in the way educational environments are constructed to collaborate with learning. The need for increased collaboration between educators and designers to successfully adopt a holistic approach is expounded by McLennan (2004) and others. This collaboration would change how culture, facilities, and curriculum manifest in learning environments. Using the principles of sustainability as a guide, this collaboration between design and learning would allow future generations to be sustainability natives (USGBC, 2009), armed with an education positioning them to be environmental and societal stewards.

To facilitate this collaboration, mediators are needed who can speak to design and educations constructively bridging these disciplines. The knowledge held by educators and designers is incomplete if excluding an understanding of the other.

The results of this study confirmed the school facility, including building and grounds, plays a large role in the curriculum program and culture of a school. Shared values form the foundation for all elements of the whole-school sustainability process, and guide the successful implementation of these practices. The use of school facilities and grounds as teaching tools can be enhanced through the collaboration of designers and educators in order to integrate curriculum needs into design and design into curriculum.

School facilities and grounds form the context for whole-school sustainability, and enables or enhances the integration of sustainability into curriculum and culture. Each construct of whole-school sustainability is synergistic, but more importantly, each aspect is guided by a shared commitment to values among stakeholders.

There is significance in the ability to visualize a process. The relationship and process models developed in this study, clearly and concisely illustrate key components of whole-school sustainability and methods for developing these components. It is hoped that these models will assist educators, building professionals, and green school advocates in understanding and applying best practices to the benefit of current and future generations of students.

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# APPENDICES

# Appendix A: LEED Project Directory

## LEED NC & Schools Certified Projects; January 2005-December 2011

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1. | Knapp Forest Elementary | Grand Rapids | MI | NC 2.0 | Certified | 4/7/2006 | Elementary |
| 2. | North Charleston Elementary School | N Charleston | SC | NC 2.0 | Silver | 8/23/2006 | Elementary |
| 3. | The Dalles Middle School | Dalles | OR | NC 2.0 | Gold | 7/27/2007 | Middle School |
| 4. | Woodward Academy Middle School Brand-Tuc | College Park | GA | NC 2.0 | Silver | 4/8/2005 | Middle School |
| 5. | Wrightsville Elementary School | Wrightsville | PA | NC 2.0 | Silver | 6/7/2006 | Elementary |
| 6. | Albany Park Middle School | Chicago | IL | NC 2.1 | Certified | 8/21/2008 | Middle School |
| 7. | BAKER PRAIRIE MIDDLE SCHOOL | CANBY | OR | NC 2.1 | Gold | 1/20/2010 | Middle School |
| 8. | Barnard Environmental Magnet School | New Haven | CT | NC 2.1 | Gold | 3/12/2008 | P-8 |
| 9. | Bertschi Center | SEATTLE | WA | NC 2.1 | Gold | 9/16/2008 | P-8 |
| 10. | Bethel Middle School | Little Rock | AR | NC 2.1 | Silver | 2/28/2008 | Middle School |
| 11. | Case Middle School - Punahou | Honolulu | HI | NC 2.1 | Gold | 6/26/2006 | Middle School |
| 12. | Chartwell School | Seaside | CA | NC 2.1 | Platinum | 11/27/2007 | P-8 |
| 13. | Davidson Elementary School | Tucson | AZ | NC 2.1 | Certified | 9/7/2007 | Elementary |
| 14. | Daybreak Elementary School & Recreation | South Jordan | UT | NC 2.1 | Silver | 5/5/2006 | Elementary |
| 15. | Ethical Culture Fieldston School | Bronx | NY | NC 2.1 | Silver | 9/23/2008 | Middle School |
| 16. | First Mesa Elementary School | Polacca | AZ | NC 2.1 | Certified | 12/13/2005 | Elementary |
| 17. | GERALD R. FORD MIDDLE SCHOOL | GRAND RAPIDS | MI | NC 2.1 | Certified | 5/1/2009 | Middle School |
| 18. | GREYBULL ELEMENTARY SCHOOL | GREYBULL | WY | NC 2.1 | Certified | 6/8/2009 | Elementary |
| 19. | GRPS Sibley Elementary School | GRAND RAPIDS | MI | NC 2.1 | Certified | 6/3/2008 | Elementary |
| 20. | Great Seneca Elementary School | Germantown | MD | NC 2.1 | Gold | 4/18/2007 | Elementary |
| 21. | Green Valley Elementary School | Lower Heidelberg | PA | NC 2.1 | Certified | 5/15/2007 | Elementary |
| 22. | HECTOR GARCIA MIDDLE SCHOOL | DALLAS | TX | NC 2.1 | Certified | 7/22/2008 | Middle School |
| 23. | Hampton Bays UFSD - New Middle School | Hampton Bays | NY | NC 2.1 | Silver | 4/5/2010 | Middle School |
| 24. | Hawaii Baptist Academy Middle School | Honolulu | HI | NC 2.1 | Gold | 4/27/2007 | Middle School |
| 25. | Hermitage Elementary | Virginia Beach | VA | NC 2.1 | Certified | 10/27/2005 | Elementary |
| 26. | Hilltop Montessori School | Birmingham | AL | NC 2.1 | Certified | 6/19/2008 | P-8 |
| 27. | Homewood Middle School | Birmingham | AL | NC 2.1 | Silver | 3/30/2005 | Middle School |
| 28. | Hurricane Creek Elementary | BENTON | AR | NC 2.1 | Silver | 2/3/2009 | Elementary |
| 29. | Kersey Creek Elementary | Mechanicsville | VA | NC 2.1 | Silver | 4/18/2007 | Elementary |
| 30. | Lincoln Heights Elementary School | Spokane | WA | NC 2.1 | Gold | 1/4/2008 | Elementary |
| 31. | Linus Pauling Middle School | Corvallis | OR | NC 2.1 | Silver | 11/10/2006 | Middle School |
| 32. | Miles Davis Academy | Chicago | IL | NC 2.1 | Silver | 4/6/2010 | P-8 |
| 33. | Montessori School of Maui | Makawao | HI | NC 2.1 | Silver | 9/17/2009 | P-8 |
| 34. | Prairie Crossing Charter School | Grayslake | IL | NC 2.1 | Gold | 2/7/2008 | Elementary |
| 35. | RUFFING MONTESSORI SCHOOL EXPA | CLEVELAND HEIGHTS | OH | NC 2.1 | Certified | 5/14/2010 | P-8 |
| 36. | St. Catherines Montessori School | Houston | TX | NC 2.1 | Certified | 5/14/2007 | P-8 |
| 37. | Stanley Elementary | Waltham | MA | NC 2.1 | Silver | 7/7/2006 | Elementary |
| 38. | Summerfield Elementary | Neptune | NJ | NC 2.1 | Gold | 12/8/2007 | Elementary |
| 39. | THE CHILDREN'S SCHOOL | STAMFORD | CT | NC 2.1 | Certified | 2/2/2009 | P-8 |
| 40. | THE WILLOW SCHOOL ART BARN | GLADSTONE | NJ | NC 2.1 | Platinum | 11/13/2007 | Elementary |
| 41. | THOMPSON ELEMENTARY REPLACEMENT | HOUSTON | TX | NC 2.1 | Certified | 8/25/2008 | Elementary |
| 42. | Tarkington School of | Chicago | IL | NC 2.1 | Certified | 4/18/2008 | P-8 |

