GREEN SCHOOLS – THE IMPLEMENTATION AND PRACTICES OF ENVIRONMENTAL EDUCATION IN LEED AND USED GREEN RIBBON PUBLIC SCHOOLS IN VIRGINIA

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ABSTRACT

The purpose of this study was to examine the environmental education curriculum which has been utilized within Green Schools. For this study the researcher defined Green Schools as educational facilities with Leadership in Energy and Environmental Design (LEED) certification or United States Education Department (USED) Green Ribbon recognition. Currently, there is no set standard for the implementation of environmental education in Green Schools or for schools that utilize the building as a teaching tool for students. This descriptive study surveyed Green Schools in the Commonwealth of Virginia in order to better understand what common programs and curricula were being utilized. This study will also assist in establishing pedagogical best practices for environmental education while describing how LEED certified buildings are currently being used by educators as a teaching tool to support sustainable practices.

Overall, 14 Green Schools in the Commonwealth of Virginia agreed to participate in the study. Once principals gave consent for their school to participate in the study, they were asked to respond the survey instrument and invite teachers to participate in the Green Schools eSurvey also. The survey instrument consisted of 14 multiple choice and open response survey items. Overall, 98 principals and staff participated in the survey. Multiple choice survey questions served as the quantitative data for the research study. Quantitative data were examined to report descriptive statistics to provide parameters about the sample population. The frequency and percentage from each category, mean, and mode were also reported from each quantitative

survey item. Qualitative data were examined by emerging themes according to pedagogical strategies and programs.

The findings from the study indicated that teachers are employing practices that are consistent with current emphases on environmental education. Data also supported that educators take pride in their buildings and incorporate the facility as a teaching tool in a variety of instructional practices throughout the Commonwealth of Virginia.

DEDICATION

This study is dedicated to my wife Leah and my children Avery, Hayley, and Alex. Without your constant support, encouragement, and understanding, this would not have been possible. Leah, you make me a better person and I am truly lucky to have a loving wife and family to share these successes. Thank you for pushing me when I needed it and always being there to encourage me. Yes, finally, daddy is finished with his 'project.'

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Chapter 1: Introduction

Background

America's public schools are scrutinized for what is being taught, how it is being taught, and who is teaching in and leading our schools. Some contend that where teaching and learning occur is equally important but has long been ignored, resulting in building conditions that negatively impact student and staff health and performance (Filardo, 2013, 2008). This new awareness has resulted in a growing trend in school construction over the past decade - the development of Green Schools.

Gordon (2010) defines Green Schools as the results of the planning, designing, and construction process that, "takes into account a building's performance over its entire 50-60 year live cycle" (p. 1) with a focus on creating an environment that is optimal for learning. Green Schools create this optimal environment by providing fresh air, a comfortable temperature range, with plenty of natural lighting, and minimizes distractions from nearby noises "while also maximizing resource efficiency, minimizing pollution, and teaching students the importance of innovation in the built environment" (p. 1).

In 2000, the United States Green Building Council (USGBC) created Leadership in Energy and Environmental Design (LEED) as a benchmark for new construction and modernization of Green Schools. The LEED certification provides verification that a building was designed and built using strategies aimed at achieving high performance in key areas previously mentioned, in addition to sustainable site development, water savings, energy efficiency, and materials selection (USGBC, 2012a).

While there has been a growing trend in Green School research, much of the research has emphasized the building components and energy conservation, rather than how the building

features are utilized to teach students about sustainability, not much research has been conducted with regard to the two educational components of Green Schools. In order to be called a Green School, the building must teach about sustainability. Green Schools have two components that are tied directly to educating students about sustainability. The first component is that the building is utilized as a teaching tool for students to learn about sustainability. LEED 2009 for Schools New Construction defines the school as a teaching tool when it has a curriculum based on the green performance features of the building that is implemented within 10 months of the LEED Certification. The curriculum must meet state requirements and go beyond a mere description of the features. Instead, the building should "explore the relationship between human ecology, natural ecology and the building" (USGBC, 2012a, np).

