LEON VILLASMIL, ISABEL, M.F.A. Promoting Environmentally Responsible Behaviors in Public Elementary Schools' Children. (2018)
Directed by Dr. Amanda Gale. 95pp.

Environmental education (EE) has become necessary due to the environmental problems affecting the world. Schools have made efforts to incorporate the content into the curriculum to educate future generations about the environment, with the goal of increasing environmental literacy and the practice of environmentally responsible behaviors (ERBs) (Chapman, 2014; Conde & Sanchez, 2010). Research and design guidelines have been developed to help schools design buildings that enhance health, wellbeing, and environmental literacy. The design strategies proposed thus far have been successful in creating sustainable learning environments, particularly within new construction (United States Green Building Council, 2018; CHPS, 2006). However, existing aging buildings have more constraints when trying to incorporate these strategies, specifically Title I public schools facilities. High-poverty schools do not receive enough funding to improve learning environments and transform the building into a teaching tool for EE.

This research sought to understand the relationship between knowledge and ERBs and explored students' perceptions of the school at one Title I public elementary school. A paper-based questionnaire was used to collect data from 38 fifth-grade students in the exploratory study. The results indicate that students did not have adequate knowledge on the environment, but they did engage in the practice of ERBs. Physical opportunities and visual elements were mentioned as components of the school interior that would encourage ERBs. Considering these findings, low-cost design recommendations were created to be easily implemented in existing buildings that house

Title I schools. The goal is that through the implementation of these design recommendations, schools can increase environmental knowledge and encourage the practice of environmentally responsible behaviors without adding more work for teachers.

PROMOTING ENVIRONMENTALLY RESPONSIBLE BEHAVIORS IN PUBLIC ELEMENTARY SCHOOLS' CHILDREN

by

Isabel Leon Villasmil

A Thesis Submitted to
the Faculty of The Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Master of Fine Arts

Greensboro
2018

Approved by

_____
Committee Chair

APPROVAL PAGE

This thesis written by Isabel Leon Villasmil has been approved by the following committee of the Faculty of The Graduate School at The University of North Carolina at Greensboro.

Committee Chair_____

Committee Members_____

_____

_____
Date of Acceptance by Committee

_____
Date of Final Oral Examination

ACKNOWLEDGEMENTS

First of all, I would like to thank my thesis chair, Dr. Amanda Gale, and committee members Dr. Maruja Torres-Antonini and Tommy Lambeth for all your support and guidance throughout this process. Amanda, thank you for all the positive energy you brought to every meeting, your motivation certainly helped me to complete my thesis. On many occasions you brought me out of my comfort zone, which made me grow professionally. Without you, I think I were still stuck in the first semester. Maru, you always seem to have the right answers and provide excellent guidance. Your experience and knowledge in all areas taught me something new in every class and meetings. Tommy, your approach to life in general inspires anyone who is lucky enough to meet you. I always looked forward to hearing your suggestions to improve my projects and thesis.

I am grateful to the Graduate School and the Department of Interior Architecture for believing in me. The financial support UNCG has provided me has allowed me to achieve my master's degree. Thank you to the director of the program, Jo Leimenstoll, for her help and guidance in every circumstance. To Guilford County Schools and the participant school for allowing me to complete my research, thank you as well.

To my partners in crime, Sofia, Jessica, and Carolina. Thank you for always being there to help me keep my sanity. Last but not least, to my parents, Hernando and Gisela, and my siblings, Hernando and Paola, for being my main support. Thank you for all you have done to help me achieve my dreams, for your encouragement and positive vibes. This would not have been possible without you.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

The built environment – the human-made surroundings where human activities take place – encompasses neighborhoods, transportation systems, and buildings. The built environment can have a positive or negative impact on users' health, satisfaction, productivity, and learning outcomes. In the learning context, the built environment serves as a setting where teaching and learning take place. Therefore, the form and the state of these educational buildings are factors that may influence the practice of education (Cooper, 1985). Design professionals could intervene in these spaces to create active environments that teach, helping students to learn through the design of the physical place.

Education is one of the most crucial factors in achieving sustainability (United Nations Educational, Scientific and Cultural Organization [UNESCO], 1997) and the school environment is considered the most important place to promote sustainable practices through the participation of students in whole-school approaches (Henderson & Tilbury, 2004). In addition to the built environment, individual role models, school governance, and school culture have all been found to increase sustainable actions in schools (Higgs & McMillan, 2006; Schelly, Cross, Franzen, Hall, & Reeve, 2012). Therefore, by exposing students daily to a sustainable environment, we may be able to positively impact students' actions and knowledge.

The idea of implementing whole-school approaches is to teach students about sustainability not only through the formal curriculum but also to reflect sustainability in

daily practice through the non-formal curriculum (Shallcross & Robinson, 2007). While students are in class, they learn knowledge transmitted by teachers, but they also learn informally, by exploring the environment around them. The whole-school sustainability framework proposes a constructivist approach, which supports experiential learning and promotes the idea of acquiring knowledge through the interaction with the environment (Barr, Leigh, & Dunbar 2011). In the framework, the school's built and natural environment provide diverse opportunities for students to learn about sustainability, science, technology, and conservation (Barr, et al., 2011; Barr, Cross, & Dunbar, 2014).

Recently, new buildings have been designed to educate the future generation of environmental stewards. During the last decade, there has been significant engagement with environmental education (EE), education for sustainable development (ESD), and strategies to teach students about sustainability through the design of the built environment. Green schools (Heming, 2017), teaching green buildings (Cole, 2014), schools as 3-D textbooks (Taylor & Enggass, 2009), and schools as a third teacher (Cannon Design, VS Furniture, & Bruce Mau Design, 2010), are a few of terms used to describe a building that serves as a teaching tool for EE.

No matter the term used, each one refers to a building that aides in teaching through sustainable features, such as providing indoor-outdoor connections and reducing environmental impacts through the conservation of resources in the design, construction, and operation of the building. Typically, these new buildings are designed following guidelines that sustainability rating systems propose, that not only look at the impact that the building will have on the environment over the life-cycle, but also the impact it will have on users (Olson & Kellum, 2003).

Resources and design guidelines have been developed specifically for schools, such as the Collaborative for High-Performance School (CHPS) and the Center for Green Schools. The latter measures the effectiveness of the whole-school sustainability framework through three pillars of the school: reduced environmental impact, increased health and wellbeing, and the ability to increase environmental and sustainability literacy for all students (Heming, 2017). The implementation of these design guidelines results in a building that is sustainable and enhances users' wellbeing. In addition, research has shown that these buildings can improve students' performance, reduce absenteeism, and increase property values (Filardo, 2016).

Unfortunately, there are a great number of students who do not have the privilege to attend a high-quality school facility, including students who attend Title I public schools. In the U.S., there are more than 100,000 public elementary and secondary schools in roughly 14,000 districts, serving nearly 50 million students. One-sixth of the U.S. population spends their childhood (i.e., kindergarten through twelfth-grade) within public schools' facilities (Filardo, 2016), therefore, these spaces may have a great impact on children's health and performance.

Title I public schools, which are considered high-poverty schools (Schanzenbach, Boddy, Mumford, & Nantz, 2016), do not receive enough federal funding to improve the academic achievement of children (Weinstein, Stiefel, Schwartz, & Chalico, 2009). Clearly, Title I public schools are at a disadvantage when compared with high-performance schools that are designed to foster a healthy, safe, and supportive learning environment.

Unfortunately, the budget for Title I elementary and middle schools is not as large as non-Title I eligible schools (Weinstein, et al., 2009). In fact, states with higher

percentages of low-income students actually receive less Title I funding per student, which mostly affects southern states, see Figure 1 (Schanzenbach, et al., 2016). Therefore, the funds that these Title I schools receive may not be enough to provide the services necessary to improve students' performance and test scores (Weinstein, et al., 2009) to successfully prepare children for the future. From these findings, we could say that Title I public schools do not have the tools necessary to prepare children for a sustainable future.

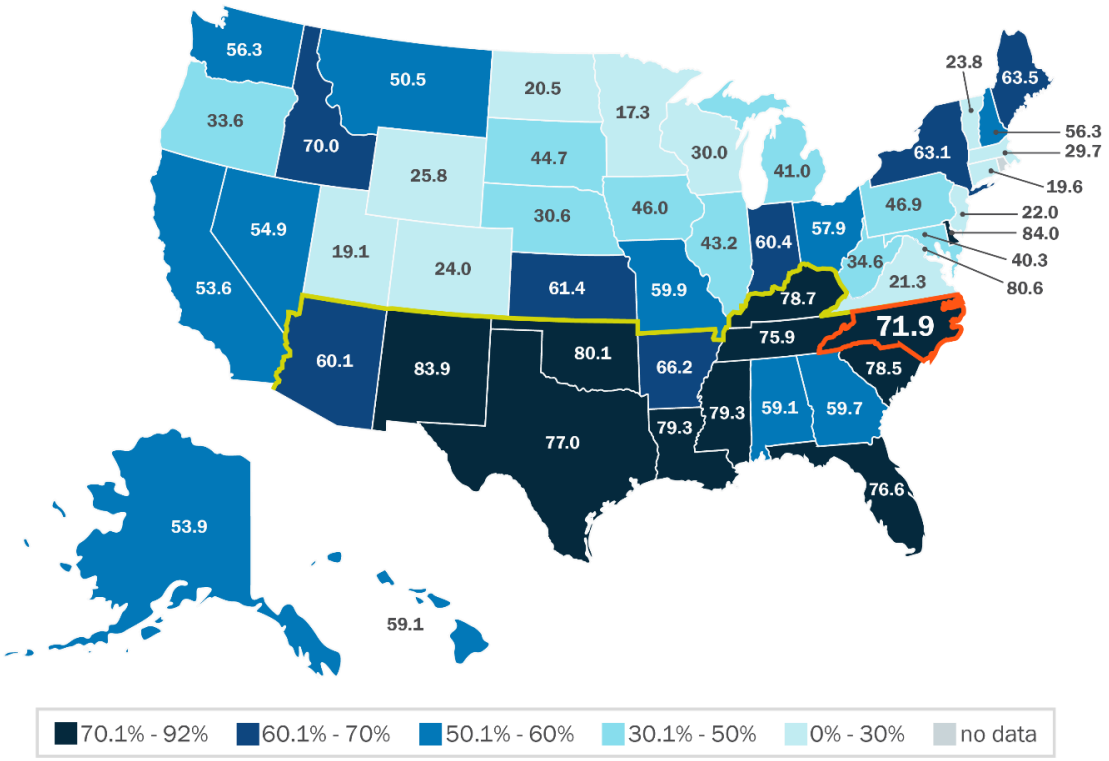

Figure 1. Public Schools' Students Attending High-Poverty Schools, 2013-2014. Adapted from Schanzenbach, et al. (2016, p. 10)

In the U.S., public schools have tried to incorporate EE and sustainability. This has become important due to the complex environmental issues that our planet confronts. However, public schools must overcome many obstacles when trying

to incorporate environmental education and sustainability practices. These obstacles are, mainly due to lack of resources, funding initiatives, and limited time to devote to the effort (Day 2009; Chapman, 2014).

In addition, the strategies and design guidelines that have been proposed thus far are mostly feasible for new construction and are not viable for implementation in existing buildings with low budgets. Of the public schools in the U.S. that have implemented green strategies, just a few of them have adopted a holistic Teaching Green Building concept, partially due to costs (Cole, 2015). This demonstrates the importance of low-cost, easily implemented, and feasible design recommendations that enhance educational efforts of sustainability. In addition, a report by the United Nations Educational, Scientific and Cultural Organization (UNESCO) (2008) notes the importance of starting education for sustainable development (ESD) very early in children's lives to create a foundation for lifelong learning. This is important because during this age, basic values, attitudes, skills, behaviors, and habits are developed and are therefore more likely to become long-lasting.

Therefore, this research studied environmental knowledge and the practice of environmentally responsible behaviors (ERBs) in a public elementary school to determine whether a relationship existed between these two variables. Knowledge of environmental issues has been associated with responsible environmental behavior in adults, which means that knowledge is a prerequisite to taking environmental action (Hines, Hungerford, & Tomera, 1987). However, there is no significant research that has determined whether environmental knowledge is a variable that influences children's environmental behaviors.

Knowledge is not the only factor that may influence ERBs. Cole (2015) indicates that the educational context of the school highly influences ERBs in students. In fact, students' satisfaction with the school's environmental conditions, which refers to physical conditions of the school building such as lighting, supportive environment, (i.e., the support from teachers and peers) and environmental education, (i.e., the school's curriculum) are all significant predictors of ERBs at school.

The present study focused on environmental knowledge and the school's physical environment. The objective of this research was to explore students' environmental knowledge, perceptions, and the practice of ERBs at one elementary school. The exploratory research investigated the relationship between environmental knowledge and actions. Then, the research explored students' perceptions of the school's features, which could be used in future research and the design field.

For this purpose, the following research questions were developed:

1. What is the relationship between students' environmental knowledge and environmentally responsible behaviors?
2. What are the students' perceptions of the school building features that would enhance their environmentally responsible behavior intentions?

This research begins to contribute to our understanding of the influence of the physical environment on students and ERBs. This research could be beneficial in improving school design, especially for existing public educational facilities to incorporate design strategies that could be easily and inexpensively implemented to create learning environments where environmental education takes place. The goal of this study is to increase students' environmental knowledge and the practice of ERBs at school.

CHAPTER II

LITERATURE REVIEW

This chapter is divided into three sections. The first section discusses pedagogical approaches to teaching about sustainability. The second section explains whole-school approaches and their incorporation into schools to develop EE and ESD. This section also reviews the three main components of the whole-school sustainability framework: organizational culture, educational program, and the physical place. The third section focuses on the study of knowledge as a predeterminant of environmentally responsible behaviors (ERBs) and age of the child as an important factor to be considered when trying to influence ERBs in children.

Pedagogy

Since the 1970s, there has been a movement to change education to incorporate sustainability into the curriculum. International documents and commitments, such as the Tbilisi Declaration15, Agenda 2116, the Dakar Framework for Action17, and Local Agenda 21, have advocated for educational reform to reflect the sustainability agenda. As a result, different programs emerged in the United Kingdom (U.K.), North America and Europe such as U.K.'s "Learning through Landscapes" (LtL), Canada's "Evergreen", and Environment and Schools Initiative's (ENSI) "Learnscapes" in Europe (Henderson & Tilbury, 2004).

These programs were successful because they focused on applying sustainable principles to schools and "greening" grounds as a mean to enhance educational and environmental interactions (Henderson & Tilbury, 2004). Thereby enhancing the physical

place through the incorporation of sustainability to teach students about the environment while providing hands-on experiences.

Education for sustainable development

Education for sustainable development (ESD) helps students develop the skills, knowledge, and experiences necessary to contribute to building an environmentally responsible society ("Education for sustainable development", 2017). This concept goes beyond teaching knowledge by promoting a holistic and interdisciplinary approach to change behaviors.

ESD embraces all aspects of education including planning, policy development, program implementation, finance, curricula, teaching, learning, assessment, and administration with the goal of creating a sustainable society (UNESCO, 2012). ESD not only increases environmental knowledge but may also influence students to adopt EBRs since they will have a better understanding of the impact their actions have on the environment.

Environmental education

Different than ESD, environmental education (EE) refers to the process through which people explore and understand environmental issues, engage in problem-solving, develop the knowledge, awareness, and skills necessary to act to improve the environment (“What is Environmental Education?”, 2017). Even though this definition is similar to ESD, EE is more focused on the environment while ESD has a broader focus, which includes the society and economy, conforming to what we know as the triple bottom line. The ESD view includes more complex issues such as climate change, poverty reduction, sustainable consumption, and disaster risk reduction. However,

despite the differences, both terms have the same vision: to achieve a better world through education.

In terms of pedagogical emphasis, EE and ESD share some characteristics. Both terms emphasize a curriculum that integrates formal and informal education, interdisciplinary, problem solving, and critical thinking (Pavlova, 2013), see Figure 2. As explained before, the main goal of EE is to increase people's understanding of environmental issues and encourage people to take ERBs. Therefore, it would be ideal to implement EE in schools since children will have social, economic, and environmental challenges to overcome in the next decades, more difficult than the problems we are facing today as a society.