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|---|---|---|---|---|---|---|---|
| | Excellence | | | | | | |
| 43. | Twenhofel/Kenton County Middle School | Independence | KY | NC 2.1 | Silver | 6/30/2009 | Middle School |
| 44. | Twin Valley Elementary Center | Elverson | PA | NC 2.1 | Silver | 6/28/2006 | Elementary |
| 45. | W. G. Pearson Elementary | Durham | NC | NC 2.1 | Certified | 8/26/2008 | Elementary |
| 46. | WALNUT BEND Elementary | HOUSTON | TX | NC 2.1 | Certified | 7/10/2009 | Elementary |
| 47. | WATERTOWN MAYER ELEMENTARY SCH | WATERTOWN | MN | NC 2.1 | Certified | 10/15/2009 | Elementary |
| 48. | WEST PLACER MIDDLE SCHOOL | ROSEVILLE | CA | NC 2.1 | Gold | 9/29/2009 | Middle School |
| 49. | A L Wilson Elementary | Fairchance | PA | NC 2.2 | Silver | 10/22/2009 | Elementary |
| 50. | ASPEN MIDDLE SCHOOL | ASPEN | CO | NC 2.2 | Gold | 10/29/2008 | Middle School |
| 51. | Avon Middle School | Avon | IN | NC 2.2 | Certified | 3/3/2010 | Middle School |
| 52. | Bell Prairie Elementary | Kansas City | MO | NC 2.2 | Gold | 12/2/2009 | Elementary |
| 53. | Commodore John Barry Elementary | Philadelphia | PA | NC 2.2 | Gold | 2/17/2009 | Elementary |
| 54. | DAVEY JACKSON Elementary | JACKSON | WY | NC 2.2 | Gold | 8/4/2009 | Elementary |
| 55. | Edy Ridge ES & Laurel Ridge MS | Sherwood | OR | NC 2.2 | Gold | 7/5/2010 | P-8 |
| 56. | Elementary School 'P' | Wesley Chapel | FL | NC 2.2 | Certified | 10/12/2009 | Elementary |
| 57. | Evergreen Elementary (SMCPS 0606) | California | MD | NC 2.2 | Gold | 10/26/2009 | Elementary |
| 58. | Francis Scott Key Middle School | Silver Spring | MD | NC 2.2 | Gold | 8/22/2009 | Middle School |
| 59. | GARRISON FOREST MIDDLE SCHOOL | Owings Mills | MD | NC 2.2 | Silver | 10/28/2009 | Middle School |
| 60. | GRPS Burton School | Grand Rapids | MI | NC 2.2 | Certified | 11/17/2009 | Elementary |
| 61. | Governor Mifflin Elementary | Shillington | PA | NC 2.2 | Silver | 8/13/2010 | Elementary |
| 62. | Gulf Trace Elementary | Holiday | FL | NC 2.2 | Silver | 5/9/2008 | Elementary |
| 63. | Joppatowne Elementary | Joppatowne | MD | NC 2.2 | Certified | 11/12/2010 | Elementary |
| 64. | KPS New Elementary | Kalamazoo | MI | NC 2.2 | Gold | 10/26/2009 | Elementary |
| 65. | LJCDS Kindergarten Center | La Jolla | CA | NC 2.2 | Gold | 11/25/2009 | Elementary |
| 66. | Langston Hughes Davis Elementary | Chicago | IL | NC 2.2 | Gold | 5/13/2010 | Elementary |
| 67. | Laurel-Beltsville Elementary | Beltsville | MD | NC 2.2 | Gold | 8/27/2009 | Elementary |
| 68. | Manassas Park Elementary School & Pre-K | Manassas Park | VA | NC 2.2 | Gold | 6/4/2010 | Elementary |
| 69. | Neil Armstrong Elementary | Port Charlotte | FL | NC 2.2 | Certified | 4/25/2008 | Elementary |
| 70. | PLEASANT RIDGE ELEM SCHOOL | CINCINNATI | OH | NC 2.2 | Silver | 10/2/2009 | Elementary |
| 71. | PORCUPINE K-8 SCHOOL | PORCUPINE | SD | NC 2.2 | Silver | 1/25/2010 | P-8 |
| 72. | Paradise Elementary | Paradise | PA | NC 2.2 | Gold | 9/23/2010 | Elementary |
| 73. | Peace River Elementary | Charlotte Harbor | FL | NC 2.2 | Silver | 6/18/2008 | Elementary |
| 74. | Pine Jog Elementary 03Y | West Palm Beach | FL | NC 2.2 | Gold | 5/14/2009 | Elementary |
| 75. | Poly Prep Lower School | BROOKLYN | NY | NC 2.2 | Silver | 3/4/2008 | Elementary |
| 76. | Poquoson Elementary School | POQUOSON | VA | NC 2.2 | Gold | 2/16/2010 | Elementary |
| 77. | Prairie View Middle School | Henderson | CO | NC 2.2 | Gold | 3/2/2009 | Middle School |
| 78. | Punta Gorda Middle School | Punta Gorda | FL | NC 2.2 | Silver | 6/2/2009 | Middle School |
| 79. | Rio Rancho NE Elementary | Rio Rancho | NM | NC 2.2 | Silver | 10/8/2009 | Elementary |
| 80. | Rio Rancho NW Elementary | Rio Rancho | NM | NC 2.2 | Gold | 10/22/2010 | Elementary |
| 81. | SECOND NATURE ACADEMY ELEMENTA | NASHUA | NH | NC 2.2 | Platinum | 2/25/2010 | Elementary |
| 82. | Salmon Creek Eco-Resource Building | Occidental | CA | NC 2.2 | Platinum | 11/19/2009 | Middle School |
| 83. | Sarasota County - Middle School EE | North Port | FL | NC 2.2 | Silver | 7/16/2010 | Middle School |
| 84. | Savannah Country Day - Lower School | Savannah | GA | NC 2.2 | Silver | 8/26/2010 | Elementary |
| 85. | Savoy Elementary | Washington | DC | NC 2.2 | Gold | 9/13/2010 | Elementary |
| 86. | Stamford Environmental Magnet School | Stamford | CT | NC 2.2 | Silver | 3/31/2010 | P-8 |
| 87. | Subregion VI Elementary | Upper Marlboro | MD | NC 2.2 | Gold | 12/9/2010 | Elementary |
| 88. | Tarpon Springs Elementary | Tarpon Springs | FL | NC 2.2 | Gold | 10/22/2009 | Elementary |
| 89. | Tyrone Elementary | St Petersburg | FL | NC 2.2 | Gold | 6/4/2009 | Elementary |
| 90. | UNO Brighton Park | Chicago | IL | NC 2.2 | Gold | 1/19/2009 | Elementary |