The second component a school must incorporate to maintain its Green School status is that the building must utilize a curriculum for teaching environmental (or sustainable) education. This component does not directly tie sustainability to the features of the building; rather, it infuses sustainable practices and education throughout the curricula taught in the building. However, there is no set standard with regard to environmental education curriculum.

The United States Department of Education recently launched its Green Ribbon Schools, the first comprehensive federal policy for schools that relates environment, health, and education. This award recognizes the work and programs in place at schools reaching high levels of achievement in environmental impact, healthy environment, and environmental literacy. This seemed to be one of the closest efforts in creating a standard for a curriculum that supports environmental education in Green Schools. At the same time teachers and administrators in LEED Schools were implementing the educational components of that certification requirement. To date the degree that this implementation adheres to the intent of the educational LEED requirement is more of an individual matter than a specified effort.

Statement of the Problem

Higher accountability, higher energy cost, and shrinking school budgets are some of major issues many school systems currently face. In addition, school divisions and administrators are carrying the heavy burden and increased pressure to improve student's achievement levels with less money and resources (Okcu, 2011; Kats, 2006). One subject that has recently grown in interest over the past decade is the development of sustainable or Green Schools. Another recent trend in research related to Green Schools was the use of the building as a teaching tool for sustainability. However, this was not emphasized in research and there are no set of standards or consistency with regard to school implementation and little research has been conducted on the subject (Chan, 2013; Cole, 2013).

Research Questions

The available research and scholarly reviewed literature was examined for the following research questions:

1. How do USED Green Ribbon and LEED schools in Virginia implement environmental education into the curriculum?
    a. In what way is environmental education included in the curriculum of the school division?
    b. To what extent is the implementation of environmental education directed by individual classroom teachers?
    c. What common practices and strategies are used to implement environmental education?
    d. What level are the practices used to implement environmental education formally evaluated?

e. How do LEED schools in Virginia utilize the building components as teaching tool?

Significance

While considerable research has been conducted linking building conditions to student achievement and staff performance, there has been little research linking any added benefits of newly designed sustainable school buildings, and even less on the topic of Green Schools as a teaching tool (Barr, 2013; Chan, 2013, Cole, 2013; Issa, 2011; Okcu, 2011; Kats, 2006; and Edwards, 2006; Olson and Kellum, 2003). Green buildings have criteria of an educational program to help students become aware of their environment (Chan, 2013; Cole, 2013; Barr, 2011). While Green Schools are designed to utilize a curriculum for environmental education which uses the building as a teaching tool, there is no set standard or criteria of implementation (Barr, 2012). LEED and USED Green Ribbon schools provide a framework for the implementation of environmental education which can be further examined to assist in establishing what common themes are currently found in environmental education curricula.

As an educational leader, it is important for principals to consider the economic impact the school program has on the school division and the community as tax payers. It is equally important to understand how environmental education can positively influence staff, and students, and how the surrounding community can assist in the promotion of civic and environmental responsibility. Each of these components is important to consider as a responsibility of the school system.

This study will add to the current, but limited, body of research involving Green Schools with regard to usage of the building as a teaching tool and implementation of environmental education. The findings from this study will help educators see current trends of sustainability curricula in Green Schools and how Green Schools are used as a teaching tool for sustainability.

Definitions of Key Terms

Several key terms were used throughout the study and are defined here to facilitate the understanding of their usage.

- *Environmental Education* a curriculum that explores the relationship between human ecology, natural ecology and the school building (USGBC, 2012a).
- *School as A Teaching Tool is* a curriculum based on the high-performance features of the Green School building (USGBC, 2012a).
- *Green Schools* are school buildings that utilize design features and building technology to provide a healthy indoor environment, conserve energy, educate and teach environmental sustainability (Kats, 2006). Both sustainable schools and high-performance schools are synonymous with the term Green Schools. USED Green Ribbon and LEED schools are considered to be Green Schools.
- *Leadership in Energy and Environmental Design (LEED)* is a rating system which awards certification to buildings that meet standards designed by the U.S. Green Building Council. This third party verification process rates buildings as "certified," "silver," "gold," or "platinum," depending on the number of credits received certification provides verification that a building was designed and built using strategies aimed at achieving high performance in key areas (USGBC, 2012b).
- *USED Green Ribbon Schools* is a recognition award that honors "schools and districts that are exemplary in reducing environmental impact and costs; improving the health and wellness of students and staff; and providing effective environmental and sustainability education, which incorporates STEM, civic skills and green career pathways" (USED, 2013, np).