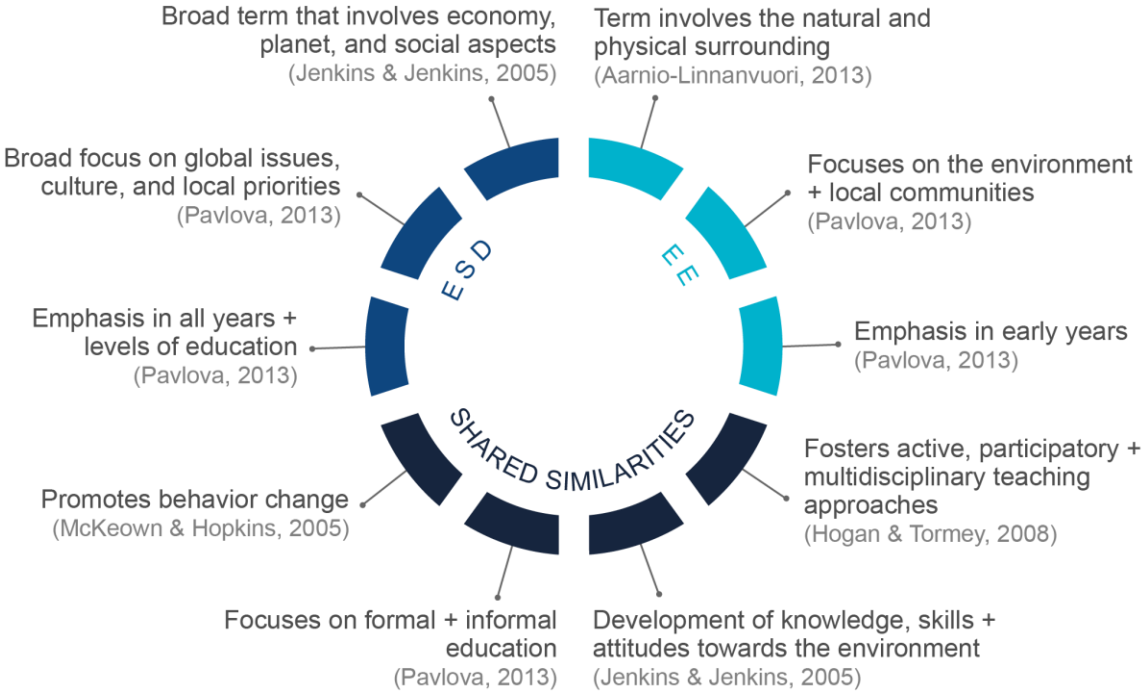

Figure 2. EE and ESD – Differences and Similarities

Whole-school Approaches

A whole-school approach (or framework) to environmental education integrates all aspects of the school, including curriculum, resource management, extracurricular activities, school operations, and relationships with the community, with the aim of creating a safe and sustainable school (UNESCO, 2016). Education has been recognized as the foundation to address the critical environmental challenges that we currently face. Therefore, school is considered the most important place to promote sustainable practices through the participation of students in whole-school approaches. Traditional approaches to environmental education sought to teach students about the environment and learn values to protect it, however, research demonstrates that these traditional approaches are not enough to build a sustainable future (Henderson & Tilbury, 2004).

Recently, whole-school programs have been recognized as the most promising way to develop EE and ESD. In the last decade, whole-school programs have evolved and adopted a holistic focus to integrate curriculum, pedagogy, governance, resource management and grounds, including the relationship between the school and the community. However, each whole-school program is different, focusing on school improvement or development and is customized to the school's unique characteristics and needs.

Henderson and Tilbury (2004) conducted a study in which they assessed different international whole-school programs, including "Enviroschools" in New Zealand, "Green School Award" winners in Sweden, "Green Schools" in China, and the international programs of Foundation for Environmental Education (FEE) "Eco-schools" in Europe and South Africa, and ENSI "Eco-schools" in Europe and Australia.

Henderson and Tillbury (2004), reviewed secondary data from websites, journals, theses, evaluations, national policies, frameworks, guidelines, and curriculum materials, to identify factors that allow the successful implementation of sustainability. They identified eight factors: leadership and participation, partnerships, learning approaches to encourage students develop skills and critical thinking, integration of EE in the curriculum, professional development for teachers and staff, “greening” school grounds and facilities, reduction of the school’s footprint, research, and regular water, energy, and waste audits.

Similarly, Higgs and McMillan (2006) conducted research on four secondary schools that were considered leaders in sustainability education through observations, interviews, and document reviews. The authors concluded that, in this case, the schools were successful because they modeled sustainability through individual role models, governance, school culture, and school facilities and operations.

Based on Henderson and Tilbury’s (2004) report and Higgs and McMillan’s (2006) findings, Barr et al., (2011) conducted a study in five Leadership in Energy and Environmental Design (LEED) certified schools built between 2005 and 2010. The findings from this study were used to develop the whole-school sustainability framework (Barr, et al., 2014). The whole-school sustainability framework refers to the relationship that should exist among the school’s governance, culture, curriculum, physical environment, and adult role models to effectively transmit sustainability messages and values to students.

These aspects should reflect the values and attributes of the school organization making each school’s process unique. The authors also state that the absence of one of these aspects is possible but may weaken the communication of sustainability to

students (Barr et al., 2011). The framework is organized into the three main components of the school: organizational culture, educational program, and the physical place (Figure 3).

Figure 3. Whole-School Sustainability Framework. Adapted from Barr, et al. (2014, p.2)

In addition, Schelly, et al., (2012) conducted focus groups, interviews, observations, and document reviews, to investigate how energy conservation efforts contributed to both sustainability education and the adoption of ERBs within a high school. This case study was conducted in Rocky Mountain, a public high school, located in Fort Collins, Colorado. The findings demonstrate that ERBs and conservation efforts

can be modeled through the four primary means already proposed by Higgs and McMillan (2006). However, the authors suggest a fifth component: communication. This research found that both, school culture and the built environment serve as educational tools for EE, reinforcing the important role that the built environment plays in teaching EE.

Organizational culture

One of the three main components of the whole-school sustainability framework is organizational culture, which refers to the values, social norms and practices within the school organization (Barr et al., 2014). To better understand this component of the framework, Schein (1984) defines organizational culture as the pattern of assumptions that a group of people has established as the correct way to think, feel, and perceive.

Schein (1984) identifies three levels within the organizational culture: artifacts and behaviors, espoused values, and basic assumptions. Artifacts and behaviors refer to the constructed environment of the organization, what is visible and tangible. This level includes architecture, furniture, technology, office layout, dress code, and behavior patterns. Thus, the physical environment is a visible and tangible representation of the culture of the organization. The second level is espoused values, which refers to standards, norms, strategies, objectives, and philosophies within the organization. The last level, basic assumptions, are deeply embedded in the organization and are usually unconscious. This last level defines the way individuals perceive, feel, and think.

The mission and vision of the school are also aspects of the organizational culture. The vision is “what grounds an organization and allows it to gain momentum and collectively move in the same direction... An inspiring vision for the future can engage a community of people and provide a sense of purpose” (Barr et al., 2014, p. 5).

Therefore, a thoughtful vision statement should be created by the leaders of the organization that reflects the educational mission, values, priorities, and culture. The vision should be easy to understand to engage students and stakeholders and should be focused on a sustainable future.

Educational program

The educational program is the second main component of the whole-school sustainability framework. This aspect is a representation of the school vision and mission. The educational program includes curriculum, role models, and place-based connections. Schools transmit sustainable principles such as social justice, systems thinking, local and global citizenship, and respect to students through the curriculum (Barr et al., 2014).

Research on schools that holistically promote sustainability through the school organization demonstrates that schools are guided by principles of constructivism, project-based learning, exploration and weave sustainability into the curriculum by integrating faculty collaboration (Barr et al., 2011). By applying these principles, faculty promotes student engagement, allowing students to participate in activities related to school operations; such as leading building tours, managing recycling and composting programs, tracking energy use, and taking care of the school garden (Barr et al., 2014). The whole-school sustainability framework also suggests a curriculum that integrates formal and informal learning to allow students to interact with the built environment using hands-on experience and exploration.

Individual role models - or “charismatic champions” - are also part of the school educational program (Barr et al., 2014). Individual role models refer to any person in the school that influences, inspires, or motivates students. Schelly et al. (2012) identified

principals, teachers, and other students as role models in the school that can inspire and lead to behavioral change. Higgs and McMillan (2006) suggest that students are more likely to imitate a role model who is warm and affectionate. In addition, a close student-faculty relationship improves sustainability role modeling. Cole (2015) determined that ERBs at school are largely predicted by social and physical factors of the school, including teachers, peers, and facility opportunities. These studies highlight the important role that teachers play in facilitating ERBs, as they are an influential role model for children.

School governance is another aspect of the educational program. It refers to the administration and decision-making within a school and the way this process is accomplished. Kensler and Uline (2016) explain that every decision, even those that do not seem relevant, should adopt an ethical importance. “The chemicals used to clean the tables and floors influences your students’ health via indoor air quality and impacts the watershed in which the school sits… The food you serve has many student and environmental health implications” (p. 39). Children learn from what they see, therefore, each decision that schools make influences students’ learning, but also can have an impact on their health.

The whole-school sustainability framework recommends that school leaders make decisions based on their core values and the best interests of students. In addition, stakeholders such as teachers, custodians, and students should be involved in the decision-making process. Research has shown the importance of students’ participation in school leadership and governance. Involving students in the decision-making process serves as an incentive to promote environmental awareness,

responsibility, and to empower students by making them feel that their decisions have an impact, either positive or negative (Schelly et al., 2012).

Barr et al. (2014) also indicate connection to place as part of the educational program. The school serves as a hub where students and the community participate in different projects and learn together. Place-based connections refers not only to the built and natural environment but also to the history and culture of the surrounding community. The whole-school sustainability framework encourages the connection between students and the community to strengthen or establish relationships that helps students understand issues at the local level. Global issues may seem difficult to solve and students may feel overwhelmed and that their efforts will not make a significant impact. Therefore, encouraging students to participate in activities within a smaller scope such as in the school and the community, may help them develop a sense of efficacy where they realize their efforts make a positive impact (Barr et al., 2014).

The physical place

The physical place, or the built environment, is the third main component of the whole-school sustainability framework. The physical place has been studied as the context where ERBs occur – encouraging or discouraging people to act. Roof and Oleru (2008) define the built environment as “the human-made space in which people live, work, and recreate on a day-to-day basis. It includes the buildings and spaces we create or modify” (p. 24). Architecture is a discipline within the design field in charge of the creation of the buildings where human activities take place. The interior of these buildings also influences human behavior, through both mental and physical stimuli. Therefore, the relationship established between the physical environment and human behavior is interwoven (Moneim, 2005).

Research in environmental psychology has studied the connection between place and ERBs. Most of the studies have identified a relationship between sense of place or place attachment, ERBs, and intentions (Halpenny, 2010; Ramkissoon & Mavondo, 2014; Scannell & Gifford, 2010). Place attachment can be defined as the emotional, cognitive, and functional bond between the individual and the place, and it is believed that an individual's connection to place, or the lack of it, influences the willingness to protect it (Scannell & Gifford, 2010).

A positive attachment to a particular place, especially a nature-based setting, may be strongly linked to an individual's performance of ERBs (Halpenny, 2010; Scannell & Gifford, 2010). Therefore, it could be concluded that an individual is more likely to present ERBs in a place to which a connection has been established. In addition, Kudryavtsev, Stedman, and Krasny (2012) conducted an extensive literature review of the components of sense of place, including place attachment and place meanings. Based on their findings, they propose that environmental education can influence sense of place through the combination of experiential learning and traditional instruction.

The experiential approach suggests that an individual develops a sense of place through active interaction with the place (Kudryavtsev, et al., 2012). Environmental education could foster a sense of place through long-term and frequent experiences, including activities that require spending time in outdoors exploring the place without requiring formal instruction. The instructional approach encourages the development of a sense of place conveyed by instructors through discussions, books, art, and other indirect means. The authors explain that most of the educational programs have incorporated a combined approach to promote a sense of place and environmental

education, allowing students to gain direct experiences both through the interaction with the place and through discussions and instruction (Kudryavtsev, et al., 2012).

Sense of place highlights the importance of the design of the physical place. A design that encourages students to explore the built and natural environment and that enables teachers to use the physical place to teach environmental education. The design of the built environment can foster the development of sense of place, and hopefully, will help students to develop the sense of caring of their school and take environmentally responsible actions.

The physical place not only influences human behavior, it also can be designed to teach the user. The physical place can provide a context for learning and provide an observable representation of school values (Barr, et al., 2014). According to Higgs and McMillan (2006), school facilities and operations can serve as powerful tools to teach students about sustainability. Orr (1993) suggests that “buildings have their own hidden curriculum that teaches as effectively as any course” (p. 226) and are capable of encouraging students’ participation to acquire knowledge, discipline, and useful skills that cannot be acquired other than by doing.

Cole (2014) explains that buildings that serve as a teaching tool have physical features that can be engaged and used by students and teachers. Physical features in buildings can include vegetable gardens, chicken coops, compost piles, and energy system motoring. These physical features have been effectively used in schools to promote hands-on experience (informal learning) to teach students about sustainability.

Cole (2013) conducted research in five schools using a survey to investigate middle school students’ green building knowledge and ERBs using photo-elicitation to determine where, in the school, students learn about sustainability. Three of these

schools were Teaching Green Buildings (TGBs), and LEED certified buildings, while the two other schools were conventional buildings. The results suggest that the built environment can improve students' green building knowledge and ERBs while they are in the building. The research also indicated that it is not necessary to have a new building to enhance green building knowledge. Small improvements and interventions to the school facility could be effective to teach students.

Cole (2013) indicates four major considerations of the physical place in learning environments (Figure 4). The author explains that the environment should be supportive to encourage behavior change, providing opportunities for the user to take environmental actions such as the presence of recycling bins. However, a supportive environment also refers to how the person perceives the environment and what they think they can do (Cole, 2013). This concept could be linked to what Ajzen (1991) defines as perceived behavioral control, which refers to how easy or difficult it is to perform a behavior in a particular place, according to the individual's perspective. Therefore, the elements in the space that would facilitate the performance of a behavior should be accessible and visible to the user and without barriers that impede them to take actions.

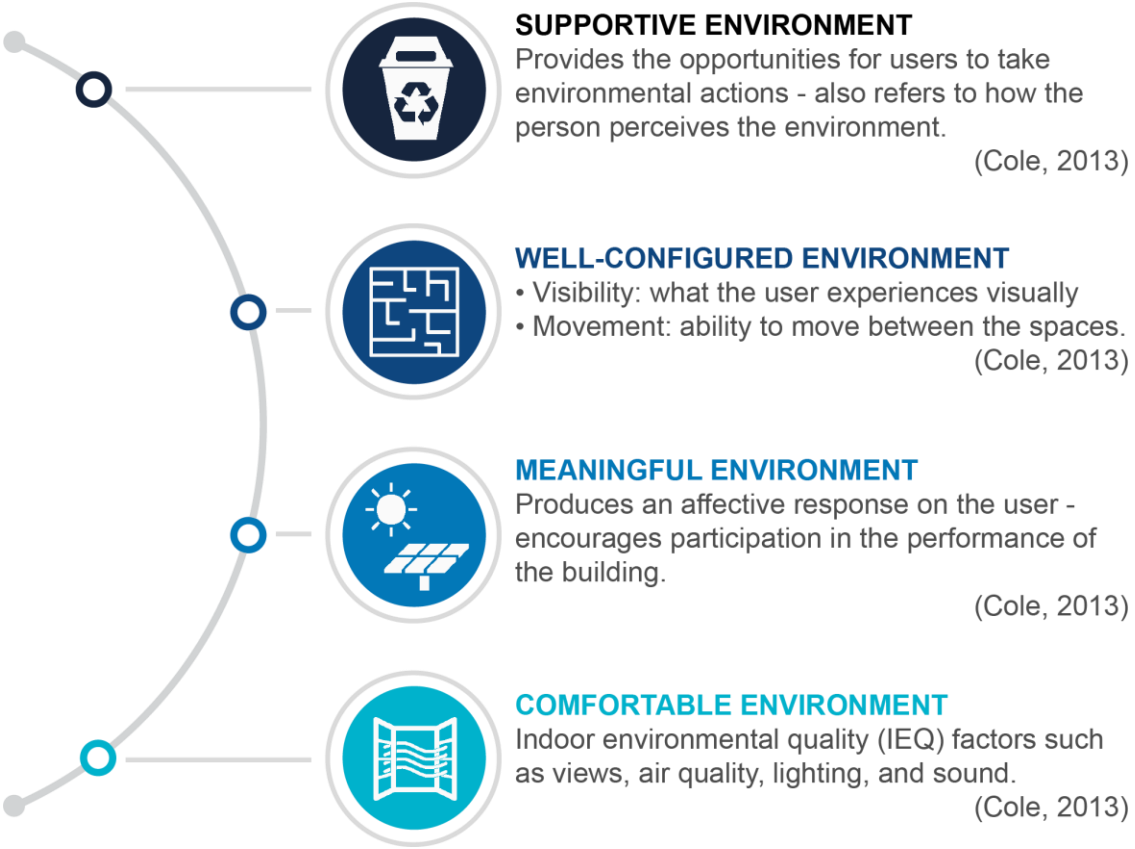

Figure 4. Considerations of the Physical Place in Learning Environments

The interior spatial configuration is another aspect that influences students' behavior in schools. Cole (2013) explains that a well-configured environment considers two major spatial factors: visibility and movement. Visibility refers to what the user can observe while they move through the building; this includes people, objects, and scenes. Movement refers to the ability of the user to move between the spaces in the layout.

Cole (2013) explains that a well-configured environment could increase the likelihood that an individual perceives opportunities in the environment to exhibit ERBs. Both visibility and movement-based accessibility are determinants of whether and how often an individual interacts with green building features like signage and displays. In addition, the author explains that it is important to take into account the distance an

individual needs to travel to arrive at the green building features (Cole, 2013). For example, multiple recycling bins near the spaces where students will be, are more likely to be used than a single and distant recycling bin.

Seibold-Bultmann (2007) proposes the use of visible and tangible elements of sustainability that are attractive and simple enough to hold the attention of the user. Based on Seibold-Bultmann's idea, Cole (2013) explains that to create a meaningful environment, it is important to consider these physical manifestations that are educational but also serve as inspiration for the users. The use of aesthetic choices such as materials, colors, shapes, and scale communicate sustainability messages to the user. Usually, these design choices reflect nature. Cole (2013) also suggests the importance of creating a meaningful environment that produces an affective response on the user and encourages them to participate in the performance of the building.

In addition, the whole-school sustainability framework proposes an engaging and active design that sparks curiosity in students and that teachers can use as a tool. To this end, the building should be multi-sensory, accessible, and attractive. Students should be able to interact with the building; see and touch the elements and components that make the building sustainable. Likewise, the whole-school sustainability framework proposes that students should take responsibility for the efficiency and maintenance of the school building (Barr et al., 2014) reinforcing the need for experiential learning.