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|---|---|---|---|---|---|---|---|
| | School | | | | | | |
| 91. | William B Gibbs ES (Clarksburg No 8) | Germantown | MD | NC 2.2 | Gold | 7/15/2010 | Elementary |
| 92. | Willowwind School | Iowa City | IA | NC 2.2 | Gold | 7/14/2009 | P-8 |
| 93. | Windrush School Classroom Building | El Cerrito | CA | NC 2.2 | Platinum | 7/20/2009 | P-8 |
| 94. | Woodland Elementary | Olathe | KS | NC 2.2 | Silver | 11/17/2009 | Elementary |
| 95. | da Vinci Arts Middle School HP Classroom | Portland | OR | NC 2.2 | Platinum | 5/15/2010 | Middle School |
| 96. | 10197577 Julia Green Elementary | Nashville | TN | S 2.0 | Silver | 1/4/2010 | Elementary |
| 97. | 2008 Elementary | Fort Collins | CO | S 2.0 | Gold | 10/16/2008 | Elementary |
| 98. | APS Tony Hillerman Middle School | Albuquerque | NM | S 2.0 | Gold | 9/10/2010 | Middle School |
| 99. | Ada Christian School | Ada | MI | S 2.0 | Certified | 4/6/2010 | P-8 |
| 100. | Barcelona Elementry School | Albuquerque | NM | S 2.0 | Gold | 4/15/2010 | Elementary |
| 101. | Bowling Green Middle School and P.A.C. | Bowling Green | OH | S 2.0 | Gold | 7/29/2010 | Middle School |
| 102. | Brownsville Elementary Additions | Crozet | VA | S 2.0 | Gold | 12/17/2010 | Elementary |
| 103. | Butterfield Elementary Addition | Fayetteville | AR | S 2.0 | Certified | 11/18/2010 | Elementary |
| 104. | CPS - Southwest Middle School | Chicago | IL | S 2.0 | Gold | 2/17/2010 | Middle School |
| 105. | Cashell Elementary | Rockville | MD | S 2.0 | Gold | 10/4/2010 | Elementary |
| 106. | Chipeta Elementary | Grand Junction | CO | S 2.0 | Gold | 3/11/2010 | Elementary |
| 107. | Darlington Middle School | Rome | GA | S 2.0 | Gold | 3/30/2010 | Middle School |
| 108. | East Elementary | Punta Gorda | FL | S 2.0 | Silver | 6/2/2009 | Elementary |
| 109. | Eco Schoolhouse | Columbia | MO | S 2.0 | Gold | 4/14/2010 | Elementary School |
| 110. | Forest View Elementary | Olathe | KS | S 2.0 | Silver | 4/28/2010 | Elementary |
| 111. | G.D. Rogers Garden Elementary | Bradenton | FL | S 2.0 | Silver | 6/29/2010 | Elementary |
| 112. | Greenwich Academy Middle School | Greenwich | CT | S 2.0 | Silver | 8/20/2009 | Middle School |
| 113. | H.D. Cooke Elementary | Washington | DC | S 2.0 | Gold | 3/8/2010 | Elementary |
| 114. | Hillandale Elementary | East Flat Rock | NC | S 2.0 | Gold | 9/28/2010 | Elementary |
| 115. | Hillsboro Elementary 27 | Hillsboro | OR | S 2.0 | Gold | 2/25/2010 | Elementary |
| 116. | Jim G. Martin Elementary | San Antonio | TX | S 2.0 | Silver | 11/11/2010 | Elementary |
| 117. | Learning Gate Community School | Lutz | FL | S 2.0 | Platinum | 6/2/2010 | P-8 |
| 118. | Machetanz Elementary | Palmer | AK | S 2.0 | Silver | 12/17/2009 | Elementary |
| 119. | Marin Country Day School, Step 1 | Corte Madera | CA | S 2.0 | Gold | 3/13/2009 | P-8 |
| 120. | Marin Country Day School, Step 2 | Corte Madera | CA | S 2.0 | Platinum | 4/29/2010 | P-8 |
| 121. | Mills River Elementary | Mills River | NC | S 2.0 | Gold | 9/28/2010 | Elementary |
| 122. | Muckleshoot Tribal School K-12 | Auburn | WA | S 2.0 | Silver | 1/28/2010 | P-8 |
| 123. | New Fulton Pre-K -5 Elementary | Tinley Park | IL | S 2.0 | Silver | 7/22/2010 | Elementary |
| 124. | New Hubble Middle School | Warrenville | IL | S 2.0 | Gold | 5/3/2010 | Middle School |
| 125. | Paul J. Olson Elementary | Madison | WI | S 2.0 | Silver | 10/27/2009 | Elementary |
| 126. | Pine Crest Prep Boca Raton Lower School | Boca Raton | FL | S 2.0 | Gold | 4/15/2010 | elementary |
| 127. | River Crest Elementary | Hudson | WI | S 2.0 | Gold | 8/6/2009 | Elementary |
| 128. | SAS Lower School Addition | Boca Raton | FL | S 2.0 | Gold | 6/8/2009 | Elementary |
| 129. | Selinsgrove Elementary | Selinsgrove | PA | S 2.0 | Gold | 9/22/2010 | Elementary |
| 130. | Shadow Valley (Browning Park) Elementary | Ogden | UT | S 2.0 | Certified | 11/18/2009 | Elementary |
| 131. | Skinner Elementary | Chicago | IL | S 2.0 | Gold | 4/13/2010 | Elementary |
| 132. | St. Thomas School | Medina | WA | S 2.0 | Gold | 6/10/2009 | P-8 |
| 133. | Stuart Middle School | Commerce City | CO | S 2.0 | Silver | 10/21/2010 | Middle School |
| 134. | The Lovett School- New Middle School | Atlanta | GA | S 2.0 | Gold | 7/27/2010 | Middle School |
| 135. | Timber Creek Elementary | Overland Park | KS | S 2.0 | Silver | 9/22/2010 | Elementary |
| 136. | Van Buren Elementary | Caldwell | ID | S 2.0 | Silver | 9/21/2010 | Elementary |
| 137. | Washington Elementary | Caldwell | ID | S 2.0 | Gold | 10/7/2010 | Elementary |
| 138. | Water Grass Elementary | New Port Richey | FL | S 2.0 | Gold | 1/15/2010 | Elementary |
| 139. | Weldon Valley Phase III | Weldona | CO | S 2.0 | Silver | 12/7/2010 | Elementary |
| 140. | William E. Miller Elementary | Bend | OR | S 2.0 | Gold | 3/29/2010 | Elementary |
| 141. | Wooster Elementary | Greenbrier | AR | S 2.0 | Silver | 12/10/2009 | Elementary |

## Appendix B: E-Survey

zoomerang

# Green Schools That Teach

Created: February 22 2011, 4:16 PM
Last Modified: April 13 2011, 1:45 PM
Design Theme: Fine Line Gray
Language: English
Button Options: Custom: Start Survey: "Start Survey!"  Submit: "Submit"
Disable Browser “Back” Button: False

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**Green Schools That Teach**

Page 1 - Heading

Directions & Consent:
You are invited to be in a research study about your whole-school sustainability program. You were identified as an individual with valuable insights into ways this building is being used to reinforce sustainability in curriculum, operations, or school culture. This survey consists of 25 questions (19 required and 6 optional).
Please read through the following information and ask any questions you may have before agreeing to be in the study. This study is being conducted by Katharine Leigh, a professor in Interior Design and myself, Stephanie Barr, a graduate student at Colorado State University.
Background Information: The combination of green school design, green organizational behavior, and aligned curriculum sets the stage for a green school to be a teaching tool. The purpose of this study is to explore the methods, processes, and resources serving as the foundation for successful whole-school sustainability – schools promoting sustainability through building and site design, culture, and curriculum.
Procedures: If you agree to be in this study:
- Check a) to indicate that you understand and agree with the information provided in this consent form, or b) to opt out of the survey.
Risks and Benefits of Being in the Study: This study has minimal risks. It is not possible to identify all potential risks in a survey procedure, but the researchers have taken reasonable safeguards to minimize any known and potential risks. There are no direct benefits to you for participating. However, it is hoped that this study will benefit future participants in green school design processes.
Confidentiality: The records of this study will be kept private. In any report we might publish, it will not be possible to identify the responses of an individual participant from a specific school. Responses from schools will be grouped in the analysis.
Voluntary Nature of the Study: Your participation in this study is entirely voluntary. Your decision whether or not to participate will not affect your current or future employment, and will not be shared individually with school administrators. If you decide to participate, you are free to withdraw at any time without affecting these relationships. If at any point you feel that you would like to withdraw from the study, simply exit the survey.
Contacts and Questions: The researchers conducting this study are Katharine Leigh, IIDA, Associate AIA, LEED AP BD+C and Stephanie Barr, LEED AP BD+C. You may ask any questions you have now. If you have questions later, you may contact Stephanie Barr at: s.barr@colostate.edu. You may also contact the Research Integrity and Compliance Review Office at Colorado State University: Janell Barker, Human Research Administrator, (970) 491-1655. You may print this form to keep for your records.
Please, do not put your name on any part of the survey.
Thank you for your support and participation in advance,
Stephanie Barr, LEED AP BD+C