Limitations

There are a myriad of variables that affected how, and to what extent, teachers and schools utilize curriculum. This study focused only on the implementation of environmental education for LEED and USED Green Ribbon public schools within the Commonwealth of Virginia. As a result, this study was limited to public schools that were LEED certified or USED Green Ribbon recognized within the Commonwealth of Virginia. The response data from school administrators and teachers were also limited by their interpretation of programs utilized and varieties that may exist from one school division to another school division.

Private schools in the Commonwealth of Virginia were not included in the study. Furthermore, the LEED certified private schools in the state have campuses that included multiple buildings and only specific buildings were recognized as LEED certified.

Organization of the Study

This study was organized into five chapters. Chapter 1 contains an introduction of the topic, statement of the problem, research questions, significance, definition of key terms, limitations, and the organization of the study.

Chapter 2 contains the critical reviews of studies related to LEED schedules in chronological order.

Chapter 3 includes the methodology for the study, population, data gathering, and data analysis.

Chapter 4 describes the findings of the data collection and methodology of the findings of the research study.

Chapter 5 includes the summary of the findings, discussion, conclusion, and implications for further study.

Chapter 2: Review of Literature

The purpose of the literature review that follows is to identify current research that has been conducted on Green Schools or LEED certified schools. Currently, the body of published research regarding Green or LEED schools is limited. This chapter will provide a background of current trends in Green School construction and design and a review of the current published research.

Principles and Guidelines of Sustainable Design

According to the USGBC,

> The quality of educators and curriculum are the most important factors in a student's scholastic performance, but the quality of school facilities – *where* students learn – is often overlooked. School buildings can enhance a student's ability to learn by keeping them healthy, attentive and present. (USGBC, 2012a, np)

There are several components of Green Schools that are oftentimes tied to improving student and staff health and performance. These components are improved indoor air quality, acoustics, thermal comfort, and increased daylighting. Each of these components, and other elements, can be utilized to in the implementation of environmental education. All Green Schools work to improve indoor air quality by controlling the exposure to contaminants such as carbon monoxide, dust, pollen, and mold spores. Green Schools, by improving indoor air quality, can improve overall health of staff and students and thus potentially reduce absenteeism related to illnesses (USGBC, 2012a; Okeu, Ryherd, and Bayer, 2011; Schneider, 2002).

The usage of daylighting in Green Schools helps reduce to reduce energy costs, but the USGBC also stated that increases in natural daylighting can help improve student and staff alertness (USGBC, 2012a; Tanner, 2009; Heschong, Wright, and Okura, 2002). Acoustics in Green Schools gives an added attention to acoustical ceiling tiles, and lined ductwork and HVAC

systems with consideration to vent placement, which assist in creating an environment that minimizes distractions caused by background noise (USGBC, 2012a). Lastly, thermal comfort builds on the benefits of indoor air quality by ensuring comfortable temperatures and that fresh air is circulated appropriately throughout the building. Comfortable temperatures and fresh air help increase productivity and alertness (USGBC, 2012b; Okeu et al, 2011, Olson and Kellum, 2003).

Several components of the building can be utilized to help teach about sustainability practices and environmental education. Curricula and programs are also implemented in many Green Schools.

Leadership in energy and environmental design (LEED).