Higgs and McMillan (2006) explain that students can contribute to the efforts to keep the school and its systems functioning. Students and teachers can participate by collecting trash, recycling, composting, cooking meals, and taking care of animals. Furthermore, the authors explain that making the school transparent is essential. Economic, ecological, and social impacts of the school operations should be shared with

the occupants; thus, students are interested in reducing the negative impacts of the school. Higgs and McMillan's study (2006) found that student involvement in school operations engaged students in the discussion while providing the opportunity for them to adopt ERBs.

Finally, a comfortable environment is the last aspect of the physical place. Cole (2013) explains that a comfortable environment provides opportunities for mental restoration and decreases distractions that can affect learning. To this end, indoor environmental quality (IEQ) variables should be considered, such as temperature, air circulation, natural light, lighting levels, and views. These variables are important to take into consideration since they are known to impact students' health and learning outcomes. Research has found that healthy learning environments reduce rates of absenteeism and improve performance, learning, test scores, students' health, and wellbeing (Baker & Bernstein, 2012). IEQ variables have demonstrated to be highly important to create the best school environment for students.

Issa, Rankin, Attalla, and Christian (2011) surveyed staff, teachers, and students in three green schools in Toronto, Canada to determine their satisfaction with IEQ variables such as indoor air quality, lighting, thermal comfort, and acoustics. The findings showed that students, teachers, and staff absenteeism rates were reduced, and students' performance improved by 8–19%, compared with conventional school buildings. IEQ variables are easier to control within a new school building. Unfortunately, existing buildings struggle to enhance these variables.

This section of the literature review demonstrates the influence that the built environment has on users, influencing learning, behaviors, and even health. Hence the importance of the consideration of the physical place as a teaching tool for

environmental education and the context where learning and ERBs occur. However, other variables should be studied to create a building that effectively teaches students about sustainability, such as the relationship between knowledge and behaviors within the school as well as students' age.

Knowledge and ERBs

Explaining human behavior is a difficult task. The Theory of Planned Behavior (TPB) was developed by Ajzen (1991) to predict and explain human behaviors. This theory suggests that the occurrence of a behavior is determined by behavioral intention; the intention an individual has to perform a particular behavior. Ajzen (1991) explains that, in general, the stronger the intention of the individual to engage in a behavior, the greater the probability to perform the behavior. However, in some cases, the performance will depend on the opportunities and resources available. In short, if the individual has the intention to perform the behavior, and the opportunities or resources are provided, the person will succeed in doing it.

According to the TPB, intentions and actions can be predicted by three determinants: attitudes (personal), subjective norms (social) and perceived behavioral control (self-efficacy) (Figure 5). Attitude refers to the individual's feelings of the behavior, which is the positive or negative disposition a person has toward performing a behavior. The subjective norm is defined as the social pressure to perform or not perform the behavior. Perceived behavioral control, is defined as the perceived ease or difficulty of performing the behavior. Therefore, people will perform a behavior when they determine it is positive, when they feel social pressure to perform it, or when they believe that they have the opportunities to do so (Ajzen, 2005).

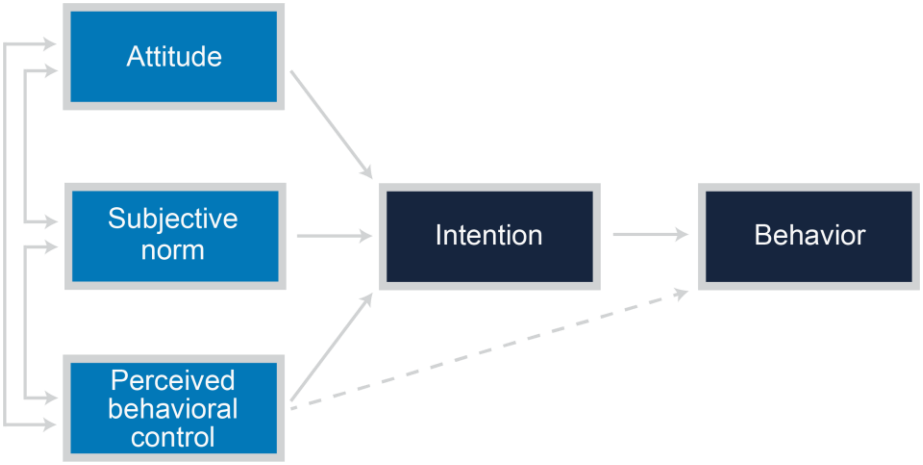

Figure 5. Theory of Planned Behavior. Adapted from Ajzen (2005 p.118)

The TPB suggests that perceived behavioral control, along with behavioral intention, can be used directly to predict behaviors and actions. Ajzen (1991) explains that these two variables are positively correlated. Behavioral intention showed to be the most influential toward actions. In addition, Ajzen (1991) explains that perceived behavioral control will not influence the individual if the person has little information about the behavior and how to perform it. Therefore, if the physical environment does not offer the required opportunities for people to take environmental action, this may decrease the likelihood that people perform a particular behavior. The same will occur if the person does not know how to perform a given behavior (i.e., recycling), therefore, education is important.

Over the years, different variables have been investigated as determinants of ERBs, (Hines, et al., 1987; McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995). Hines, et al, (1987) conducted a meta-analysis of 128 studies to identify variables associated with ERBs and the relationship between each variable and ERBs. The analysis identified six variables associated with ERBs: knowledge of issues, knowledge

of action strategies, attitudes, the locus of control, verbal commitment, and an individual's sense of responsibility (Figure 6).

However, more recent studies dispute this position. McKenzie-Mohr (2011) states that the relationship between knowledge and behavior is often weak. The author indicates that increasing knowledge on environmental issues and educating the public is not enough to lead to behavior change. McKenzie-Mohr (2011) argues that information by itself will not have any effect on behavior change, but the lack of knowledge could be considered a barrier to engage in the practice of behaviors.

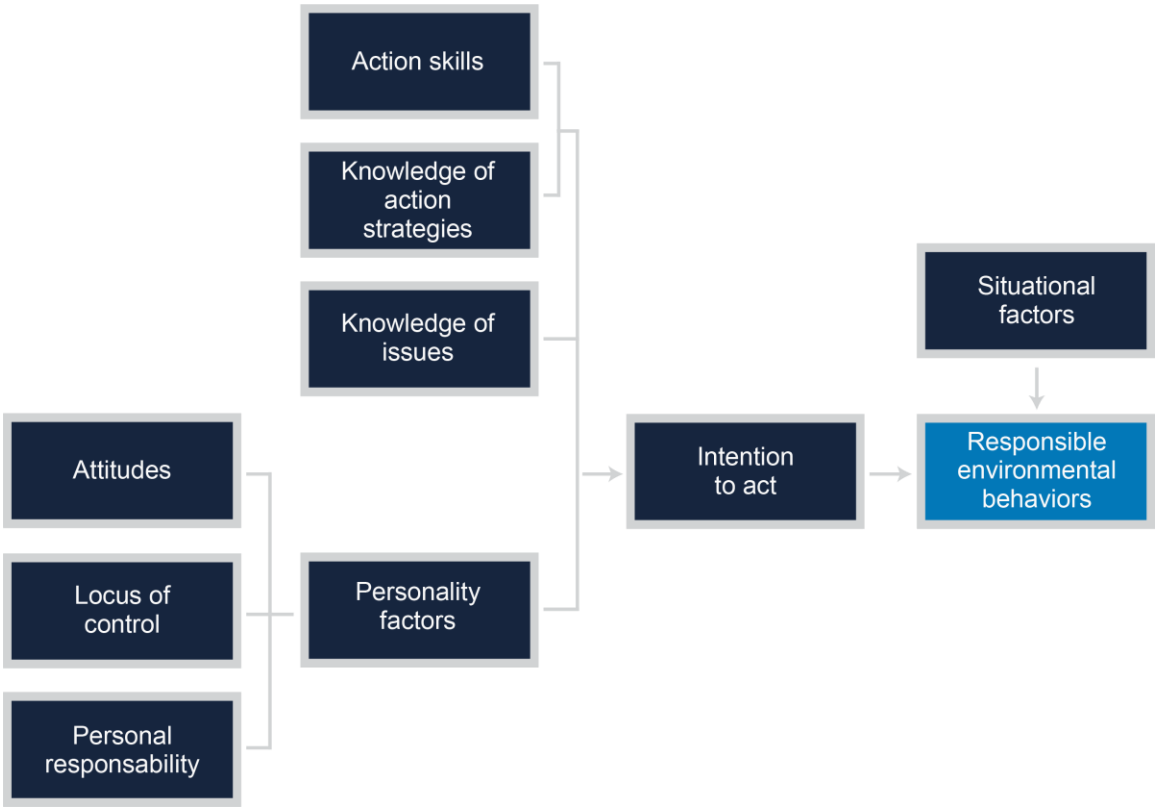

Figure 6. Model of Responsible Environmental Behavior. Adapted from Hines, et al. (1987, p. 7)

Hines et al. (1987) also indicate that those individuals with a positive attitude towards the environment were more likely to engage in ERBs than those with less positive attitude. Also, the analysis demonstrates that there is a slightly stronger relationship between attitudes towards environmental actions than attitudes towards the environment and ecology in general (Hines et al., 1987). Supporting Ajzen's theory (1991), Hines et al. (1987) determined that those individuals that express the intention to perform an environmentally responsible behavior are more likely to engage in the behavior than those who do not express the intention.

Through narrative synthesis, Hines et al. (1987) determined that some classrooms strategies can be successful in influencing students to adopt ERBs. Among them, discussions of solutions to environmental issues, increasing students' knowledge about environmental issues, development of action-taking skills, and problem-solving skills. However, short-term exposure to these factors was found to not be successful in the development of ERBs.

The studies previously explained suggest that having the knowledge and skills, are necessary to engage in ERBs. Therefore, schools would be the ideal place to shape these skills and teach students about environmental issues and the impact their actions have on the environment. School is the place where most education takes place and it is necessary to prioritize the development of knowledge and skills linked to the 21st-century needs.

Age

The meta-analysis developed by Hines et al. (1987) determined that there is a tenuous relationship between a subject's age and their ERBs. The results indicate that younger individuals are slightly more likely to engage in the practice of ERBs than older

individuals. However, a meta-analysis developed by Wiernik, Ones, and Dilchert (2013) resulted in conflicting findings. Wiernik et al. (2013) studied the relationship between age and other variables such as environmental concern, values, attitudes toward environmental behaviors, environmental awareness, environmental knowledge, environmental motives, environmental intentions, and ERBs. The authors included studies between 1970 and 2010 to determine the relationship between age and the variables previously mentioned. This meta-analysis found that there was no relationship between age and environmentally responsible attitudes nor intentions. However, the findings determined that older individuals are more likely to engage with nature, reduce environmental harm, and conserve materials and natural resources than younger individuals.

Little attention has been paid to the relationship between children's age and the practice of ERBs in school. Krettenauer (2017) studied adolescents' pro-environmental behaviors and moral judgments. The research included adolescents attending sixth-grade through second-year undergraduate university students. The research found that as children's age increases, the practice of ERBs decreases as well as their emotional affection with nature. The reason for this is unknown but could be due to social media, pop culture, and the entertainment industry that adolescents start to experience while they grow up.

Wells and Lekies (2006) interviewed around 2,000 adults living in urban areas in the U.S. to learn about their experiences with nature during childhood and their current adult attitudes and behaviors towards the environment. The authors determined that exposure to nature during childhood had a positive impact on adult environmental attitudes. Similarly, the United Nations Educational, Scientific, and Cultural Organization

(UNESCO) also manifests that environmental education should be introduced very early in childhood because during this age, children develop basic values, attitudes, and behaviors that are likely to be long-lasting (UNESCO, 2008). But, when is the ideal age to teach students about sustainability and to encourage them to adopt ERBs?

In research about preschool children's understanding of ERBs, the results revealed that children between 5 and 6 years old possess a low initial understanding of the ERBs they regularly practice (Kos, Jerman, Anžlovar, & Torkar, 2016). They do not understand how their behaviors impact the environment or the relationship actions-impact. The results demonstrate that children perform ERBs due to social norms. However, some behaviors that require a greater measurement of abstract reasoning, such as turning off the lights, are more difficult to be adopted for children between 5 and 6 years old.

Middle childhood (9 to 11 years old) is a period of growth where children start to develop competencies and interests in different areas. During this stage, children are in a period of cognitive development where they become more logical thinkers. Children at this stage become better learners and new knowledge is processed more easily. During middle childhood, children use knowledge to take actions and they also spend more time in schools with teachers and less time under the supervision of parents at home (Eccles, 1999). In addition, during this age the thinking process is more logical and flexible than early ages and develop the ability to reason, remember, repeat, reorganize, relate, and reflect (Middle Childhood Development, n.d.).

Furthermore, research by Lieflander and Bogner (2014) suggests that environmental education could enhance the practice of ERBs. However, the authors found this to be more effective in younger children than older. The information presented

here demonstrates the importance to introduce environmental education as young as possible for the most impact in their future decisions, taking into account that childhood experiences, knowledge, and education are some of the most important factors that influence students to adopt ERBs (Gifford & Nilsson, 2014).

Summary

Children who attend elementary school, spend an average of 940 hours per year within the school (Chalabi, 2014). The school environment serves as a context where students learn but also where students develop social and cognitive skills and create experiences that are shaped by their surroundings. At school, they interact with their peers, staff, teachers, and principals that act as role models, and also with the built and natural environment. Considering the influence that the physical environment has demonstrated to have on users, and the time students spend in the school building, designers should consider design strategies that can be implemented in schools to transmit sustainable messages and encourage the practice of ERBs. There are resources and design guidelines to design and build healthy educational buildings, however, more effort should be devoted to expanding them with low-cost recommendations that existing schools can implement to promote sustainability and environmental education.

CHAPTER III

METHODOLOGY

This exploratory study sought to gather preliminary data that could serve as basis for future research. This predictive correlational study investigated the relationship between the variables, in this case, knowledge and environmentally responsible behaviors (ERBs). In a prediction design, the purpose of the research is “to identify variables that will positively predict an outcome or criterion. In this form of research, the investigator identifies one or more predictor variables and a criterion variable” (Creswell, 2004, p. 328).

It has been established that knowledge is a prerequisite for action (Hines, et al., 1987). However, this relationship requires further study in children. Understanding this relationship is important for the design of learning spaces that transmit knowledge to students to encourage the practice of ERBs. Therefore, the following research questions will be examined in this study:

1. What is the relationship between students’ environmental knowledge and environmentally responsible behaviors?
2. What are the students’ perceptions of the school building features that would enhance their environmentally responsible behavior intentions?

Site and Participants

This research was conducted in a Title I public elementary school that housed grades Pre-kindergarten through fifth, located in Greensboro, North Carolina. The school is part of the Guilford County Schools, the 47th largest school district in the U.S. The

school is located in an area characterized as lower middle class and moderately educated. The school also has a large immigrant population; whose native language is not English, but all speak English. The participants considered for this study were children who were in fifth grade. Typically, this includes students between 10 and 11 years old.

The fifth-grade was chosen because students at this age are more likely to have a high cognitive and comprehension level. Also, it is important to introduce environmental education and encourage the practice of ERBs as earlier as possible but considering an age where they are able to process the knowledge taught and understand the impact of their actions. Therefore, this age group was chosen because this it is an ideal time for students to adopt ERBs.

The school had four fifth-grade classrooms, which are highlighted in red on the site plan in Figure 7. Figure 8 depicts an average classroom, while figure 9 shows a typical fifth-grade classroom in plan view. Each classroom had 31 students, totaling 124 students. Thirty-eight of the 124 students participated in the study, with a response rate of 30.6%. This means that this study has a 69.4% of nonresponse bias, affecting both the reliability and validity of the research findings. Therefore, the results obtained are not a representation of all fifth-grade students.