Page 1 - Question 1 - Choice - One Answer (Bullets)[Mandatory]

AN ANSWER TO ONE OF THESE TWO CHOICES IS REQUIRED TO CONTINUE THE SURVEY

- ○ Yes, I understand this consent form and consent to participate. Take me to the next part of the survey
- ○ No, I do not choose to give my consent at this time. Exit me from this survey.

Page 2 - Question 2 - Choice - One Answer (Drop Down)[Mandatory]

I am associated with the following school:

- ○ Barnard Environmental Magnet
- ○ Bertschi Center
- ○ Prairie Crossing Charter School
- ○ The Willow School
- ○ Evergreen Elementary
- ○ Manassas Park Elementary
- ○ Pine Jog Elementary
- ○ Second Nature Academy
- ○ Salmon Creek
- ○ Stamford Environmental Magnet
- ○ Windrush School
- ○ Learning Gate

Page 2 - Question 3 - Choice - One Answer (Bullets)[Mandatory]

My association with this school is: (please choose option which most applies)

- ○ School Employee
- ○ Parent/Community Member
- ○ Building Professional [Skip to 4]

Page 2 - Question 4 - Choice - One Answer (Bullets)[Mandatory]

How many years have you worked with or been associated with this school/district?

- ○ less than 1 year
- ○ 1-5 years
- ○ 6-10 years
- ○ 11-15 years
- ○ 16-20 years
- ○ 21-25 years
- ○ 26-30 years
- ○ over 30 years

Page 2 - Question 5 - Choice - One Answer (Bullets)[Mandatory]

How many years of experience do you have in your discipline/field?

- ○ less than 1 year
- ○ 1-5 years
- ○ 6-10 years
- ○ 11-15 years
- ○ 16-20 years
- ○ 21-25 years
- ○ 26-30 years
- ○ over 30 years

Page 2 - Question 6 - Choice - One Answer (Bullets)[Mandatory]

Are you LEED Accredited?

- ○ Yes
- ○ No
- ○ In Progress

Page 2 - Question 7 - Choice - One Answer (Bullets)[Mandatory]

How satisfied are you with the LEED process resulting in your facility?

- ○ Extremely
- ○ Moderately
- ○ A Little
- ○ Not at All

Page 3 - Question 8 - Choice - Multiple Answers (Bullets) [Mandatory] [Up To 2 Answers]

My role within the school is:

- ❑ School Administrator/Principal [Skip to 5]
- ❑ District Staff [Skip to 5]
- ❑ School Instructor/Teacher (Full-time) [Skip to 5]
- ❑ School Instructor (Part-time) [Skip to 5]
- ❑ School Support Staff [Skip to 5]
- ❑ Parent/ Guardian [Skip to 5]
- ❑ Community Member [Skip to 5]
- ❑ Other, please specify

.....

Page 4 - Question 9 - Choice - Multiple Answers (Bullets)[Mandatory]

My role within the school's project team was:

- ❑ Architect [Skip to 7]
- ❑ Interior Designer [Skip to 7]
- ❑ Landscape Architect [Skip to 7]
- ❑ Lighting Designer [Skip to 7]
- ❑ Civil Engineer [Skip to 7]
- ❑ Mechanical Engineer [Skip to 7]
- ❑ Electrical Engineer [Skip to 7]
- ❑ Structural Engineer [Skip to 7]
- ❑ Contractor [Skip to 7]
- ❑ Sustainability Consultant/LEED Manager [Skip to 7]

Page 5 - Question 10 - Rating Scale - Matrix[Mandatory]

School Culture
Please rate the degree to which the following norms or values are a consistent feature in your school.
(available from Idaho Department of Education @http://www.sde.idaho.gov/site/innovation_choice/docs/bp/Jim%20Johnson_School%20Culture%20Survey2.pdf; norms/values derived from the work of King and Saphier (1985).

| | Almost Always Characteristic of Our School | Generally Characteristic of Our School | Seldom Characteristic of Our School | Not Characteristic of Our School |
|---|---|---|---|---|
| Collegiality (Professional Collaboration on educational issues) | ❍ | ❍ | ❍ | ❍ |
| Experimentation (Interest in exploring new, not yet proven techniques) | ❍ | ❍ | ❍ | ❍ |
| High Expectations (A pervasive push for high performance for students and teachers) | ❍ | ❍ | ❍ | ❍ |
| Trust & Confidence (A pervasive feeling that people will do what is right) | ❍ | ❍ | ❍ | ❍ |
| Tangible Support (Financial and material assistance that supports teaching/learning) | ❍ | ❍ | ❍ | ❍ |
| Reaching out to the Knowledge Base (Use of research reading of professional journals, workshops) | ❍ | ❍ | ❍ | ❍ |
| Appreciation & Recognition (Acknowledgement of quality student/staff work and effort) | ❍ | ❍ | ❍ | ❍ |
| Caring, Celebration, Humor | ❍ | ❍ | ❍ | ❍ |
| Appreciation of Leadership (Specifically leadership provided by teachers, principals, professional staff) | ❍ | ❍ | ❍ | ❍ |
| Clarity of Goals | ❍ | ❍ | ❍ | ❍ |

| | | | | |
|---|---|---|---|---|
| Protection of What's Important (School goals & priorities) | ❍ | ❍ | ❍ | ❍ |
| Involvement of Stakeholders in Decision Making (Those who will be affected by decisions are involved in making them) | ❍ | ❍ | ❍ | ❍ |
| Traditions (Rituals and events that celebrate and support core school values) | ❍ | ❍ | ❍ | ❍ |
| Honest, Open Communication | ❍ | ❍ | ❍ | ❍ |

Page 5 - Question 11 - Open Ended - Comments Box

Optional: For at least one norm which you scored (1) Almost Always, please provide an example that illustrates this norm/value within your school culture.

Page 6 - Question 12 - Open Ended - Comments Box

Why is sustainability integrated into your curriculum?

Page 6 - Question 13 - Open Ended - Comments Box[Mandatory]

In what ways does your curriculum promote sustainability?

Page 6 - Question 14 - Open Ended - Comments Box

Optional: What resources have you used to develop and enrich your sustainability curriculum?

Page 7 - Question 15 - Open Ended - Comments Box[Mandatory]

Why did you design a green school?