Figure 7. School Site Plan

Figure 8. Sample Fifth-Grade Classroom

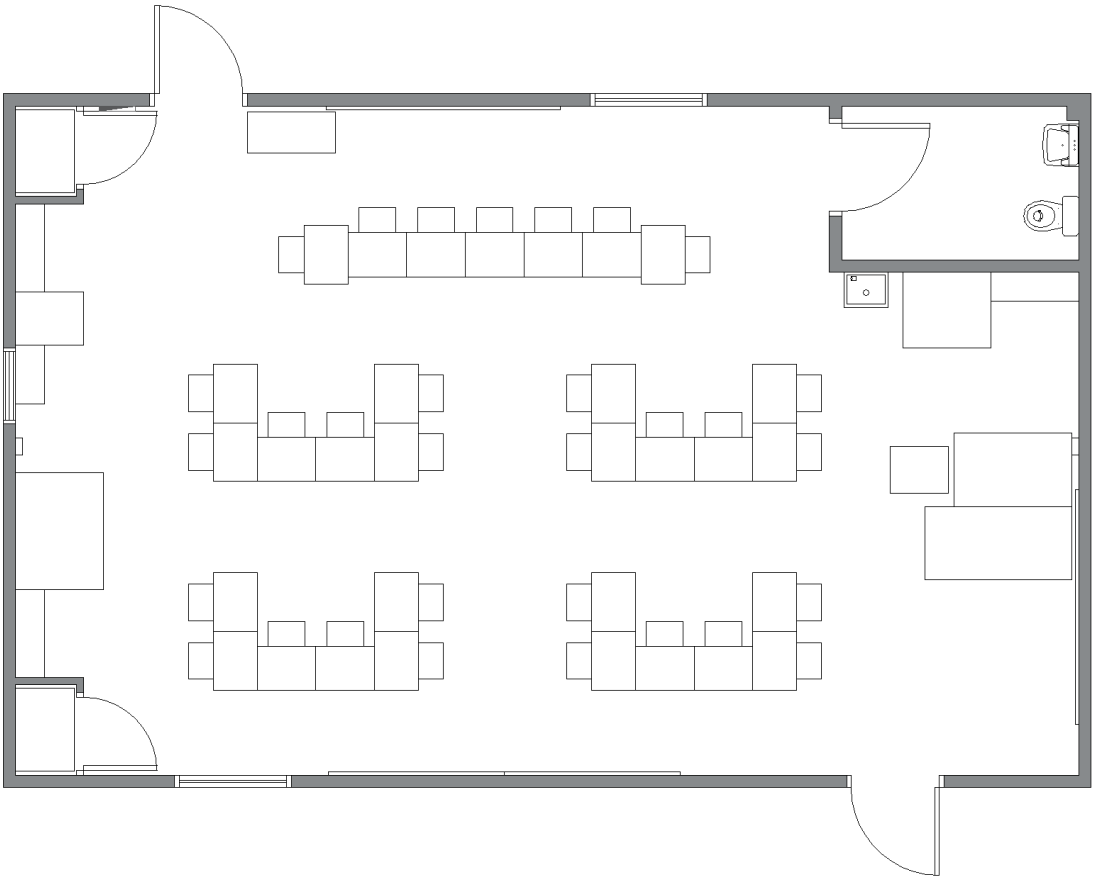

Figure 9. Typical Furniture Plan of Fifth-Grade Classroom

Instrument

The instrument consisted of a printed questionnaire, containing 19 items divided into three sections: *environmental knowledge*, *environmentally responsible behaviors in school*, and *students' perceptions of the built environment* (Appendix A). The first section, *environmental knowledge*, consisted of eight items. Six of these items were adopted from the knowledge section of the Children's Environmental Attitude and Knowledge Scale (CHEAKS) developed by Leeming, Dwyer, and Bracken (1995). One item was modified with simpler vocabulary making it easier to understand for children (Table 1). The CHEAKS scale was developed as a need for research instruments in the

environmental education context. It was administered in 1,040 elementary schools, to children who were attending grades first through third and grades fourth to seventh on two opportunities, demonstrating good reliability and validity.

Table 1. Adapted Items – Knowledge and Environmentally Responsible Behaviors Sections

Original scale	Adapted for the instrument
Knowledge	
Which is an example of a perpetual energy source? (CHEAKS)	Which is an example of a never-ending energy source?
Environmentally Responsible Behaviors	
Do environmentally responsible behaviors at school (GBLS)	How often do you do environmental actions at school?
Help others at school to remember to do environmentally responsible actions (GBLS)	How often do you help others at school to remember to do environmental actions
Recycle things like paper, glass, plastic or metals in your school building (GBLS)	How often do you recycle things like paper, plastic or metals in your school building?
To save energy, I turn off lights at home when they are not in use (CHEAKS)	How often do you turn off lights at school when leaving the room to save energy?
I do not let a water faucet run when it is not necessary (CHEAKS)	How often do you let the water faucet run when it is not necessary at school?

In this first section of the questionnaire, two new items were developed by the researcher in a similar multiple-choice format. Following the same criteria established in the CHEAKS scale, the eight items of this first section of the questionnaire are subdivided into four categories to determine students' environmental knowledge: water (2 items), recycling (2 items), energy (2 items), and pollution (2 items). The format of the original scale consisted of multiple-choice questions with five possible answers. However, the questions were adapted for this questionnaire based on feedback from the school staff to consist of four possible answers. In addition, school staff suggested replacing "perpetual" with "never-ending" in one of the questions of the knowledge section (Table 1).

The second section, *environmentally responsible behaviors*, consists of six items. Five of these items were adopted from the Green Building Literacy Survey (GBLS) developed by Cole (2013). Three questions were then modified based on feedback from the school staff. Two of those items were adapted using a vocabulary that was easier for children to understand. One item was modified to only determine whether students recycle paper, plastic or metals in school, excluding glass from the question as this is not an option at the school chosen for this study (Table 1). In addition, this section adapted two items from the CHEAKS scale that were modified changing the word “home” to “school” (Table 1). Questions in this section were closed-ended using a 5-point Likert-type scale, ranging from always to never, and were subdivided into five categories: water (1 item), recycling (1 item), energy (1 item), pollution (1 item), and general (2 items).

The last section of the questionnaire, *the built environment*, consisted of five open-ended questions to explore children’s behavioral intention of ERBs. The questions were developed to gain feedback from the students on what elements influence environmental actions in different areas of the school. The items presented in the last section of the questionnaire were subdivided into four categories: water (1 item), recycling (2 items), energy (1 item), and general (1 item).

Data Collection Method

The instrument was initially reviewed by school staff to help determine the most appropriate grade level and assist in vocabulary. Prior to data collection, the questionnaire was piloted with a convenience sample of three children to determine question-wording and organization. The pilot study determined the average amount of time for completing the survey, which was an average of 15 minutes. Once the instrument was finalized, materials were submitted, reviewed, and approved by the

Institutional Review Board (IRB) at the University of North Carolina Greensboro (Appendix B). Additional approval was required by the Guilford County Schools Research Review Committee (Appendix C). After receiving approval from both entities, stamped and approved documents were sent to the participating school.

Parental consent forms (Appendix D) were sent to parents of students of the four fifth-grade classrooms. All signed consent forms were collected before the survey was administered. Students who agreed to participate were gathered and asked to complete the three parts of the questionnaire using a pencil. They were told not to include their names or any identifying information in the questionnaire. If they were unfamiliar with any word they could write it next to the question. Likewise, if they did not know how to complete a part of the questionnaire they could ask for assistance. They were told that they could stop completing the survey anytime.

Analysis

The collected data was transferred from the instrument to a digital Excel spreadsheet for cleaning and analysis. Quantitative and qualitative methods were used to analyze the collected data. The first part of the questionnaire, which measured students' knowledge of the environment, was analyzed quantitatively. All multiple-choice answers were converted to dichotomous answers. Therefore, correct answers were coded as 1, while incorrect answers were coded as 0. Blank questions in this section were not counted for analysis. Thus, each item could have a different number of responses. Total correct answers were calculated for each question. Then, the questions were grouped according to the respective categories (water, recycling, energy, pollution) to calculate the percentage of students who correctly answered the questions.

Similarly, in the second part of the questionnaire, which measured students' environmentally responsible behaviors in school, the Likert scale was transformed to dichotomous answers. To determine the total responses for each item, students' responses were coded as 1 while the rest of the choices that were not marked were coded as 0. Total answers were calculated for each option (always, frequently, sometimes, rarely, and never) in each question. Then, to determine the frequency to which students perform that particular behavior, the Likert scale was transformed to an ordinal scale where "never" was 1 and "always" was 5. Blank questions in this section were not counted for analysis. Thus, each item could also have a different number of responses.

To determine the relationship between knowledge and environmentally responsible behaviors, the data of the first two sections of the questionnaire was transferred to SPSS to be analyzed using simple linear regression. This statistical method allows the study of relationships between an independent variable, in this case, knowledge, and a dependent variable, environmentally responsible behaviors. To determine whether the relationship between the variables is statistically significant, a p-value lower than .05 ($p < .05$) was necessary. This meant that a change in the independent variable was related to changes in the dependent variable. Before proceeding with the analysis, seven cases were eliminated since participants failed to respond one or more items in one of the sections. In total 31 cases were analyzed.

The last section of the questionnaire, intended to explore students' perception of the school, was analyzed using qualitative content analysis. The students' responses were transcribed to a digital Excel spreadsheet and then were analyzed and coded using thematic categories for each question. For the first item in this section, the following

categories emerged: comfortable environment, friendly environment, and learning environment. The remaining four items were analyzed individually, and the same thematic categories emerged among them: physical opportunities, visual elements, self-interest, social influence, sound elements, and incentives. Finally, descriptive statistics were used to summarize each category. Figure 10 summarizes the methodology of this study.

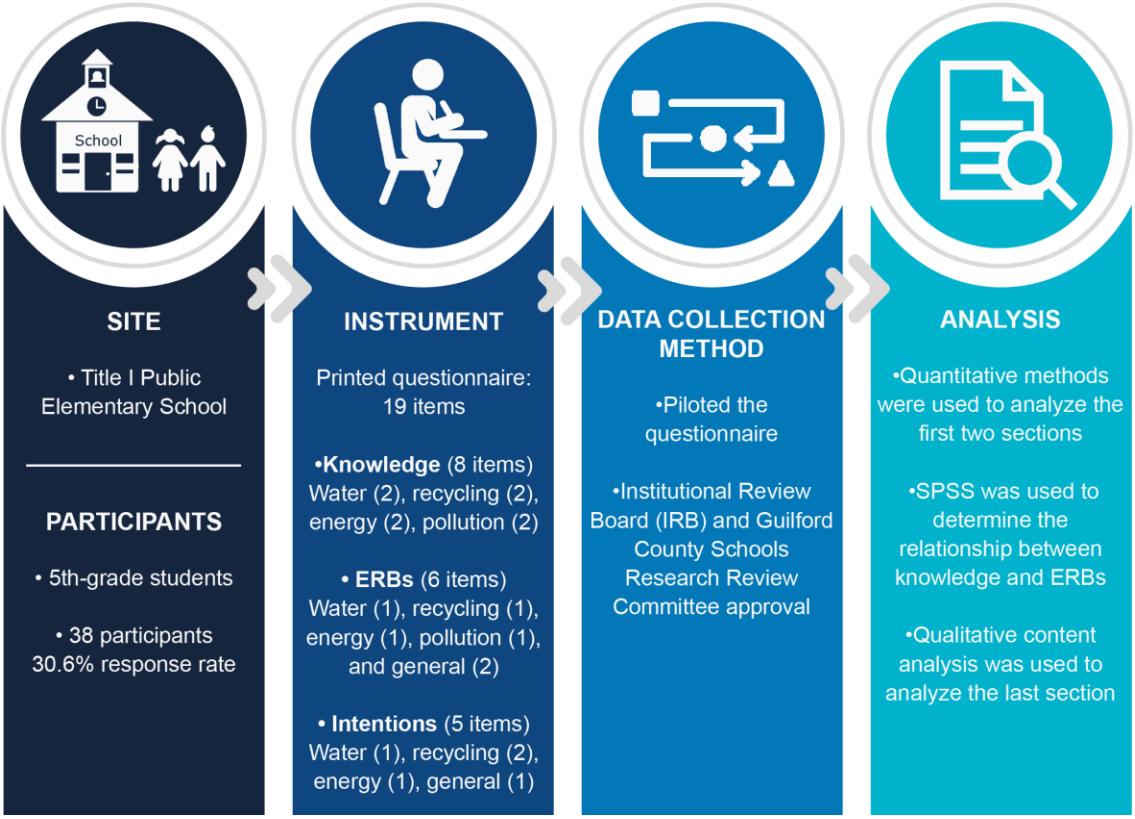

Figure 10. Study Methodology

CHAPTER IV

RESULTS AND DISCUSSION

This chapter reports the results obtained after analyzing the questionnaire and includes discussion. The first part of this chapter will discuss the statistical process, analysis, and results of the first two sections of the questionnaire, *environmental knowledge* and *environmentally responsible behaviors* (ERBs). The relationship between these two variables is addressed in the first research question of this study. The second part of this chapter will discuss the results of the third section of the questionnaire, *the built environment*. The qualitative data from the last section of the questionnaire addresses the second research question.

1. What is the relationship between students' environmental knowledge and environmentally responsible behaviors?
2. What are the students' perceptions of the school building features that would enhance their environmentally responsible behavior intentions?

Data Preparation and Reliability

Prior analysis, survey categories and questions were organized to conduct factor analysis. The Kaiser-Meyer-Olkin (KMO) value, which measures how suited the data is for statistical factor analysis, is .310. This indicates that there is a weak correlation between the variables, meaning that the questionnaire categories are not suited for factor analysis. In addition, a reliability analysis was conducted using Cronbach's Alpha. The value for the first category, which contains eight items is .028 and .36 in the second category with six items. However, .7 is considered the lower limit for reliability analyses.

In the case of the Green Building Literacy Survey (Cole, 2013) all groups of items demonstrated to have an acceptable reliability value (close to .7). The school behavior section, from which some items were adapted for use in the instrument for this study, had a Cronbach's Alpha value of .71. Similarly, the CHEAKS instrument (Leeming, Dwyer, & Bracken, 1995) showed to be reliable (α = .65), especially in children who are in first grade or older grades. However, the instrument developed and used in this research did not reach an acceptable reliability value. This could be because some of the questions from the original scales were eliminated, or because the sample considered for this study did not have the same level of knowledge or understanding on environmental issues than the samples that completed the Green Building Literacy Survey (Cole, 2013) and CHEAKS (Leeming, et al., 1995).

Environmental Knowledge

Using descriptive analysis in SPSS, the results demonstrate that overall, most of the respondents correctly answered between 3 and 5 items out of 8. Two participants demonstrated the greatest knowledge on the environment, correctly answering 7 items (Figure 11). Most of the respondents had the greatest knowledge on *water.* In the water category, on average, 75% of the respondents correctly answered items 7 and 8. The second category in which participants demonstrated the greatest knowledge was *recycling* (61.9%), followed by *energy* (50.9%). Lastly, the results indicated that participants had the least knowledge in the category of *pollution* (38.3%). The rationale behind these results may be the level of difficulty of the questions, wording, and the focus of the fifth-grade curriculum. In this section, some students expressed that they did not know the meaning of some words such as "acid rain" and "landfill." The researcher

met with school staff to find the right wording for the grade level prior to IRB approval, unfortunately, those terms were not identified as problematic.

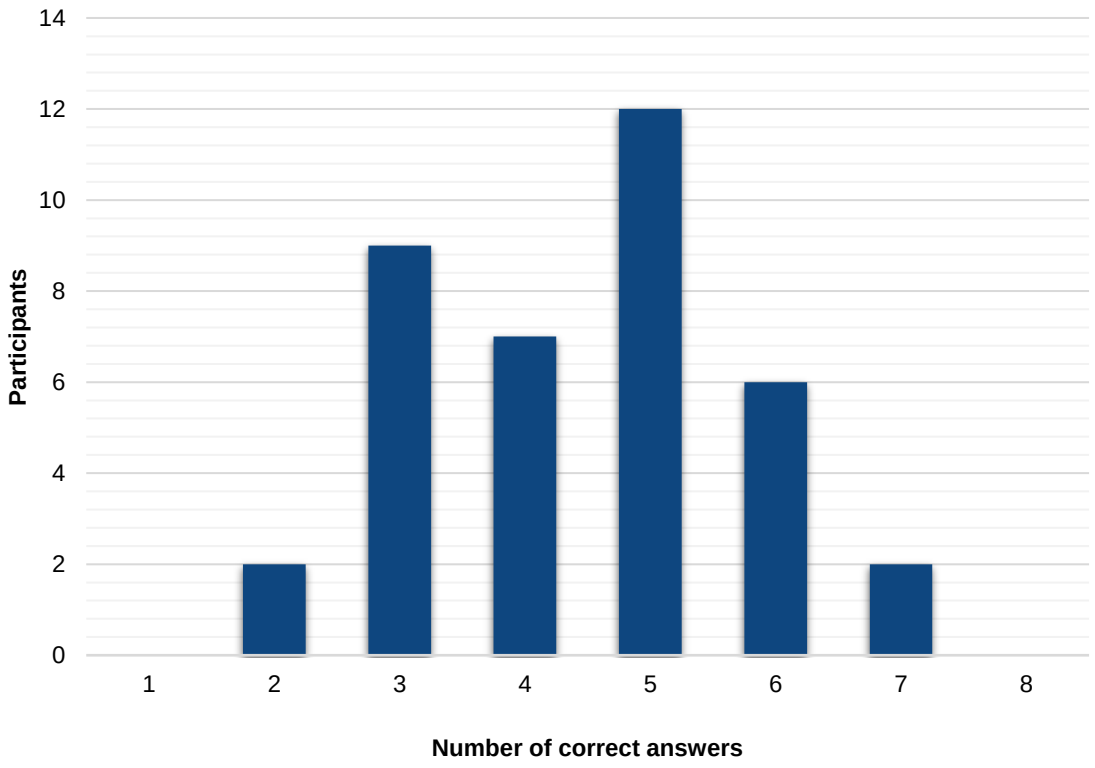

Figure 11. Participants' Correct Answers – Environmental Knowledge

In addition, according to the North Carolina Essential Standards for Science, students start learning about the Earth and human impact on the environment in fifth grade (Public Schools of North Carolina, n.d.). This may be the first time the participants learned about the complex situations about the environment and may not have retained the information.

Table 2 summarizes the number of respondents who correctly answered each question within the environmental knowledge section. Figure 12 illustrates the categories measured within environmental knowledge variable and the percentage of correct

answers for each. The results demonstrated that students have a very low understanding of environmental issues, which indicates that better efforts should be made to teach students about these topics.

Table 2. Descriptive Analysis – Environmental Knowledge

Item	N	Frequency	Percent
1. Where does most of the garbage go after it is dumped from the garbage trucks? ***(Recycling)***	38	Correct: 18	47.4
		Incorrect: 20	52.6
2. Which is most responsible for creating acid rain? ***(Pollution)***	36	Correct: 19	52.8
		Incorrect: 17	47.2
3. Which is an example of a never-ending energy source? ***(Energy)***	36	Correct: 23	63.9
		Incorrect: 13	36.1
4. Coal and petroleum are examples of: ***(Energy)***	37	Correct: 14	37.8
		Incorrect: 23	62.2
5. Most air pollution in our big cities comes from: ***(Pollution)***	38	Correct: 9	23.7
		Incorrect: 29	76.3
6. An item which cannot be recycled and used again is: ***(Recycling)***	38	Correct: 29	76.3
		Incorrect: 9	23.7
7. What happens when people dump waste into oceans, lakes, or rivers? ***(Water)***	38	Correct: 24	63.2
		Incorrect: 14	36.8
8. Why is it important to conserve water? ***(Water)***	38	Correct: 33	86.8
		Incorrect: 5	13.2

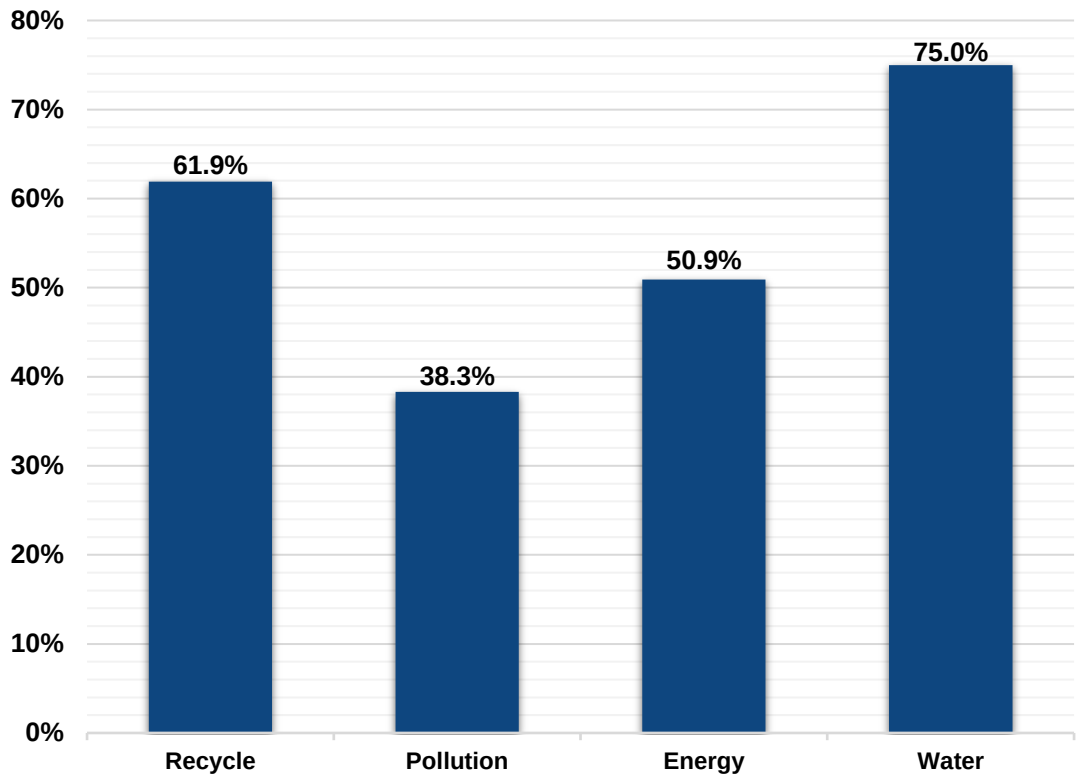

Figure 12. Average Correct Answers per Category – Environmental Knowledge

Environmentally Responsible Behaviors (ERBs)

The section of ERBs was analyzed using SPSS. Overall, 65.8 % of the participants reported taking environmentally responsible actions *sometimes* to *frequently*. Table 4 summarizes the items and categories contained in this section with descriptive statistics. Figure 13 illustrates the percentage of students and the frequency to which they perform a certain behavior. Each behavior is categorized as either general, pollution, recycling, energy, or water. Overall, the practice of environmentally responsible behaviors ranks between *sometimes* and *frequently*, ($\mu_{\bar{x}}$ = 3.5). *Never* was coded as 1 and *always* was coded as 5.

Table 3. Descriptive Analysis – Environmental Responsible Behaviors

Item	N	Mean	SD	Percent				
				5*	4*	3*	2*	1*
How often do you do environmental actions at school? ***(General)***	38	3.34	1.04	18.4	18.4	44.7	15.8	2.6
How often do you help others at school to remember to do environmental actions? ***(General)***	37	3.27	1.24	21.6	16.2	40.5	10.8	10.8
How often do you recycle things like paper, plastic or metals in your school building? ***(Recycling)***	38	3.79	1.36	42.1	26.3	7.9	15.8	7.9
How often do you pick up litter around the school building? ***(Pollution)***	37	3.41	1.24	27.0	16.2	32.4	18.9	5.4
How often do you turn off the lights al school when leaving the room to save energy? ***(Energy)***	38	3.74	1.62	55.3	7.9	10.5	7.9	18.4
How often do you let water faucet run when it is not necessary at school? ***(Water)***	38	3.68	1.60	18.4	7.9	10.5	13.2	50

*Behavior frequency: 5: Always, 4: Frequently, 3: Sometimes, 2: Rarely, 1: Never

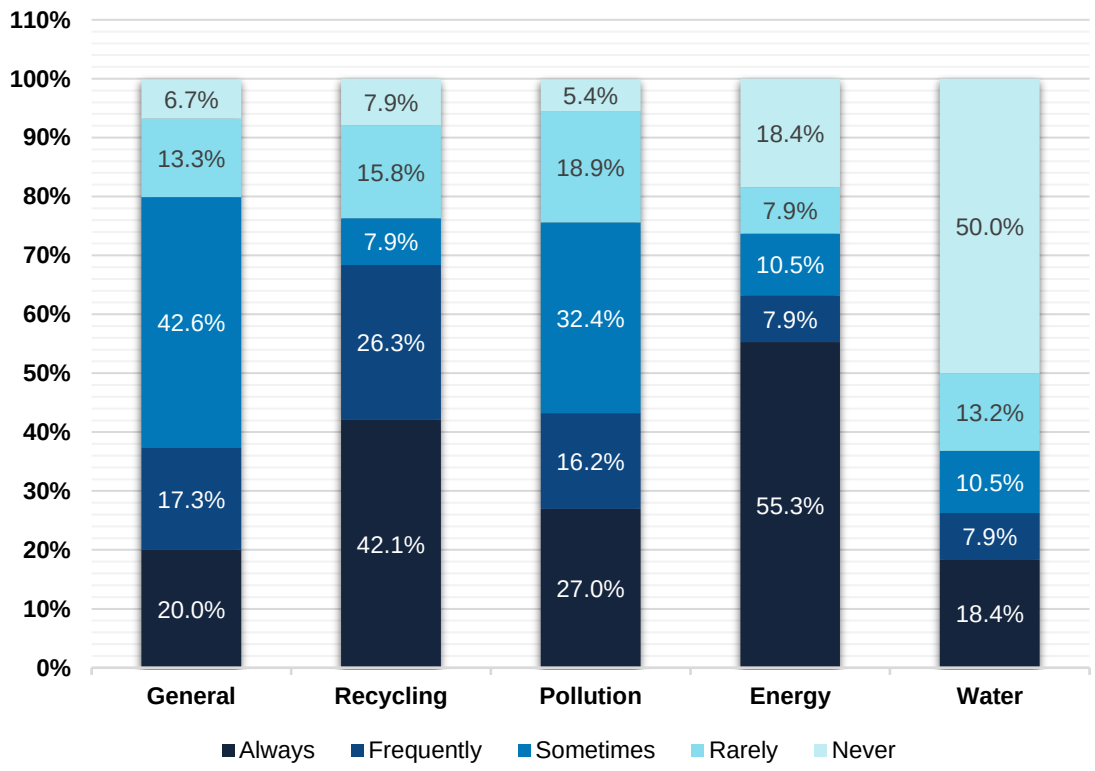

Figure 13. Frequency of Behavior per Category

General

Within the *general* category, the first item investigated the frequency of students' ERBs in the school. Forty-five percent of the participants indicated that they *sometimes* (μ =3.34) take environmental actions at the school while roughly 37.0% reported they *frequently* to *always* do it. However, in the following items that measure the practice of ERBs in specific categories, *frequently* and *always* obtained the most responses. Therefore, it could be that students did not understand the meaning of "environmental action" since when they were asked if they do a specific environmental action, most of the respondents indicated they *frequently* to *always* do it. This potential misunderstanding will be further discussed within the limitations sections of chapter five.

The second question in this section measured the frequency to which participants help others at school take environmental actions. The majority of respondents, 56.7%, indicated that they *sometimes* to *frequently* help their peers. It is encouraging, however, the percentage of always (21.6%) shows there is room for improvement. Implementing role models in the school to encourage students to engage in ERBs may help. As Schelly, et al. (2012) state, any role model in the school; teachers, staff, and even other students, can motivate others and lead to behavioral change.

Recycle

In this section, there was one question in the category *recycling*. In item 3, 68.4% of the respondents indicated that they *frequently* to *always* (μ =3.79) recycle in the school. Only 23.7% of participants *rarely* to *never* recycle. There are several opportunities to recycle at the school. Even though there were not recycling bins inside the fifth-grade classrooms, there were two bins right before entering each classroom. In addition, there were some in the cafeteria and the media center, to which the students

go daily. In this particular case, the school offers opportunities to recycle. However, in the classrooms, the location of recycle bins were not as conveniently placed as they could be. All recycling bins found in the school were standard blue bins that co-mingle recyclable materials, including paper, plastic, metal, and cardboard. In addition, the recycling bins were without signs, graphics or elements to draw students' attention.

McKenzie-Mohr (2011) indicates that recycling is commonly practiced because it is "easy" to perform. The author also indicates that some people engage in this behavior because it is convenient or because there are people around (social pressure). However, the research was conducted with adults. Therefore, further research is necessary to study what motivates students to recycle.

Pollution

The majority, 43.2%, of the participants indicated that they *frequently* to *always* pick up litter. Just as with the recycling bins, the school has several trash cans that allow students to pick up litter and easily throw it away. Contrary to the recycling bins, each classroom had a trash receptacle, which makes it easier for students to throw items away. Similar to the recycling bins, the gray trash cans were without any indications or signs to encourage students to pick up litter or to throw it away.

Energy

The question in the category of *energy* provided the highest *always* response of all the categories. More than half of the participants (55.3%) indicated that they *always* turn off the lights when leaving the room. Overall, 63.2% of the respondents *frequently* to *always* save energy by turning off the lights. It might be said that students who decide to turn off the lights, do it because it has become a "norm" in the classroom. Neither

classrooms nor restrooms have signs or stickers to prompt individuals to turn off the lights before leaving the room.

Water

Lastly, 63.2% of the respondents said that they *never* to *rarely* let the water faucet run when it is not necessary. While 18.4% of the respondents said they always let the water run, these students might not have carefully read the question. They may have thought that the “best” answer was the first choice, which was the format for the other questions. In rooms that have sinks, such as the art classroom and restrooms in the school, there are no indications for students to remember to turn off the water faucet. All sinks in the school are manually controlled. These were the only areas in the school where there were sinks that can be used by students. Therefore, students might turn off the water either because teachers remind them to do it or because they have formed the habit, from either being taught at home or in the school.

Summary

The findings of this research indicate that students do not have adequate knowledge on environmental issues since most of the participants correctly answered between 3 and 5 questions out of 8. The results also indicated that students have the greatest knowledge on water (75.0%), followed by recycling (61.9%). However, the results also indicated they had the least knowledge on pollution (38.3%). The results of the environmentally responsible behaviors section indicate that the majority of the participants engage in the practice of ERBs. On average, 65.8% indicated they *sometimes* to *frequently* take environmental actions. Participants were most engaged in recycling, followed by turning off the lights and the water faucet.

There are some factors that may be motivating or preventing students to take environmental actions. McKenzie-Mohr (2011) explains the importance of identifying barriers that may impede individuals to take environmental actions as well as exploring what would motivate them to perform a particular behavior. The author indicates that barriers to perform a behavior could be internal (lack of knowledge on how to perform the behavior) or external that impede that the behavior would be more convenient (i.e., lack of recycling bins). This theory is aligned with what Ajzen (1991) defines as perceived behavioral control. Individuals should have the knowledge of the behavior they practice, and the environment should make the practice of the behavior convenient by providing the opportunities to take action. This may explain why recycling is the most common behavior practiced in the school since the environment provided the tools necessary to perform the behavior.

In addition, Cole's findings (2015) indicate that ERBs at school are predicted by social and physical aspects, such as teachers, peers, and facility opportunities. The same conclusion resulted after analyzing the ERBs section of this research. Therefore, it could be argued that the opportunities that the school offers to the students and what the students are allowed to do, influenced whether they take environmental actions or not. This ERBs section indicates that the school environment may play a significant role in the performance of ERBs. In addition, social norms established in the school, and role models in the school (teachers, staff, or peers) may be influencing students' behaviors.

Research question 1: What is the relationship between students' environmental knowledge and environmentally responsible behaviors?

To study the correlation between the variables environmental knowledge and environmentally responsible behaviors, simple linear regression was used since there is

one predictor variable (knowledge) predicting one outcome variable (ERBs). Before the analysis, seven participants were excluded since they failed to answer one or more items within the two categories of the survey. In total, 31 responses were analyzed to identify the potential relationship between variables (Table 4). The results were not statistically significant, indicating that there is a weak correlation between ERBs and knowledge (.225 > .05). Therefore, in this sample, there was not a relationship between ERBs and knowledge.

Table 4. Single Linear Regression Results

Variables	N	Mean	SD	Correlation	
				Pearson Correlation	Sig. (1-tailed)
ERBs	31	3.46	.64	.225	.083
Knowledge	31	4.55	1.31		

Research has demonstrated that there is a relationship between knowledge and behavior, suggesting that knowledge is a prerequisite needed to take environmental action (Hines, et. al 1987). However, in this particular case, a statistically significant relationship was not found between knowledge and ERBs in public elementary schools' children. Also, the low percentage of correct answers in the knowledge section could have resulted in the lack of evidence to argue that knowledge can predict ERBs.

Participants reported participation in ERBs, without having an understanding of the implications of their actions. Their behaviors, therefore, could be influenced by teachers, their peers, or their parents. This reasoning is linked to research by Kos, et al. (2016). The authors indicated that preschool children engaged in ERBs but they did not understand the relationship between the behavior and the environmental impact. They

suggest that in early years, children adopt ERBs due to social norms in the school, similar to what Cole (2015) hypothesizes.

Based on these findings, the relationship between environmental knowledge and ERBs requires further study, especially in early years. It is unknown whether students would engage more in the practice of ERBs if they had more knowledge on the environment, knew how to take actions, or if they understood the effect their actions would have on the environment.

The Built Environment

The second research question addressed in the third section of the questionnaire involved qualitative analysis. Answers were transferred into Excel prior to coding. This section investigated classroom preferences as well as students' behavioral intention. Ajzen (1991) explains that if an individual has the intention to perform a behavior, the probability to perform the behavior is greater. Ajzen's theory indicates that, in addition to behavioral intention, if the opportunities to perform a behavior are given, the individual will succeed in performing that behavior. In addition, Ajzen (1991) suggests that perceived behavioral control and behavioral intention can be used directly to predict behavior. Therefore, it is important to explore what elements in the environment, according to the students, would help them to engage in the practice of ERBs.

Classroom preferences

The first item within this section, addressed classroom preferences, specifically, "*what do you like about your classroom?"* In this question, a total of 37 responses were obtained. However, responses such as "everything" or "nothing" were eliminated from the analysis since participants did not provide a specific example. A total of 29 responses were analyzed and three major thematic categories emerged (Table 5). After

identifying the themes, the occurrence for each theme was summarized using descriptive statistics.

Table 5. Classroom Preference Themes

Thematic codes	Rational
Comfortable environment	Considers IEQ factors including air, views, and cleanliness. This section deals with sensory perceptions and connection to nature
Friendly environment	Refers to the availability of people within the school who provide a pleasant environment
Learning environment	Refers to the context or objects that facilitate learning in the classroom

The theme with the most occurrences was *comfortable environment* (44.4%). This category includes environmental factors such as classroom size, openness, cleanliness, connection to nature, smell, and air. Within this category, 3 respondents indicated that they like that the classroom is outside, and they also enjoy having views to the exterior. It is important to reiterate that the fifth-grade classrooms within this school are outside. Therefore, students walk outside to get to their classroom in the morning, after lunch and recess, and any time they take general classes such as art or visit the library. *Learning environment* (27.8%) and *friendly environment* (27.8%) were tied for the second most frequently referenced preference. Within *learning environment*, respondents mentioned elements of the classroom associated with learning, like books. However, they also; indicated that the classroom it is a space where they learn new things.

Within *friendly environment*, respondents referenced people that make the classroom a comfortable and enjoyable space. In this theme, the respondents identified classmates and teachers. In some instances, participants listed multiple themes within a

single response. The most common grouping was *comfortable environment* and *friendly environment*; three students mentioned both themes together. Table 6 illustrates the frequency for each theme identified. Likewise, the table includes respondent quotes for each of the thematic categories.

Table 6. Classroom Preference Frequencies

It. 1: What do you like about your classroom?		
Thematic codes	**Occurrences (%)**	**Quotes**
Comfortable environment	16 (44.4)	“That it is outside and I like to look outside”
Friendly environment	10 (27.8)	“Everyone is nice”
Learning environment	10 (27.8)	“The books thing they have in my classroom”

Themes influencing ERBs

The remaining four items within the section of the built environment resulted in the same six themes. These four items were developed to investigate which elements in the school would help students take environmental actions. The themes were: social influence, self-interest, visual elements, sound elements, physical opportunities, and incentives. Table 7 summarizes the thematic codes identified during the analysis and a rational explanation for each.