Page 7 - Question 16 - Open Ended - Comments Box[Mandatory]

In your opinion, what values are represented in the design of your school?

Page 7 - Question 17 - Rating Scale - Matrix[Mandatory]

In addition to the project team, who was involved in the planning & design of your green school?

| | YES | NO |
|---|---|---|
| School Admin /Principal | ❍ | ❍ |
| School Support Staff | ❍ | ❍ |
| Maintenance/Facilities Staff | ❍ | ❍ |
| Teachers | ❍ | ❍ |
| Parents/Guardian | ❍ | ❍ |
| Community Members | ❍ | ❍ |
| Sustainability Consultant | ❍ | ❍ |

Page 7 - Question 18 - Open Ended - Comments Box

Optional: Provide an example of the value added by at least one of these individuals to the project's success:

Page 7 - Question 19 - Open Ended - Comments Box[Mandatory]

Are there aspects about your school's design that encourage students to engage and learn about their school building? Please explain.

Page 7 - Question 20 - Open Ended - Comments Box[Mandatory]

Is student engagement/exploration of their school building and grounds valuable to the learning process?

Page 8 - Question 21 - Open Ended - Comments Box[Mandatory]

In what ways do you use your green school building and grounds in your curriculum?

Page 8 - Question 22 - Open Ended - Comments Box[Mandatory]

Are there specific building or site features that you consider valuable teaching tools?

Page 8 - Question 23 - Open Ended - Comments Box

Optional: How have students responded to their green learning environment?

Page 8 - Question 24 - Open Ended - Comments Box

Optional: In what ways is the learning environment in this green school different from the learning environments in non-green schools?

Page 8 - Question 25 - Open Ended - Comments Box

Optional: Share any comments you would like before exiting the survey that would help in understanding your green school and your success in whole-school sustainability:

Thank You Page

Thank you for your time and your support for green school research!

## Appendix C: Phone Script

Good morning/afternoon, _____;

My name is Stephanie Barr and I am conducting research on Green School that Teach: The role of green building in whole-school sustainability. May I take about 15 minutes of your time to tell you about my study and invite the participation of your school?

Through a review of literature, and my personal experience in the field of green school design, I have learned that successful green schools involve more than just green building; they must promote sustainability through building design, operations, and curriculum. A high-performing green school should also be a teaching tool. Your school has been identified as a model, and one that would be an excellent addition to this study. Through this survey, we hope to explore the various methods, processes, and resources used to establish whole-school sustainability. Survey question will center of aspects of your green school design, your school's culture, and educational goals.

As the co-PI, I am the working on this study with Professor Katharine Leigh from the Design and Merchandising Department at Colorado State University. The study is also supported by Brian Dunbar of the Institute for the Built Environment, and the Center for Green Schools at the USGBC.

If you agree for your school to participate in this study, I will send you the survey link. I request that you forward this link to your teachers, parent volunteers and community members, and any district staff or administration who might have insight into the school mission or its design.

May I ask you a few baseline questions about your school?

- Is your school:
  - Private
  - Public
  - Charter
- Number of:
  - Students _____
  - Faculty _____
  - Support Staff _____
- Location
  - Rural
  - Suburban
  - Urban
- Who was the project architect? _____
- What is their contact information? _____

- Does your school have any special spaces (i.e., school garden, weather station, science lab, etc.)

I will send you email shortly requesting confirmation of your cooperation, including directions on how to proceed. If you have questions regarding the study, you may contact me at 405 606 5051 or s.barr@colostate.edu and if you have any questions about your rights as a volunteer in this research you may contact Janell Barker, Human Rights Administrator at 970-491-1655. This consent form was approved by the CSU Institutional Review Board for the protection of the human subjects in the research on _____.

We greatly appreciate your time and thank you in advance, for your valuable assistance.

## Appendix D: Sample Letter of Cooperation

*Sample Text for Email of Cooperation*

Principal _____,

Please review the following text and reply to this email confirming you understand and agree with this text, and consent to participate in the study.

After reviewing your request to include our school in your research study, *Green Schools that Teach,* we have determined that our participation would be appropriate. We understand that the objective of this work is to shed light on the design, culture and curriculum of green schools practicing whole school sustainability.

We understand the following:

- The research protocol has been approved by Colorado State University's Institutional Review Board and there are no known concerns regarding the safety of our staff participating in this study;
- We will support the research by permitting and encouraging our staff to access the survey through the survey provider ; we understand that participation is voluntary by our staff;
- Data will be collected over a three week period;
- The survey takes roughly 20 minutes to complete;
- Two reminders will be sent to participants according to the schedule you have provided;
- At the conclusion of the thesis, you will provide our office with a research summary; and
- No costs will be incurred by our office other than normal access to the internet.

Thank you,

Stephanie Barr

## Appendix E: Sample Notice to Participants

[School LOGO/LETTERHEAD]

To All Staff:

The firm has given permission to Stephanie Barr, LEED AP BD + C, a graduate student and master's candidate in interior design/sustainable design at Colorado State University to include our school and staff in this study of green schools. The study entitled *GREEN SCHOOLS THAT TEACH: THE ROLE OF GREEN BUILDING IN WHOLE-SCHOOL SUSTAINABILITY i*s a component of her thesis. Your participation will help to develop a publication for best practices to help others wishing to create schools like yours in the future.

PLEASE support her effort and contributions to sustainable practices in schools; spend about 20 minutes completing the survey you can access at:

http://www.zoomerang.com/Survey/WEB22BXGCSK76R/

It is important for everyone to complete the survey by April 29!

THANK you!

*Principal*

## Appendix F: Sample Email Reminder to Participants

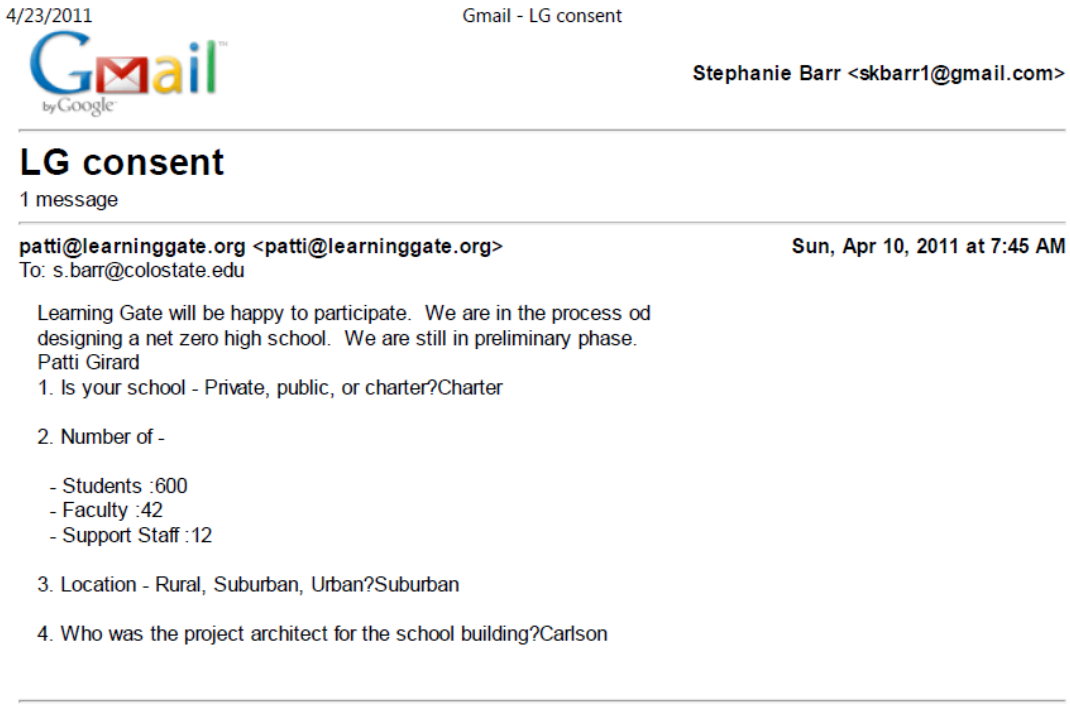
To All Staff:
You are reminded to participate in the study *GREEN SCHOOLS THAT TEACH: THE ROLE OF GREEN BUILDING IN WHOLE-SCHOOL SUSTAINABILITY* aimed at improving best practices to help others wishing to create schools like yours in the future. Access to the study, being conducted by a master's student from Colorado State University will end on April 29th, 2011.