Table 7. Themes influencing ERBs

Thematic codes	Rational
Physical opportunities	Elements present in the space that allow the user to take ERBs
Visual elements	Two or three-dimensional elements in the space that remind or encourage the user to take ERBs
Self-interest	Individual power to engage in ERBs
Social influence	People within the school environment that may encourage behavior change
Sound elements	Elements that produce noise that may help students remember to take ERBs
Incentives	Rewards that motivates the user to take ERBs

Overall, the theme with the most occurrences was *physical opportunities* (39.2%). Respondents identified recycle bins or elements that allow them to take environmental actions. Within this category, students also mentioned technology like sensors that are convenient. The second category with the most occurrences was *visual elements* (27.0%). Students identified signs and graphics that remind them to take ERBs. Within the *self-interest* category (16.2%) participants indicated that they would perform the behavior if they developed a habit or if they remembered (without external influence) to do it.

Within the *social influence* category (10.8%), most of the respondents mentioned that they would engage in the practice of ERBs if their teachers told them to perform a particular behavior. *Sound elements* (5.4%) refers to elements that produce noise that would serve as a reminder for students to take environmental actions. Within this theme, students mentioned that the noise of the water running, or a bell, would remind them to turn off the water faucet or turn off the lights. One respondent said that they would recycle if they received rewards. This was counted within the *incentives* category (1.4%).

Social influence and visual and sounds elements, (43.2%), can all be considered a form of prompts. Figure 14 summarizes the total frequency of each thematic category.

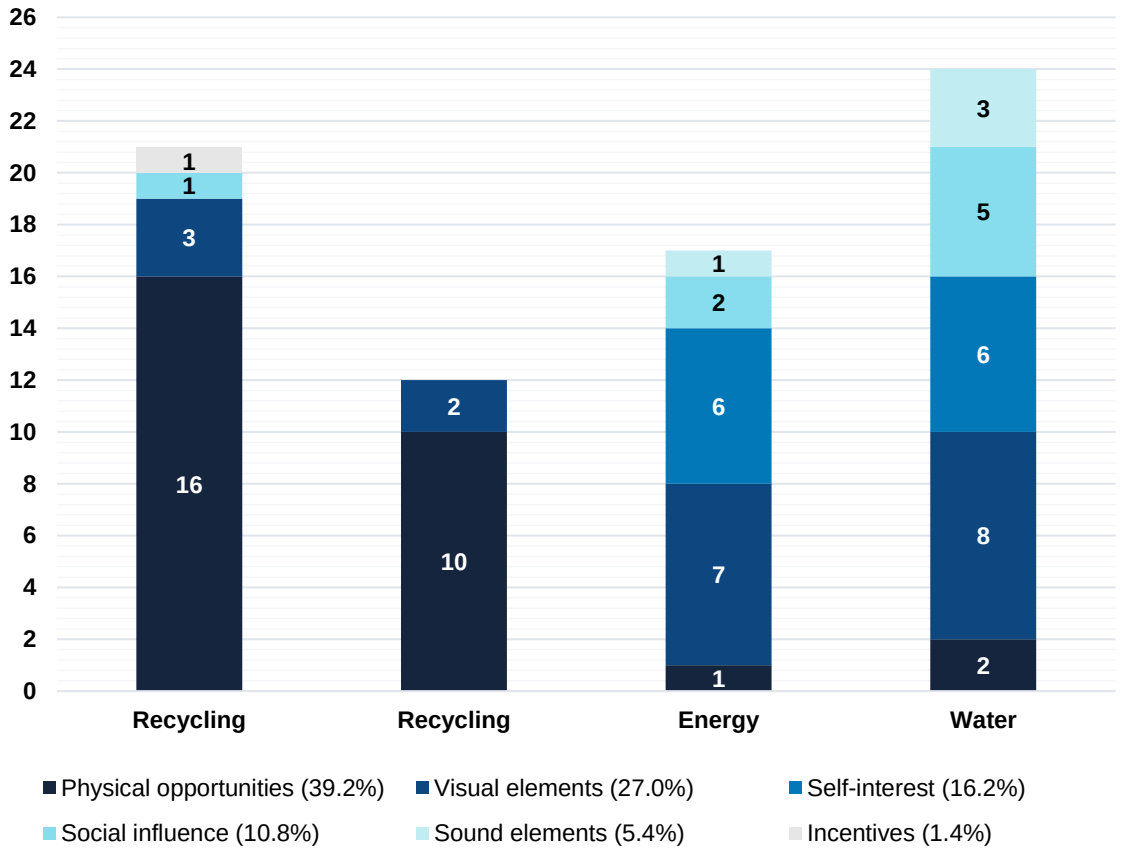

Figure 14. Frequency per Theme

Recycling

The second and third items addressed recycling, specifically asking students to identify what would help them recycle within the classroom (Table 8) and cafeteria (Table 9). The second item in this category obtained 36 responses of which 17 were eliminated. These responses were eliminated because some participants misunderstood the question by writing “sometimes”, “nothing”, “yes”, “paper and plastic”. Similarly, the third item in the section obtained 34 responses, of which 12 were analyzed. It is

important to note that English is not the native language of a number of students who attend this school. This could have been a barrier but there is no way to verify this as identifying information was not collected from the participants.

Table 8. Theme Frequencies for Classroom Recycling

What, in your classroom, would help you to recycle (paper, plastic, metals)?		
Thematic codes	**Occurrences (%)**	**Quotes**
Physical opportunities	16 (76.2)	“The recycling bin in our classroom”
Visual elements	3 (14.3)	“Signs to help me remember”
Social influence	1 (4.8)	“People”
Incentives	1 (4.8)	“We get rambucks every time we recycle something”

Table 9. Theme Frequencies for Cafeteria Recycling

What, in the cafeteria, would help you to recycle (paper, plastic, metals)?		
Thematic codes	**Occurrences (%)**	**Quotes**
Physical opportunities	10 (83.3)	“A box or something what will help recycle in the cafeteria”
Visual elements	2 (16.7)	“If we could see how much we waist [sic] in one day”

The *physical opportunities* theme had the most occurrences. Within this theme, students identified “recycle bins” as elements that would help them recycle in their classroom. This means that, if the school environment provided physical opportunities, this would increase the environmentally responsible behavior of recycling. In this case, what Cole (2013) refers to as “supportive environment”, and Ajzen (1991) as “perceived behavioral control”, demonstrated to be highly important for students to engage in the practice of ERBs.

Both authors make reference to the importance of providing the user the opportunity to practice a behavior, but also to make it easier for the user so they are more likely to engage in that behavior. For instance, it is important to have recycling bins within the school, however, the location of the bins is also important. They need to be visible for students and in areas where it is easy to access. Also, indications on the bins of what materials can be recycled could make recycling easier.

Energy

The fourth item addressed energy, specifically asking students, "*what would help you to turn off the lights?"* This item obtained 35 responses, of which 18 were eliminated from the analysis since students misunderstood the question. Similar to the previous items, responses like "IDK", "yes", "always" and "nothing" were not considered. The *visual elements* theme had the most occurrences (41.2%), see Table 10. Within this theme, students identified signs and seeing how much energy the school wastes as elements that would help them turn off the lights in the classroom or bathroom. The *self-interest* theme (35.3%) had the second most occurrences. Within this theme, students indicated that having formed a habit or remembering on their own to turn off the lights. Also, in most of the responses (58.9%), students identified some form of prompt whether it was visual, a person, or audible.

Table 10. Theme Frequencies for Energy

What would help you to turn off the lights when you leave the classroom or bathroom in your school?		
Thematic codes	**Occurrences (%)**	**Quotes**
Visual elements	7 (41.2)	"Something that says turn off the light when you leave the classroom"
Self-interest	6 (35.3)	"A habbit [sic]"
Social influence	2 (11.8)	"My teacher"
Sound element	1 (5.9)	"A bell"
Physical opportunities	1 (5.9)	"Light sensors"

Water

The fifth item addressed water, specifically asking students, "*what would help you to turn off the water faucet at school?"* This item obtained 34 responses of which 11 were eliminated since the responses were similar to those eliminated in previous items. Of the 23 responses analyzed, the *visual elements* theme had the most occurrences (33.3%), see Table 11. Similar to energy, students identified water bills and signs as elements that would help them turn off the water. Therefore, visual prompts would remind them to practice environmental actions. The *self-interest* theme (25.0%) had the second most occurrences. Within this theme, students implied that they do not depend on external influences to perform the behavior. Overall, 66.6% indicated that prompts (visual, social, or audible) would help them to engage in this behavior.

Table 11. Theme Frequencies for Water

What would help you to turn off the water faucet at school?		
Thematic codes	**Occurrences (%)**	**Quotes**
Visual elements	8 (33.3)	“If we could see what the light bill look[s] like”
Self-interest	6 (26.0)	“No one. I just do it”
Social influence	5 (20.8)	“If my teacher say”
Sound element	3 (12.5)	“The noise”
Physical opportunities	2 (8.3)	“Hand sensors”

Research question 2: What are the students’ perceptions of the school building features that would enhance their environmentally responsible behavior intentions?

Before addressing this question, it was important to determine what students like about their classroom. This is relevant when designing a learning environment for children, considering that they spend about seven hours a day in the school. In addition, they are the users for whom we are designing. Therefore, it is important to provide a learning space thoughtfully designed that promotes comfort and invites for exploration while considering their needs. Hence, the main goals are to 1) design a space that encourages students to take ERBs and 2) help them learn about the environment.

Mostly, participants expressed they like their classroom because it is spacious, clean, has natural views, the air movement, and because it is a space where they learn. These characteristics of the classrooms that students consider important, are also aspects that the Collaborative for High Performance Schools (CHPS) and the Center for Green Schools promote to enhance students’ wellbeing and learning in schools (United States Green Building Council, 2018; CHPS, 2006) Also, these aspects contribute to the

indoor environmental quality (IEQ), which is described as the conditions inside the classroom. This term involves environmental factors such as acoustics, air quality, views, daylight, and temperature. In existing buildings, it is important to improve IEQ variables since it is known that they have an impact on students' performance and learning (Issa et al., 2011) and as the findings suggest, are elements that students pay attention to.

According to the Theory of Planned Behavior (Ajzen, 1991) three determinants should exist for an individual to have the intention to perform a behavior or take action. These determinants are a positive attitude toward the behavior, social pressure to perform the behavior, and ease of performance of that behavior. To support the last determinant, the findings indicate that, *physical opportunities* (39.2%) and *visual elements* (27.0%) within the school would help students engage in the practice of ERBs. These two elements could be placed in the school together to have a stronger impact. For example, a recycle bin along with a sign with instructions on how to recycle is more likely to influence students who do not know how to recycle.

Also, *self-interest* (16.2%), which refers to the performance of a behavior without an external influence, has been shown to be influential to practice ERBs. Therefore, it is important to equip students with the knowledge, skills, and experiences necessary to form the habit of ERBs. In this way, we will be helping students to have a positive attitude towards the environment and supporting the first determinant that Ajzen (1991) proposes.

Participants also indicated *social influence* (10.8%) as influential, which supports the second factor of the Theory of Planned Behavior. In this case, not only the norms established in the school will encourage ERBs, but also role models such as teachers

and staff. Students indicated that they will perform a behavior if teachers or someone in the school tells them to do it. Overall, the results of the four items concerning the built environment demonstrate that elements in the interior such as physical opportunities and visual elements, the school culture including norms and role models, and their own willingness to act, would stimulate students to have ERBs in the school (Figure 15).

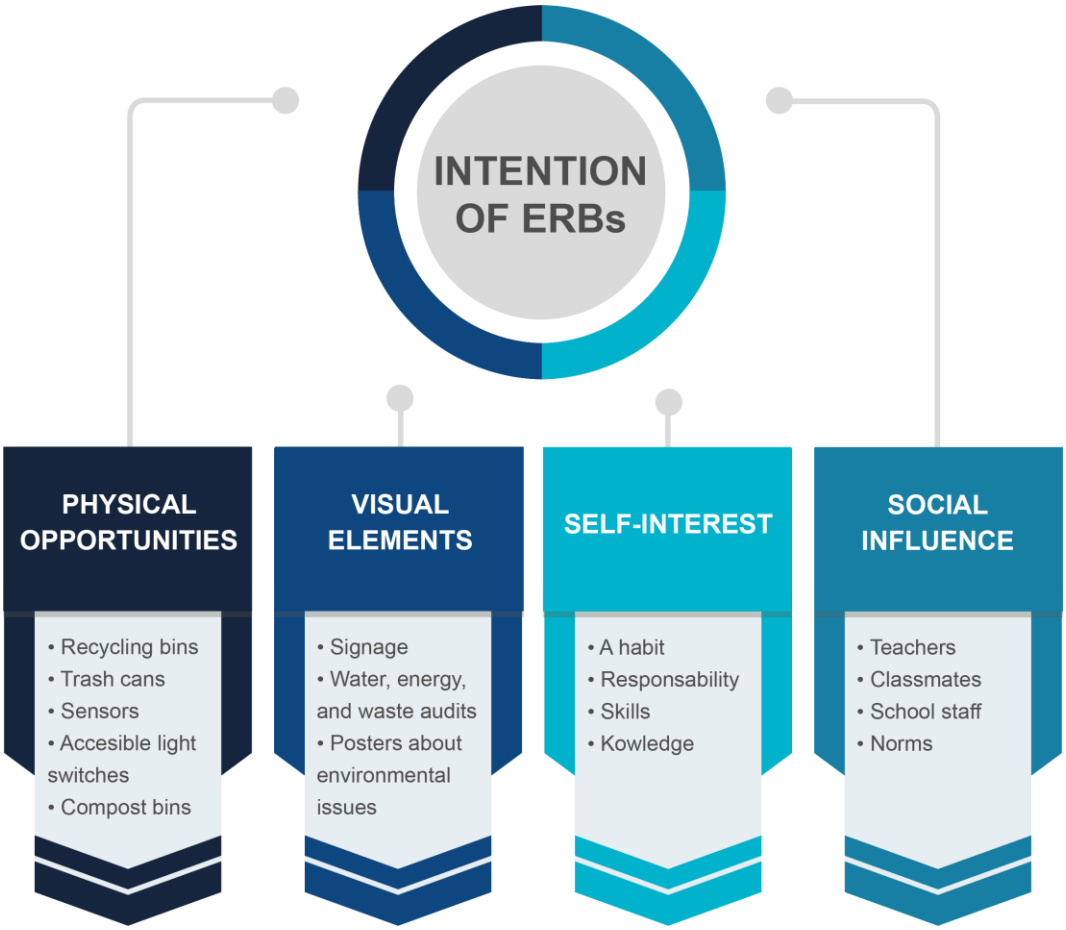

Figure 15. Factors Encouraging ERBs

CHAPTER V

CONCLUSION

The main objective of environmental education (EE) is to help students develop the knowledge, skills, attitudes, behaviors, and experiences necessary to become future environmental stewards. If students began exhibiting environmentally responsible behaviors during elementary school and understood the impact of these actions, they would be more likely to continue into adulthood. Hence, it is critically important to begin implementing EE strategies.

The results of this study, while exploratory, can serve as basis for future research in the design fields that help facilitate learning environments that encourage the practice of environmentally responsible behaviors (ERBs) in school. The results will be most helpful for existing buildings and public schools that have to overcome constraints when trying to incorporate sustainability and environmental education.

Low-cost Design Recommendations

This investigation not only sought to investigate the relationship between knowledge and ERBs, but also explored students' perception of their school to understand what elements in the interior would encourage them to engage in the practice of ERBs. The results of the questionnaire served as a basis to create general design recommendations that could be used to encourage ERBs and increase students' environmental knowledge, turning the school into a teaching tool. The design recommendations below attempt to create a learning environment that fosters learning,

EE, and ERBs. Ideally, the application of these design recommendations (Table 12) would be customized according to students and teachers' needs. The guidelines are based on suggestions for the fifth-grade classrooms that participated in the study.

Table 12. Design Recommendations to Increase EE and ERBs

Design Recommendation		
Comfortable environment	**Views:** Natural scenes on walls to offer views of nature. **Daylight/Windows:** Allow sunlight to enter without interruptions. Use blinds to control heat gain and glare. **Space configuration:** Consider location of furniture and storage **Students desks:** Durable and flexible – easy to move **Storage:** Durable and multifunctional **Lighting:** LEDs are cost-effective and last longer – less disruption for changing **Acoustics:** Incorporate materials such as fabrics or carpet that absorb noise	**General considerations**
Materials, elements, and colors	**Repurposed materials:** Use of materials reflect nature such as wood **Color:** Colors that reflect elements found in nature is a way to transmit sustainability to students	
Physical opportunities	**Trash cans:** Easy access (physical and visual) and convenient location. **Recycle bins:** Easy access (physical and visual) and convenient location **Accessible light switches:** No furniture impeding visual or physical access **Accessible water faucets:** Mounting height or assistive furniture **Sensors:** Incorporate sensors when fixtures need to be replaced	**ERBs**
Visual elements	**Visual prompts:** Locate where students are more likely to ERBs. Designed to guide users on how to perform the behavior. **Teaching graphics:** Teach students about the environment. Combine facts with graphics in engaging manner.	**Knowledge**
Social influence	**Displays:** Durable, flexible, multifunctional and reusable displays that can be changed per lessons **Visual access:** To where ERBs will take place	**ERBs**
Incentives	**Boards:** Where students can track ERBs and be recognized	

Designers should consider the existing conditions of the classroom that may affect learning like safety issues, IEQ factors that may impact students' health and wellbeing, as well as the existing spatial configuration of the classroom that could be improved considering students and teachers' needs. This research, based on the literature review and survey findings, suggests some strategies to provide a comfortable learning environment. Ideally, furniture should be flexible making it easy to be rearranged to suit different learning styles and activities. Storage should be multifunctional and durable. Students should be able to reach items like their backpacks and books.

Students reported they like their classrooms because it is outside, meaning that they enjoy having a connection with nature. Besides allowing access to windows, nature can be incorporated in the interior through scenes on walls. These natural scenes could be achieved through paintings or students' work. Windows should not be obstructed. Conversely, they should allow daylight to the interior while provided exterior views to students for restoration.

To avoid heat gains and glare, an interior shading device such as blinds can be used. Traditional fluorescent lighting should be changed for LED lighting. Even though LED lighting represents a high upfront cost, they are cost-effective in the long run and last much longer. To control sound, materials such as fabrics and carpet tiles are necessary to absorb noise.

According to Cole (2013) to create a "meaningful environment" it is necessary to create an overall environment that conveys sustainable messages. This can be achieved through the use of materials, scale, form, and color found in nature. Therefore, the use of materials and colors that represent natural elements will be optimal. For instance,

repurposed wood can be affordable and easy to acquire. Such is the case of palettes which can be easily found and possibly donated from local stores. Also, palettes can serve for multiple purposes such as bookshelves (Figure 16), vertical herb gardens, or to create furniture, etc. In this way, natural materials are introduced into the interior that represent nature and can be used to teach students the importance of conservation resources through repurposing.

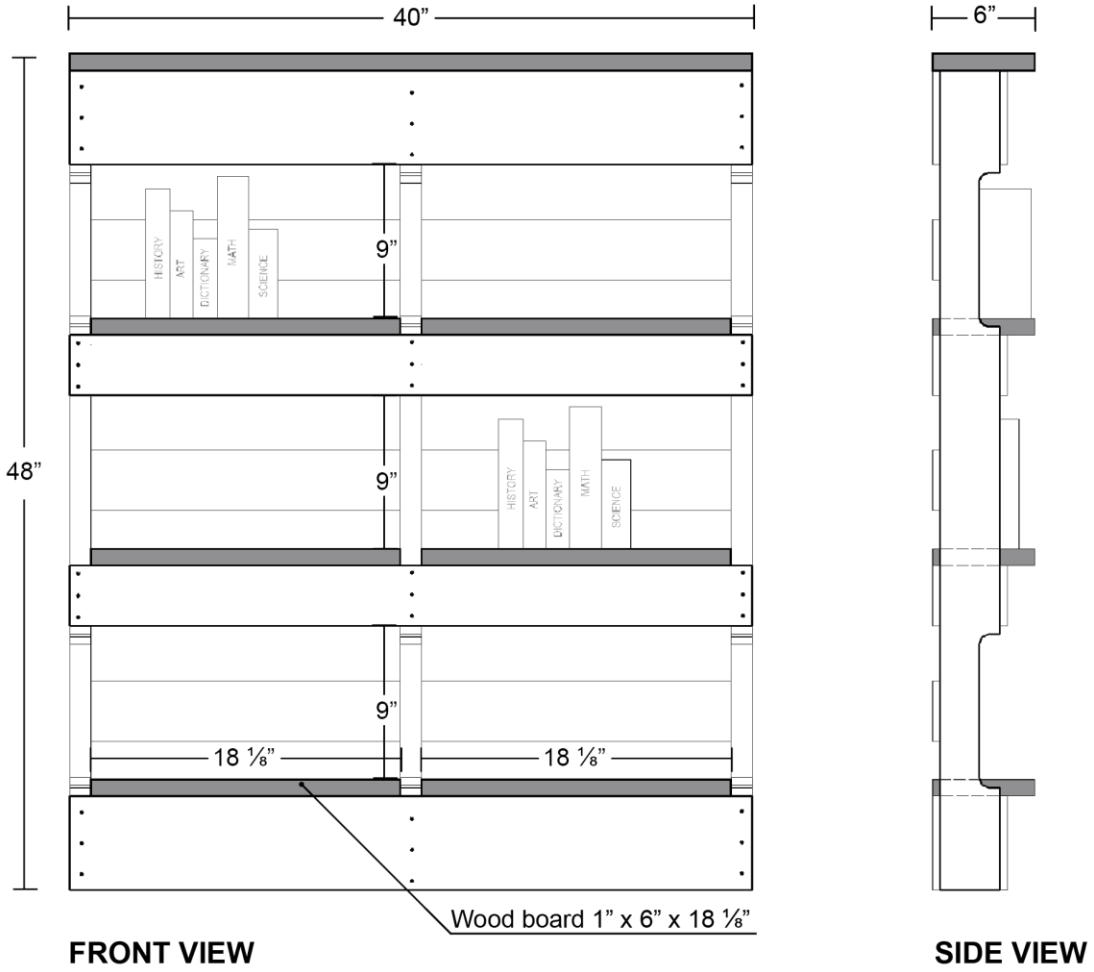

Figure 16. Wood Pallet Repurposed as a Bookshelf

Students also indicated that physical opportunities would help them practice ERBs. To this end, the school should provide recycling bins and trash cans. These elements should be located in convenient places where students have physical and visual access. Similarly, light switches should be free of barriers (i.e., furniture in front of them) that may impede the student's ability to turn off the lights. In restrooms, water faucets should be at a height that is easy for students to access and therefore turn off. Assistive furniture can also help students reach the water faucets. Technology such as motion sensors would also be ideal as that would allow shorter students or those with a dexterity impairment access the water without manipulating the faucet. Therefore, when it is necessary to replace a water faucet, those with sensors should be considered.

Participants reported that visual elements would help them take environmental actions at school, therefore, graphics should be incorporated into the interiors. Also, visual elements like graphics can be a low-cost strategy that serves to transmit information to students; to not only increase environmental knowledge but also ERBs. However, the design and application of these graphics will depend on students' age and curriculum to effectively teach students environmental education. The materials of the visual elements can range from laminated paper to paint to laser cut wood. A good strategy would be to partner with a local university's art or design program.

To encourage ERBs, visual prompts should be located where students are more likely to take environmental actions. Ideally, these prompts should be easier to understand and engaging. They may guide users on how to perform the behavior or teach them about the importance of performing the action (Figure 17). For instance, if students can recycle in the classroom, visual elements should be located where the recycling bin will be placed or on the recycling bin itself. Information on which elements

(glass, paper, cardboard or plastics) can and cannot be recycled including visual examples of the materials would be helpful.

Figure 17. Graphic Illustrating the Importance of Recycling

These visuals would be educational and serve as prompts for students to practice the behavior. In addition, teaching graphics can be incorporated to help students to learn about the environment. Visual information about the environment and environmental facts combined with graphics is an engaging way to teach students environmental education and the importance of their actions.

Social influence is another aspect that encourages the practice of ERBs in schools. This aspect involves staff, teachers, and peers that encourage others to take environmental actions. Therefore, it is necessary to incorporate elements in the interior that teachers can use to teach but that do not involve more work for them. For instance, elements such as displays that can be multifunctional and reused in different lessons are ideal. In addition, if students are able to see their peers practice ERBs, they will be more likely to imitate the behavior. Therefore, it is necessary that students have visual access to where the behaviors are more likely to be practiced. Incentives were also reported as a way to engage students in the practice of ERBs. If the school or teachers want to reward students for their actions, chalkboards or whiteboards could be incorporated at a height where students can see, write, and keep record of the different ways in which they are helping the environment.

The design recommendations presented here seek to help public schools facilities integrate sustainability in an economically feasible way. These strategies do not require technicians or experts and can be completed by school personnel or volunteers willing to help create a learning environment that promotes sustainability.

Study Findings

The findings of this research indicate that the sample of students do not possess adequate knowledge on the environment, specifically in the areas of pollution, energy, water, recycling, and general knowledge. However, students demonstrated the greatest knowledge of environmental water practices and the least knowledge on pollution. It was found that the behavior most practiced within the school was recycling, followed by saving energy by turning off the lights. It was also determined that the school has recycling bins in different areas, providing opportunities to recycle. However, there were

no prompts that encourage students to turn off the lights or recycle. Participants practiced ERBs without understanding the importance behind the action.

No relationship was found between environmental knowledge and ERBs. Therefore, due to the limitations of this research, this study could not confirm the findings of Hines, Hungerford, and Tomera's (1987). Although students in the sample did not demonstrate to have adequate environmental knowledge, they showed engagement in the practice of environmental actions. It may be that role models and social norms in the school influenced students to practice environmental actions, which would support Cole's research (2015). However, this study cannot confirm that finding. In addition, research has found that children in early years (5 and 6 years old) adopt ERBs due to social norms (Kos et al., 2016). This investigation concludes that children between 10 and 11 years old are influenced by the social norms and context of the school.

Research Limitations

This study had to cope with several limitations, among them the population chosen for the research. First, since this research was conducted with one grade level within a single school, the findings cannot be generalized. In addition, the instrument for the study was customized and had low reliability. Also, the survey was designed in English and the population considered for the study included students whose native language was not English, who may not have fully mastered the English language. Even though vocabulary was changed using simpler words, some students struggled with certain terms, like "acid rain" and "landfill". This could have caused participants to answer the question without understanding it, skewing the results.

In addition, the fifth-grade teachers were not available to talk with the researcher before or during the study, therefore, those who had the most knowledge of the students

reading comprehension were not consulted. These limitations could have affected the instrument's validity and reliability. If used in further research, the questionnaire should be tested with a larger sample. Social desirability bias was another limitation for this study. Participants could have answered questions in a way to look better socially or those interested in sustainability would have been more likely to respond. Also, while taking the survey, students were sitting with other classmates and may have copied answers.

Future Research

For further research with a population that may have multiple languages represented, it would be ideal to collect data using visuals, such as through drawings or a photo activity. Visual methods could be helpful to understand what children think about the school or what would help take environmental actions. It would be ideal to study and compare more than one public school and different grade levels to have a better understanding of the population and make more generalizable conclusions. Also, including a broader perspective for further study will be beneficial. Taking into account, schools in different states, in rural and urban areas, and even from different countries would help to create design strategies that may be applicable and practical for schools with different characteristics.

For future research, it would be ideal to consider place attachment or sense of place in the context of ERBs. Studying the relationship between these two variables in children could contribute to the understanding of whether students would engage in the practice of ERBs because they have created a bond with their school and they would like to protect it. Also, knowing which spaces within the school have meaning to them

may help to better design these areas where they would be more likely to engage in ERBs.

Contrary to Hines, Hungerford, and Tomera's findings (1987), the results of this research indicate that there is no relationship between the variables. In this case, environmental knowledge did not show to be a prerequisite to take environmental actions but given the limitations, this relationship needs further investigation, especially in elementary students.

REFERENCES

Aarnio-Linnanvuori, E. (April 26, 2013). *Defining EE and ESD.* Retrieved March 20, 2018 from https://blogs.helsinki.fi/aarnioli/2013/04/26/defining-ee-and-esd/

Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, *50*(2), 179-211. doi: 10.1016/0749-5978(91)90020-T

Ajzen, I. (2005). *Attitudes, personality and behavior.* 2nd ed. Maidenhead: McGraw-Hill International (UK) Ltd.

Baker, L., and Bernstein, H. (2012). The impact of school buildings on student health and performance. *The Center for Green Schools*. Retrieved March 28, 2017, from http://www.centerforgreenschools.org/impact-school-buildings-student-health-and-performance

Barr, S., Leigh, K., and Dunbar, B., (2011). *Green schools that teach: Whole-School Sustainability.* Institute for the Built Environment, Colorado State University. Retrieved January 29, 2017 from http://www.carlsonstudio.org/hubfs/Green_School_That_Teach.pdf?t=1529019806680

Barr, S., Cross, J., and Dunbar, B. (2014). *The whole-school sustainability framework.* Institute for the Built Environment, Colorado State University. Retrieved January 29, 2017, from http://centerforgreenschools.org/sites/default/files/resource-files/Whole-School_Sustainability_Framework.pdf

Canon Design, VS Furniture, and Bruce Mau Design (2010). *The third teacher.* New York, NY: Abrams

Chalabi, M. (September 04, 2014). *American kids will spend an average of 943 hours in elementary school this year.* Retrieved January 17, 2018, from https://fivethirtyeight.com/features/american-kids-will-spend-an-average-of-943-hours-in-elementary-school-this-year/

Chapman, P. (2014). *Environmental education and sustainability in U.S. public schools*. Inverness Associates. Retrieved March 16, 2017 from http://projectgreenschools.org/wp/wp-content/uploads/2014/08/USGreenSchools12114.pdf

Collaborative for High Performance Schools (2006) *Volume II: Design for High Performance Schools.* Retrieved Abril 06, 2018 from https://chps.net/best-practices-manual

Cole, L. (2013) *The teaching green school building: Exploring the contributions of school design to informal environmental education*. (Doctoral dissertation). The University of Michigan. Retrieved March 15, 2017, from https://deepblue.lib.umich.edu/handle/2027.42/100038

Cole, L. (2014). The teaching green school building: A framework for linking architecture and environmental education*. Environmental Education Research, 20*(6), 836–857. doi: 10.1080/13504622.2013.833586

Cole, L. (2015). Green building literacy in the school building: A Study of five middle schools in the United States. *Children, Youth and Environments, 25*(3), p.145. doi: 10.7721/chilyoutenvi.25.3.0145

Conde, M. and Sanchez S. (2010). The school curriculum and environmental education: A school environmental audit experience. *International Journal of Environmental & Science Education 5*(4), 477-494. Retrieved June 11, 2018 from https://files.eric.ed.gov/fulltext/EJ908944.pdf

Cooper, I. (1985). Teachers' assessments of primary school buildings: The role of the physical environment in education. *British Educational Research Journal, 11*(3), 253-269. doi: 10.1080/0141192850110306

Creswell, J. (2004). *Educational research* (2nd ed.). Upper Saddle River, NJ: Merrill

Day, E. (2009). *Fostering whole-systems thinking through architecture: Eco-school case studies in Europe and Japan.* (Thesis). Cornell University. Retrieved March 15, 2017 from https://ecommons.cornell.edu/handle/1813/13216

Eccles, J. (1999). The development of children ages 6 to 14. *The Future of Children, 9*(2), 30-44. doi: 10.2307/1602703

Education for sustainable development. (2017, May 18). Retrieved September 14, 2017, from https://www.heacademy.ac.uk/enhancement/starter-tools/education-sustainable-development-0

Filardo, M. (2016). *State of our schools: America's K–12 facilities 2016*. Washington, D.C.: 21st Century School Fund. Retrieved December 10, 2018 from https://centerforgreenschools.org/state-our-schools

Gifford, R., and Nilsson, A. (2014). Personal and social factors that influence pro-environmental concern and behaviour: A review. *International Journal of Psychology, 49*(3), 41-157. doi: 10.1002/ijop.12034

Halpenny, E. (2010). Pro-environmental behaviours and park visitors: The effect of place attachment. *Journal of Environmental Psychology, 30*(4), 409-421. doi: 10.1016/j.jenvp.2010.04.006

Heming, A. (2017, July 30). *What is a green school?* Retrieved September 14, 2017 from https://www.centerforgreenschools.org/what-green-school

Henderson, K. and Tilbury, D. (2004). *Whole-school approaches to sustainability: An international review of sustainable school programs*. Report Prepared by the Australian Research Institute in Education for Sustainability (ARIES) for The Department of the Environment and Heritage, Australian Government. Retrieved January 15, 2017 from http://aries.mq.edu.au/projects/whole_school/files/international_review.pdf

Hines, J., Hungerford, H., and Tomera, A. (1987). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *Journal of Environmental Education, 18*(2), 1-8. doi: 10.1080/00958964.1987.9943482

Higgs, A. and McMillan, V. (2006). Teaching through modeling: Four schools' experiences in sustainability education. *The Journal of Environmental Education*, *38*(1), 39–53. doi: 10.3200/JOEE.38.1.39-53

Hogan, D. and Tormey, R. (2008). A perspective on the relationship between development education and education for sustainable development. *Policy & Practice: A Development Education Review, (6)*, 5-17. Retrieved April 18, 2018 from https://www.developmenteducationreview.com/issue/issue-6/perspective-relationship-between-development-education-and-education-sustainable

Issa, M., Rankin, J., Attalla, M. and Christian, A. (2011). Absenteeism, performance and occupant satisfaction with the indoor environment of green Toronto schools. *Indoor and Built Environment*, *20*(5), 511-523. doi: 10.1177/1420326X11409114

Jenkins, B. and Jenkins K. (2005). Education for sustainable development and the question of balance: Lessons from the Pacific. *Current Issues in Comparative Education, 7*(2). Retrieved June 11, 2018 from https://eric.ed.gov/?id=EJ853853

Kensler, L. and Uline, C., (2016). *Leadership for green schools: Sustainability for our children, our communities, and our planet.* Retrieved March 18, 2017 from https://www.taylorfrancis.com/books/9781134737611

Kos, M., Jerman, J., Anžlovar, U., and Torkar, G. (2016). Preschool children's understanding of pro-environmental behaviours: Is it too hard for them? *International Journal of Environmental and Science Education, 11*(12), 5554–5571. Retrieved January 15, 2017 from http://www.ijese.net/makale_indir/723

Krettenauer, T. (2017). Pro-environmental behavior and adolescent moral development. *Journal of Research on Adolescence, 27*(3), 581-593. doi: 10.1111/jora.12300

Kudryavtsev, A., Stedman, R. and Krasny, M. (2012). Sense of place in environmental education. *Environmental Education Research, 18*(2), 229-250. doi: 10.1080/13504622.2011.609615