We ask you to spend about 20 minutes completing the survey at:
http://www.zoomerang.com/Survey/WEB22BXGCSK76R/

Thank you! If you have already completed the survey – have a great day!

## Appendix G: Letters of Agreement

**Learning Gate Community School Consent**
Principal: Patti Girard



4/23/2011 Gmail - LG consent

Gmail by Google

Stephanie Barr <skbarr1@gmail.com>

**LG consent**

1 message

**patti@learninggate.org <patti@learninggate.org>** **Sun, Apr 10, 2011 at 7:45 AM**
To: s.barr@colostate.edu

Learning Gate will be happy to participate. We are in the process od designing a net zero high school. We are still in preliminary phase.
Patti Girard
1. Is your school - Private, public, or charter?Charter

2. Number of -

- Students :600
- Faculty :42
- Support Staff :12

3. Location - Rural, Suburban, Urban?Suburban

4. Who was the project architect for the school building?Carlson

**Pine Jog Elementary School Consent**
Principal: Fred Barch

4/23/2011 Gmail - Green School Research Study -...

Gmail by Google

Stephanie Barr <skbarr1@gmail.com>

## Green School Research Study - Consent

**Fred Barch <barchf@palmbeach.k12.fl.us>** **Thu, Mar 31, 2011 at 1:55 PM**
To: s.barr@colostate.edu

Looking forward to participating in your research project!

Fred J. Barch
Principal
Pine Jog Elementary School
656-5401
Go Green! Please do not print this e-mail unless it is completely necessary

2009 & 2010
Palm Beach County
Green School
of Excellence

***Florida's First LEED Gold Certified School***

**Willow School Consent**
Principal: Kate Walsh

4/23/2011 Gmail - Green School Research Study -...

Gmail by Google

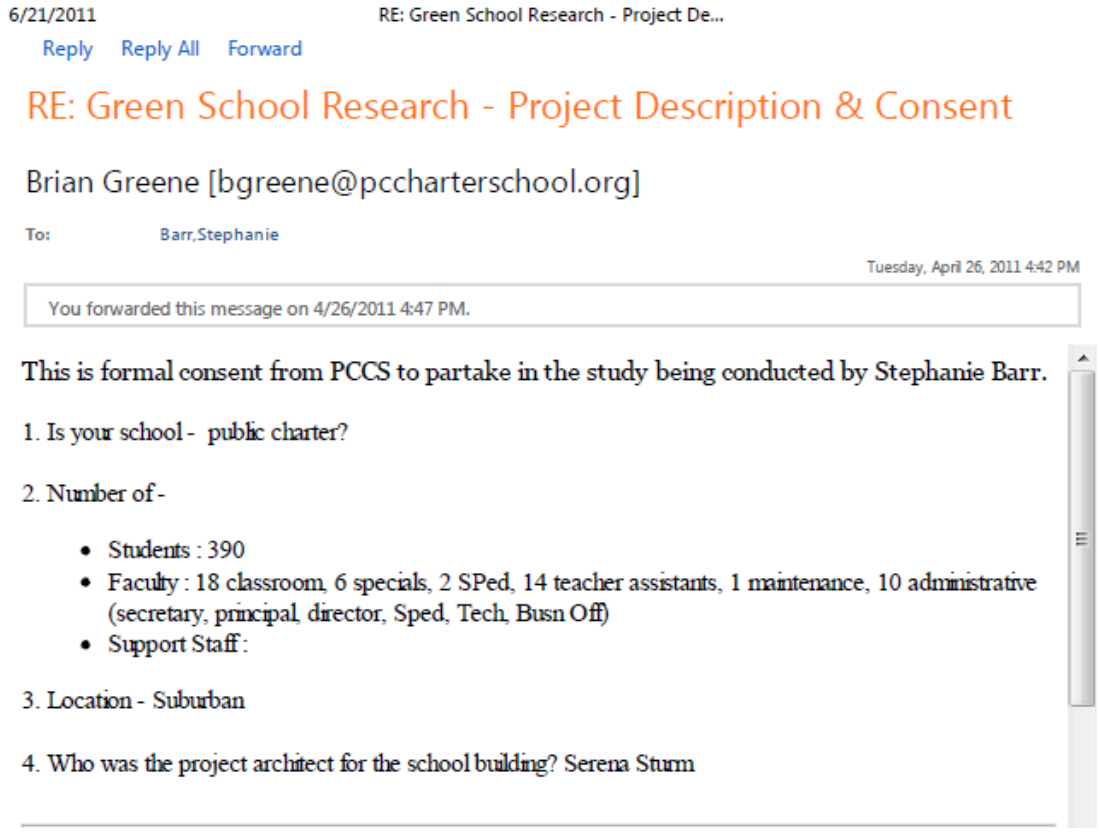
Stephanie Barr <skbarr1@gmail.com>

## Green School Research Study - Consent

**Kate Walsh <kwalsh@willowschool.org>** **Sat, Apr 9, 2011 at 7:55 PM**
To: s.barr@colostate.edu

Hello Stephanie,
Yes I have reviewed the consent info and agree to the conditions. I am happy to support the research and have our faculty and staff complete the survey if they choose.
Regards
Kate
Kate Burke Walsh
Head of School
The Willow School
1150 Pottersville Road
Gladstone, New Jersey 07934
908-470-9500 x 1010
[Quoted text hidden]

Prairie Crossing Charter School
Principal: Brian Greene



6/21/2011 RE: Green School Research - Project De...

Reply Reply All Forward

## RE: Green School Research - Project Description & Consent

Brian Greene [bgreene@pccharterschool.org]

To: Barr,Stephanie

Tuesday, April 26, 2011 4:42 PM

You forwarded this message on 4/26/2011 4:47 PM.

This is formal consent from PCCS to partake in the study being conducted by Stephanie Barr.