Leeming, F., Dwyer, W., & Bracken, B. (1995) Children's environmental attitude and knowledge scale: Construction and validation. *The Journal of Environmental Education, 26*(3), 22-31. doi: 10.1080/00958964.1995.9941442

Liefländer, A., and Bogner, F. (2014). The effects of children's age and sex on acquiring pro-environmental attitudes through environmental education. *The Journal of Environmental Education, 45*(2), 105–117. doi: 10.1080/00958964.2013.875511

Middle childhood development: Intelligence development stage of childhood (n.d.) Retrieved January 17, 2018, from http://www.childhealth-explanation.com/middle-childhood-development.html

McKenzie-Mohr, D. (2011). *Fostering sustainable behavior: An introduction to community-Based social marketing.* Canada: New Society Publishers

McKenzie-Mohr, D., Nemiroff, L., Beers, L., and Desmarais, S. (1995). Determinants of responsible environmental behavior. *Journal of Social Issues, 51*(4), 139-156. doi: 10.1111/j.1540-4560.1995.tb01352.x

McKeown, R. and Hopkins, C. (2005). EE and ESD: Two paradigms, one crucial goal. *Applied Environmental Education & Communication, 4*(3), 221-224. doi: 10.1080/15330150591004616

Moneim, D. (2005). Architecture and human behavior. Does design affect our senses?. *Journal of the Egyptian Society of Engineers.* Retrieved February 20, 2018 from http://scholar.cu.edu.eg/?q=w_moneim/publications/architecture-and-human-behavior-does-design-affect-our-senses

Orr, D. (1993). Architecture as pedagogy. *Conservation Biology, 7*(2), 226–228. Retrieved March 16, 2017 from http://www.jstor.org/stable/2386418

Olson, S., and Kellum, S. (2003) *The impact of sustainable buildings on educational achievements in K-12 Schools.* Madison, Wisconsin: Leonardo Academy Inc. Retrieved January 18, 2017 from http://www.cleanerandgreener.org/download/sustainableschools.pdf

Pavlova, M. (2013). Towards using transformative education as a benchmark for clarifying differences and similarities between environmental education and education for sustainable development. *Environmental Education Research, 19*(5), 656-672. doi: 10.1080/13504622.2012.736476

Public Schools of North Carolina (n.d). *K-12 Standards, curriculum and instruction.* Retrieved April 01, 2018 from http://www.ncpublicschools.org/curriculum/science/scos/support-tools/#standards

Ramkissoon, H. and Mavondo, F. (2014). Proenvironmental behavior: The link between place attachment and place satisfaction. *Tourism Analysis*, *19*(6), 673-688. doi: 10.3727/108354214X14146846679286

Roof, K., and Oleru, N. (2008). Public health: Seattle and King County's push for the built environment. *Journal of Environmental Health, 71*(1), 24-27. Retrieved March 3, 2017 from https://www.ncbi.nlm.nih.gov/pubmed/18724501

Scannell, L. and Gifford, R. (2010). The relations between natural and civic place attachment and pro-environmental behavior. *Journal of Environmental Psychology, 30*(3), 289-297. doi:10.1016/j.jenvp.2010.01.010

Schanzenbach, D., Boddy, D., Mumford, M., and Nantz, G. (2016) *Fourteen economic facts on education and economic opportunity.* Retrieved May 1, 2017 from http://www.hamiltonproject.org/papers/fourteen_economic_facts_on_education_and_opportunity

Schein, E., *Coming to a new awareness of organizational culture*, Sloan Management Review, 25:2 (1984:Winter) p.3. Retrieved April 15, 2018 from https://sloanreview.mit.edu/.../coming-to-a-new-awareness-of-organizational-culture

Schelly, C., Cross, J., Franzen, W., Hall, P., and Reeve, S. (2012). How to go green: Creating a conservation culture in a public high school through education, modeling, and communication. *The Journal of Environmental Education*, *43*(3), 143–161. doi: 10.1080/00958964.2011.631611

Seibold-Bultmann, U. (2007). What does sustainability look like? Green architecture as an aesthetic proposition. *Interdisciplinary Science Reviews, 32*(1), 3-6. doi: 10.1179/030801807X183614

Shallcross, T., and Robinson, J. (2007). Is a decade of teacher education for sustainable development essential for survival? *Journal of Education For Teaching, 33*(2), 137-147. doi: 10.1080/02607470701259382

Taylor, A., and Enggass, K. (2009). *Linking architecture and education: Sustainable design for learning environments*. Retrieved February 10, 2018 from https://ebookcentral-proquest-com.

United Nations Educational, Scientific and Cultural Organization. (1997) *Educating for a sustainable future: A transdisciplinary vision for concerted action.* Retrieved April 15, 2018 from http://unesdoc.unesco.org/images/0011/001106/110686eo.pdf

United Nations Educational, Scientific and Cultural Organization. (2008). *The contribution of early childhood education to a sustainable society.* Retrieved April 30, 2017 from http://unesdoc.unesco.org/images/0015/001593/159355e.pdf

United Nations Educational, Scientific and Cultural Organization. (2012). *Education for Sustainable Development* (4th ed.). UNESCO. Retrieved April 30, 2017 from http://unesdoc.unesco.org/images/0021/002163/216383e.pdf

United Nations Educational, Scientific and Cultural Organization. (2016). *Education for people and planet: Creating sustainable futures for all* (2nd ed.). UNESCO. Retrieved April 6, 2018 from http://unesdoc.unesco.org/images/0024/002457/245752e.pdf

United States Green Building Council. (2018). *LEED v4 for building design and construction.* Retrieved April 12, 2018 from https://www.usgbc.orghttp://www.usgbc.org/ShowFile.aspx?DocumentID=5547

Weinstein, M., Stiefel, L., Schwartz, A., and Chalico. L. (2009) Does Title I increase spending and improve performance? *The Institute for Education and Social Policy (IESP).* Retrieved May 5, 2017 from https://eric.ed.gov/?id=ED556781

Wells, N., and Lekies, K. (2006). Nature and the life course: Pathways from childhood nature experiences to adult environmentalism. *Children Youth and Environments, 16*(1), 1–24. Retrieved March 18, 2017 from https://www.jstor.org/stable/10.7721/chilyoutenvi.16.1.0001

What is Environmental Education? (2017, March 30). Retrieved January 14, 2018, from https://www.epa.gov/education/what-environmental-education

Wiernik, B., Ones, D., and Dilchert, S. (2013) Age and environmental sustainability: a meta-analysis. *Journal of Managerial Psychology 28*(7/8), 826-856. doi: 10.1108/JMP-07-2013-0221

APPENDIX A

QUESTIONNAIRE

I: Environmental knowledge

In this section, you will find 8 questions about environmental problems. Circle the letter that you think corresponds to the correct answer.

1. Where does most of the garbage go after it is dumped from the garbage trucks?
   a. It is dumped into the ocean
   b. It is recycled to make plastic
   c. To a landfill where it is buried
   d. To farmers to use for fertilizers

2. Which is most responsible for creating acid rain?
   a. Sulfur dioxide
   b. Ozone
   c. Nitrogen
   d. Ultraviolet radiation

3. Which is an example of a never-ending energy source?
   a. Nuclear
   b. Oil
   c. Wood
   d. Solar

4. Coal and petroleum are examples of:
   a. Fossil fuels
   b. Renewable sources of energy
   c. Alternative sources of energy
   d. Recycled resources

5. Most air pollution in our big cities comes from:
   a. Cars
   b. Factories
   c. Big trucks
   d. Landfills

6. An item which cannot be recycled and used again is:
   a. Disposable diapers

b. Newspapers
c. Aluminum cans
d. Plastic bottles

7. What happens when people dump waste into oceans, lakes, or rivers?
   a. It flows to other parts of the world
   b. It is used to water plants
   c. It causes water pollution
   d. It increases the amount of water in the Earth

8. Why is it important to conserve water?
   a. We all need it to survive
   b. It is nice to drink in a hot day
   c. We need it to swim
   d. We all need it to shower

II: Environmentally Responsible Behaviors

In this section, you will be asked questions about environmentally responsible behaviors. ***Environmentally responsible behaviors refers to activities people do to help prevent environmental issues.*** Please write an "X" for each of the questions below.

	Always	Frequently	Sometimes	Rarely	Never
How often do you do environmental actions at school?					
How often do you help others at school to remember to do environmental actions?					
How often do you recycle things like paper, plastic or metals in your school building?					
How often do you pick up litter around the school building?					
How often do you turn off the lights al school when leaving the room to save energy?					
How often do you let water faucet run when it is not necessary at school?					

III: Students' perceptions and behavioral intent

In this section, you will find five questions about your school and what you think could help you to take environmental actions in your school. Please be completely honest and detailed as possible. There are no right or wrong answers.

1. What do you like about your classroom?

2. What, in your classroom, would help you to recycle (paper, plastic, metals)?

3. What, in the cafeteria, would help you to recycle (paper, plastic, metals)?

4. What would help you to turn off the lights when you leave the classroom or bathroom in your school?

5. What would help you to turn off the water faucet at school?

APPENDIX B

IRB APPROVAL

THE UNIVERSITY of NORTH CAROLINA
GREENSBORO

OFFICE OF RESEARCH INTEGRITY
2718 Beverly Cooper Moore and Irene Mitchell Moore
Humanities and Research Administration Bldg.
PO Box 26170
Greensboro, NC 27402-6170
336.256.0253
Web site: www.uncg.edu/orc
Federalwide Assurance (FWA) #216

To: Isabel Leon Villasmil
Interior Architecture
Interior Architecture

From: UNCG IRB

Authorized signature on behalf of IRB

Approval Date: 10/03/2017
Expiration Date of Approval: 10/02/2018

RE: Notice of IRB Approval by Expedited Review (under 45 CFR 46.110)
Submission Type: Initial
Expedited Category: 7.Surveys/interviews/focus groups
Study #: 17-0343
Study Title: Promoting Environmentally Responsible Behaviors in Public Elementary School Children

This submission has been approved by the IRB for the period indicated. It has been determined that the risk involved in this research is no more than minimal.

Study Description:
This research seeks to investigate how the built environment affects environmentally responsible behaviors in public elementary schools. The goal of this research is to create feasible and sustainable recommendations that will help existing school buildings be transformed into teaching tools for environmental education, thus influencing students to adopt environmentally responsible behaviors at school.

Study Regulatory and other findings:

- This research, which involves children, meets criteria at 45 CFR 46.404 (research involving no greater than minimal risk). Permission of one parent or guardian is sufficient.
- If your study is contingent upon approval from another site (school district), you will need to submit a modification at the time you receive that approval.

Investigator's Responsibilities

Signed letters, along with stamped copies of consent forms and other recruitment materials will be scanned to you in a separate email. **Stamped consent forms must be used unless the IRB has given you approval to waive this requirement.** Please notify the ORI office immediately if you have an issue with the stamped consents forms.

Please be aware that valid human subjects training and signed statements of confidentiality for all members of research team need to be kept on file with the lead investigator. Please note that you will also need to remain in compliance with the university "Access To and Retention of Research Data" Policy which can be found :http://policy.uncg.edu/university-policies/research_data/.

CC:
Amanda Gale, Interior Architecture

page 1 of 1

APPENDIX C

GUILFORD COUNTY SCHOOLS APPROVAL

Guilford County Schools

December 21, 2017

Isabel Leon Villasmil
915 W. Gate City Blvd.
Lofts on Lee Apt 305
Greensboro, NC 27403

Re: 171824

Dear Isabel Leon Villasmil:

I am pleased to inform you that the Guilford County Schools Research Review committee has concluded that your proposal *Promoting Environmentally Responsible Behaviors in Public Elementary School Children* meets the requirements of state legislation and the current research policy of Guilford County Schools. This decision does not constitute an establishment of a joint research program between the researcher or university and Guilford County Schools.

Committee approval does not guarantee access to schools or to individuals, nor does it imply that a study can or will be conducted. The school principal makes the final decision regarding the participation of their school in the research. Students/parents decide independently whether they wish to participate and they may withdraw at any time. Only consented students can participate in the survey. The committee expects that the identities of individuals, the school, and the district will remain anonymous throughout all stages of the project.

Please present this letter upon initial contact with the principal. Thank you.

Sincerely,

Carolyn Gilbert, Ph.D.
Chair, Research Review Committee

STRIVING. ACHIEVING. EXCELLING.
501 West Washington Street Greensboro, NC 27401 P 336.370.8100

APPENDIX D

PARENTAL CONSENT FORM

CONSENT FOR A MINOR TO ACT AS A HUMAN PARTICIPANT

Project Title: Promoting Environmentally Responsible Behaviors in Public Elementary Schools' Children

Principal Investigator: Isabel Leon Villasmil

Faculty Advisor: Dr. Amanda Gale

Participant's Name: _____

What are some general things you should know about research studies?

Your child is being asked to take part in a research study. Your child's participation in the study is voluntary. You may choose for your child not to join, or you may withdraw your consent for him/her to be in the study, for any reason, without penalty.

Research studies are designed to obtain new knowledge. This new information may help people in the future. There may not be any direct benefit to your child for being in the research study. There also may be risks to being in research studies. If you choose for your child not to be in the study or you choose for your child to leave the study before it is done, it will not affect your relationship or your child's relationship with the researcher or the University of North Carolina at Greensboro.

Details about this study are discussed in this consent form. It is important that you understand this information so that you can make an informed choice about your child being in this research study.

You will be given a copy of this consent form. If you have any questions about this study at any time, you should ask the researchers named in this consent form. Their contact information is below.

What is the study about?

This is a research project. Your child's participation in this project is voluntary. With this study, the researcher will investigate how to positively influence environmentally responsible behaviors in 5th-grade students, through the design of the building and the interior. The goal of the research is to create sustainable recommendations that can be easily and inexpensively implemented in public school facilities to improve the academic environment, promote environmental education, and influence students to adopt environmentally responsible behaviors.

Why are you asking my child?

The participants selected for this research are students who are in 5th-grade. The researcher considers that students at this age are capable of answering the survey questions and their insight will be beneficial and important to this study.

UNCG IRB
Approved Consent Form
Valid from:

10/3/17 to **10/2/18**

What will you ask my child to do if I agree to let him or her be in the study?
This study consists of a questionnaire which will be administered during class. The content of the survey includes questions about what students know about the environment, and also their knowledge and behaviors towards the environment in the school building, such as turning off the lights and recycling. The last part consists of questions about the school and what students think could help them to take environmental actions in the school.

If your child does not wish to answer some of the questions included in the questionnaire, she/he may skip them and move on to the next question. Students who decide to participate in the study will not miss class. The survey is expected to take 15 to 20 minutes of the class period, thus your child will join the classroom activity when he/she has finished the questionnaire. Your child's participation is entirely voluntary. He/she is free to choose not to participate. Should you and your child choose to participate, he/she can withdraw at any time without consequences of any kind nor impact on their grades.

The investigator does not perceive any physical, legal, psychological, or other risks from your child's involvement in this study. However, your child might experience normal anxiety while answering the questions of the survey.

What are the dangers to my child?
The Institutional Review Board at the University of North Carolina at Greensboro has determined that participation in this study poses minimal risk to participants

If you have questions, want more information or have suggestions, please contact the principal investigator Isabel Leon Villasmil at (336) 938-4675 or at icleonvi@uncg.edu, or her faculty advisor Dr. Amanda Gale at ajgale@uncg.edu

If you have any concerns about your rights, how you are being treated, concerns or complaints about this project or benefits or risks associated with being in this study please contact the Office of Research Integrity at UNCG toll-free at (855)-251-2351.

Are there any benefits to society as a result of my child taking part in this research?
You or your child may not directly benefit from participating in this study. However, this study may contribute to the improvement of school facilities that not only enhance health and academic performance, but also create a built environment that can act as a teaching tool for environmental education.

Are there any benefits to *my child* as a result of participation in this research study?
There are no direct benefits to participants in this study.

Will my child get paid for being in the study? Will it cost me anything for my kid to be in this study?
There are no costs to you or payments to you or your child as a result of participation in this study.

UNCG IRB
Approved Consent Form
Valid from:
10/3/17 to **10/2/18**

How will my child's information be kept confidential?
To keep the information safe, all data collected will be kept in a file and on a password-protected computer. To protect confidentiality, your child's name and parents' names will not be used, thus, neither students or parents could be identified by name in the final report. The data from your child will be kept for three years after the closure of the study. Afterwards, all information collected will be destroyed. All information obtained in this study is strictly confidential unless disclosure is required by law.

What if my child wants to leave the study or I want him/her to leave the study?
You have the right to refuse to allow your child to participate or to withdraw him or her at any time, without penalty. If your child does withdraw, it will not affect you or your child in any way. If you or your child chooses to withdraw, you may request that any data which has been collected be destroyed unless it is in a de-identifiable state. The investigators also have the right to stop your child's participation at any time. This could be because your child has had an unexpected reaction, has failed to follow instructions, or because the entire study has been stopped.

What about new information/changes in the study?
If significant new information relating to the study becomes available which may relate to your willingness allow your child to continue to participate, this information will be provided to you.

Voluntary Consent by Participant:
By signing this consent form, you are agreeing that you have read it or it has been read to you, you fully understand the contents of this document and consent to your child taking part in this study. All of your questions concerning this study have been answered. By signing this form, you are agreeing that you are the legal parent or guardian of the child who wishes to participate in this study described to you by Isabel Leon Villasmil.

_____ Date: _____
Participant's Parent/Legal Guardian's Signature

UNCG IRB
Approved Consent Form
Valid from:
10/3/17 to **10/2/18**