1. Is your school - public charter?

2. Number of -

- Students : 390
- Faculty : 18 classroom, 6 specials, 2 SPed, 14 teacher assistants, 1 maintenance, 10 administrative (secretary, principal, director, Sped, Tech, Busn Off)
- Support Staff :

3. Location - Suburban

4. Who was the project architect for the school building? Serena Sturm

Bertschi School
Principal: Bridget Bertschi

From: Tiffany Carey [tiffanyc@bertschi.org]
> Sent: Monday, May 02, 2011 2:52 PM
> To: Barr,Stephanie
> Subject: Re: Green School Research, Description & Consent - Bertschi School
>
> Stephanie,
>
> I'm replying to yoru email to confirm our participation in your study.
>
> Bertschi School is private. We currently have 234 students and 48 members of
> our faculty/staff. The school is located an urban area of Seattle. Chris
> Hellstern and Stacy Smedley of KMD Architects spearheaded the project. Stacy
> Smedley <smedley@kmd-arch.com<UrlBlockedError.aspx>> and "Hellstern, Chris"
> <hellstern@kmd-arch.com<UrlBlockedError.aspx>>
>
> Please let me know if you need anything further,
>
> Tiffany
> --
> Tiffany Carey '91
> Director of Advancement
>
> BERTSCHI SCHOOL
> 2227 10th Ave East Seattle, WA 98102
> 206-442-6852 | www.bertschi.org
>
> Please remember Bertschi in your will and trusts.
>

# Appendix H: IRB Letter

Colorado State University

Research Integrity & Compliance Review Office
Office of Vice President for Research
Fort Collins, CO 80523-2011
(970) 491-1553
FAX (970) 491-2293

**DATE:** March 25, 2011

**TO:** Katherine Leigh, Design & Merchandising
Stephanie Barr, Design & Merchandising

**FROM:** Janell Barker, IRB Administrator
Research Integrity & Compliance Review Office

**TITLE:** Green Schools that Teach: the Role of Green-Building in Whole School Sustainability

**IRB ID:** 041-12H **Review Date:** March 25, 2011

---

The Institutional Review Board (IRB) Administrator has reviewed this project and has declared the study exempt from the requirements of the human subject protections regulations as described in 45 CFR 46.101(b)(2): Research involving the use of educational tests,....survey procedures, interview procedures or observation of public behavior, unless: a) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects.

The IRB determination of exemption means that:

- **You do not need to submit an application for annual continuing review.**
- **You must carry out the research as proposed in the Exempt application**, including obtaining and documenting (signed) informed consent if stated in your application or if required by the IRB.
- **Any modification of this research should be submitted to the IRB through an email to the IRB Administrator, prior to implementing any changes**, to determine if the project still meets the Federal criteria for exemption. If it is determined that exemption is no longer warranted, then an IRB proposal will need to be submitted and approved before proceeding with data collection.
- **Please notify the IRB if any problems or complaints of the research occur.**

Please note that you must submit all research involving human participants for review by the IRB. **Only the IRB may make the determination of exemption**, even if you conduct a similar study in the future.

## Appendix I: Permissions

Get Permission / Find Title



Advanced Search Options

1 PAYMENT 2 REVIEW 3 CONFIRMATION

**Step 3: Order Confirmation**

Print terms & conditions
Print citation information (What's this?)
**Thank you for your order!** A confirmation for your order will be sent to your account email address. If you have questions about your order, you can call us at 978-646-2600, M-F between 8:00 AM and 6:00 PM (Eastern), or write to us at info@copyright.com.

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**Order Date: 02/08/2011**
If you pay by credit card, your order will be finalized and your card will be charged within 24 hours. If you pay by invoice, you can change or cancel your order until the invoice is generated.

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**Order detail ID:** 50665236
**ISBN:** 978-1-4129-6557-6
**Publication year:** 2011
**Publication Type:** Book
**Publisher:** SAGE PUBLICATIONS
**Rightsholder:** SAGE PUBLICATIONS INC BOOKS
**Author/Editor:** Creswell
**Your reference:** Stephanie Barr's thesis, Chapter 3
**Permission Status:** **Granted**
**Permission type:** Republish or display content
**Type of use:** Republish in a dissertation
**Republication title:** Green Schools that Teach
**Republishing organization:** Colorado State University
**Organization status:** Non-profit 501(c)(3)
**Republication date:** 05/13/2011
**Circulation/ Distribution:** 2
**Type of content:** Chart
**Description of requested content:** Data Analysis in Qualitative research
**Page range(s):** p. 185
**Translating to:** No Translation

# Appendix J: Code Book

| Major Theme | Codes | # of Ref | Code Description | Top Relationships | Important Outlier Relationships |
|---|---|---|---|---|---|
| **Culture** | 03. Collaboration | 13 | Working together of teachers or students. Democratic, inclusive decision making | Commitment to Goals, Mission, Interdependence, | Innovation, Knowledge Base, Project Based |
| **Culture** | 04. Innovation | 11 | Cutting edge, ability to take chances | Conservation, Commitment to Goals/Mission, Commitment from Authority, Modeling | Collaboration, Efficiency, |
| **Culture** | 05. Knowledge Base | 15 | Reaching out to experts in community, knowledge of teachers | Community-based | Collaboration, Quality of Design, |
| **Culture** | 06. Commitment to Goals, Mission | 48 | personal belief, dedication to the school's goals/mission | Ethics/Virtues, Commitment from Authority, Future Focus, Modeling, Awareness, Empowerment, Enthusiasm | |
| **Culture** | 07. High Expectations | 9 | High performance expected of students, faculty, school, district, and facility | Ethics/Virtues, | Quality of Design, Modeling |
| **Culture** | 08. Future Focus | 26 | Priority being the future of students, community, society, and the earth | Commitment to Goals/Mission, Modeling, Awareness | Problem Solver |
| **Culture** | 09. Efficiency | 5 | Applied to word efficiency | Conservation, | Modeling, Commitment from Authority |
| **Culture** | 10. Health | 28 | Health, comfort | Conservation, Indoor/Outdoor Connection, Grounds | |
| **Culture** | 11. Interdependence | 22 | Symbiotic relationships | Integrated Topics, Respect | Social Studies, Problem Solver |
| **Culture** | 12. Respect | 16 | Applied to word respect | Interdependence, Ethics/Virtues, Conservation, Responsibility | |
| **Culture** | 14. Ethics, Virtues, Integrity | 39 | | Commitment to Goals/Mission, Modeling, Integrated Topics | Commitment from Authority, Community Based |
| **Culture** | 15. Conservation | 57 | Conserving resources, surrounding environment | Energy, Water Systems, Operations, Recycled Materials, Innovation, Responsibility | Quality of Design, Modeling |

| | | | | | |
|---|---|---|---|---|---|
| **Culture** | 16. Commitment from Authority | 43 | Commitment from principle, superintendent, district or architectural firm | Commitment to Goals/Mission, Modeling, Innovation | Collaboration |
| **Curriculum** | 19. Teaching Tools (Methods) | 60 | Applied to "teaching tools". The specific mention of using building and site features in lessons | Project Based, Grounds, Water System, Modeling | Sense of Place, Cycles/Systems, Indoor/Outdoor Connection. Quality of Design |
| **Curriculum** | 20. Community-based (Methods) | 40 | Using community resources to convey lessons | Modeling, Grounds | Social Studies, Pride |
| **Curriculum** | 21. Sense of Place (Methods) | 17 | Using history, culture, unique features of the place, to convey lessons | Plants, Grounds, Place Attributes | |
| **Curriculum** | 22. Project-based (Methods) | 57 | Descriptions of student projects, activities, using the interaction with objects or processes as subjects for lessons | Garden, Grounds, Operations, Water system, Teaching Tools, Student-Directed, Energy | Exploration, Interest/Curiosity, Exposed |
| **Curriculum** | 23. Exploration (Methods) | 20 | The discovery, or exploration, of surroundings, topics, ideas | Grounds, Teaching Tools, Awareness | Problem Solver, Interest/Curiosity, Integrated Topics, Student Directed, |
| **Curriculum** | 24. Service Learning (Methods) | 6 | Community outreach | Community-based, Project Based | Ethics/Virtues, |
| **Curriculum** | 25. Modeling (Methods) | 46 | Facility design, school culture as indirect curriculum for students, staff, community, and beyond | Community-Based, Teaching Tools, Conservation, Ethics/Virtues, Future Focus, Awareness, | Innovation, High Expectations, Commitment from Authority |
| **Curriculum** | 26. Student-Directed (Methods) | 26 | Students given responsibility, autonomy, in sustainability efforts | Operations, Garden, Project Based | Enthusiasm, Ownership, Pride, Empowerment |
| **Curriculum** | 28. Art (Subjects) | 8 | Art | Teaching Tools, | Project Based, |
| **Curriculum** | 29. Cycles, Systems (Subjects) | 21 | Teaching interdependence, relations, processes | Water Systems, Grounds, Plants, Exposed | Future Focus, Interdependence, Math, |
| **Curriculum** | 30. Integrated Topics (Subjects) | 44 | Applied to integration of subjects, the integration of sustainability into subjects, the relation of multiple topics | Grounds, Water System, Interdependence, Ethics/Virtues, Cycles/Systems | Problem Solver |
| **Curriculum** | 31. English, Reading (Subjects) | 11 | | Grounds, Windows | |

| | | | | | |
|---|---|---|---|---|---|
| **Curriculum** | 32. Social Studies (Subjects) | 8 | | Integrated Topics | Interdependence, Ethics/Virtues, Sense of Place, Service Learning |
| **Curriculum** | 33. Science (Subjects) | 53 | | Grounds, Garden, Water Systems, Cycles/Systems, Integrated Topics | Sense of Place, Service Learning, Student Directed, Interest/Curiosity, Ownership |
| **Curriculum** | 34. Math (Subjects) | 23 | | Energy, Monitoring Systems | Exposed |
| **Building Attributes** | 36. Economic Savings | 6 | Financial savings related to facility efficiencies | Energy, Water Systems, Operations, Conservation | Ethics/Virtues, Modeling |
| **Building Attributes** | 37. Indoor, Outdoor Connection | 10 | Bringing nature inside, classroom design allows easy access to the outdoors | Health, Windows, Grounds | |
| **Building Attributes** | 38. Quality of Design | 4 | Aesthetics | Energy | Knowledge Base, High Expectations |
| **Building Attributes** | 39. Air Quality | 2 | Natural ventilation, low VOC | No significant Correlation | |
| **Building Attributes** | 40. Energy | 64 | Applied to the word energy. | Monitoring System, Water System, Operations | Project Based, Teaching Tools, Cycles/Systems, Math |
| **Building Attributes** | 41. Place Attributes | 4 | Design features directly related to the "place". Vernacular architecture, materials, etc. | Project Based, Sense of Place, Community Based, Grounds, Water System | Plants, Social Studies, Integrated Topics |
| **Building Attributes** | 42. Recycled Materials | 26 | Repurposed, recycled, reclaimed building materials | Signage, Operations, Conservation | Teaching Tools |
| **Building Attributes** | 43. Automated | 11 | Sensors, automatic controls | Water System, Energy, Conservation | Interest/Curiosity, |
| **Building Attributes** | 44. Grounds (aggregate) | 243 | Campus, surrounding natural areas | Science, Operations, Water System, Science, Project Based, Teaching Tools | Health, Conservation, Community Based, Student Directed, Cycles/Systems, Integrated Topics, Sense of Place, Interest/Curiosity |
| **Building Attributes** | 45. Plants (Grounds) | 100 | Plants, act of planting | Science, Operations, Water System, Cycles/Systems, Student Directed | Interest/Curiosity, Leadership, |

| | | | | | |
|---|---|---|---|---|---|
| **Building Attributes** | 46. Garden (Grounds) | 60 | Applied to word garden | Science, Operations, Water System, Cycles/Systems, Student Directed | Exploration, Interest/Curiosity |
| **Building Attributes** | 47. Water System | 97 | Interior fixtures, cisterns, irrigation | Exposed, Operations, Monitoring Systems, Cycles/Systems, | Automated, Teaching Tools, Student-Directed |
| **Building Attributes** | 48. Windows | 29 | Applied to the word windows. | Exposed, Monitoring Systems, Teaching Tools | Indoor/Outdoor Connection, Daylight |
| **Building Attributes** | 49. Daylight | 10 | Applied to the word daylight. | Health, Conservation, Indoor/Outdoor Connection | Automated, |
| **Building Attributes** | 50. Signage | 42 | Interpretive signage, labels. | Monitoring System, Teaching Tools, Recycled Materials, Grounds | |
| **Building Attributes** | 51. Monitoring Systems | 69 | Energy, water, resource tracking. Touchscreen system. | Energy, Operations, Exposed, Student Directed, Project Based | Interest/Curiosity , Community-Based, Modeling |
| **Building Attributes** | 52. HVAC | 25 | Heating, ventilation, cooling, mechanical systems | Exposed, Water System, Teaching Tools | Awareness, |
| **Building Attributes** | 53. Exposed | 59 | Visible infrastructure, accessible by occupants | Water System, HVAC, Teaching Tools, Operations | Awareness, Cycles/Systems, Exploration |
| **Building Attributes** | 54. Operations (aggregate) | 136 | General facilities operations (controlled by users) | Recycling, Water System, Composting, Project Based, Student Directed, | Pride, Empowerment, Responsibility |
| **Building Attributes** | 55. Composting (operations) | 14 | Composting program | Garden, Project Based, Student Directed | |
| **Building Attributes** | 56. Supplies (operations) | 4 | Paper, resources, general classroom supplies | Recycling, Conservation | |
| **Building Attributes** | 57. Recycling (operations) | 50 | Facility recycling efforts | Student Directed, Art, Conservation | Responsibility, Awareness |
| **Personal Qualities** | 59. Problem-Solver | 7 | Evaluate problems, find solutions, critical thinking | Future Focus, Awareness, Exploration, Empowerment | Integrated Topics |
| **Personal Qualities** | 60. Responsibility | 22 | | Conservation, Respect, Student-Directed, | Operations |
| **Personal Qualities** | 61. Awareness | 36 | Knowledge, understanding | Future Focus, Empowerment, Commitment to Goals, Mission | Community-Based, Pride |
| **Personal Qualities** | 62. Leadership | 13 | Leading efforts, taking on responsibility | Student Directed, Pride, Empowerment | Innovation, |
| **Personal Qualities** | 63. Enthusiasm | 23 | Joy | Commitment to Goals/Mission, Pride | Grounds |
| **Personal Qualities** | 64. Interest, Curiosity | 10 | | Project Based, Teaching Tools, Grounds | Monitoring systems, Exploration |

| | | | | | |
|---|---|---|---|---|---|
| **Personal Qualities** | 65. Ownership | 3 | Pride, plus investment in success | Grounds | Student Directed |
| **Personal Qualities** | 66. Pride | 14 | Feeling proud, unique, special | Enthusiasm, Leadership, Pride, Empowerment | |
| **Personal Qualities** | 67. Empowerment | 15 | Self-direction, advocacy, students leading efforts to change family, community, and personal habits. | Responsibility, Leadership, Pride, Student Directed | Problem Solver |