Leadership in Energy and Environmental Design (LEED) was developed in 2000 by the U.S. Green Building Council (USGBC, 2012b). The LEED certification is provided through a third-party, independent verification. This certification supports that a building was designed and built using techniques focused on achieving high performance in areas of human and environmental health. These areas include: sustainable site development, water savings, energy efficiency, materials sections and indoor environmental quality (USGBC, 2012b).

LEED measures several aspects of the construction process and the building's overall performance as it relates to sustainability specifically in the following key areas:

Sustainable Sites - This pertains to the site selection as it relates to the construction and the building's impact on the surrounding environment.

Water Efficiency - This area aims to reduce the use of water both inside and outside of the building.

Energy & Atmosphere – "According to the U.S. Department of Energy, buildings use 39% of the energy and 74% of the electricity produced each year in the United States

(USGBC, 2012b). This category encourages a wide variety of energy-saving strategies, to include some of the following methods: energy use monitoring; efficient design and construction; use of efficient appliances, energy efficient systems and lighting; the use of renewable and clean sources of energy, and use of energy generated on-site or off-site (USGBC, 2012b).

Materials & Resources - This category's focus aims to reduce the amount of waste produced during construction while promoting the selection of materials that promote sustainable practices.

Indoor Environmental Quality - According the USGBC, the U.S. Environmental Protection Agency (EPA) estimates that Americans spend about 90% of their day indoors, where the air quality can be significantly worse than outside. This category promotes the improved indoor air quality, increased use natural daylight, and improve acoustics (USGBC, 2012b).

Locations & Linkages - This category relates to the building's location relative to public transportation and other community resources, such as outdoor parks, while reducing the building's visual impact within the community.

Awareness & Education - This area encourages the building to be used as an educational tool to provide information and resources regarding sustainable practices used throughout the building's design and construction process.

Innovation in Design - This area promotes the use of innovation and awards points in areas that are not otherwise credited through the LEED process, but support the overall theme of sustainable design.

Regional Priority - "USGBC's regional councils, chapters and affiliates have identified the most important local environmental concerns, and six LEED credits addressing these

local priorities have been selected for each region of the country. A project that earns a regional priority credit will earn one bonus point in addition to any points awarded for that credit. Up to four extra points can be earned in this way" (USGBC, 2012b).

During the construction process, specific criteria (mentioned above) must be met and points are awarded based on the related design features of the facility. Buildings earn various levels of LEED certifications based on the number of points earned for the design and the construction. The total number of points available is 100 with 10 additional bonus points for innovation in design and regional priority. Building certification are as follows: 40-49 points - Certified status, 50-59 points – Silver, 60-79 – Gold, and 80 points and above – Platinum (USGBC, 2009).

The section for *Innovation in design* also includes criteria for utilizing the building as a teaching tool. This criterion specifically includes the following guidelines:

- The sustainable features of the school become part of the school educational mission
- Design a curriculum based on the high-performance features of the building, and commit to implementing the curriculum within 10 months of LEED certification.
- The curriculum should explore the relationship between human ecology, natural ecology and the building.
- Curriculum must meet state curriculum standards, and provide 10 or more hours of classroom instruction per year, per full-time student (USGBC, 2009)

Collaborative for high performance schools.

The Collaborative for High Performance Schools (CHPS) is a non-profit organization committed to making school buildings better places to learn. The organization was founded in 1999 as a method of California's utilities to address energy efficiency in schools. The program

later expanded to include all aspects of school design, construction, and operation. CHPS buildings are recognized by two categories: CHPS Verified and CHPS Designed. CHPS Verified provided an independent review of the building using the CHPS criteria to assess the level of performance. Buildings that meet the minimum certification receive a CHPS plaque. CHPS Verified Leader is a higher level of distinction for schools that perform beyond the minimum eligibility requirements. Lastly, CHPS Designed is a self-certification process that provides a certificate and use of the CHPS Designed logo (CHPS, 2011).

Similar to LEED, CHPS measures several aspects of the construction process and the building's overall performance as it relates to sustainability specifically in the following key areas using a score card:

Integration - This category is similar to the LEED category - Innovation of Design. It awards points for using new sustainable technologies while creating a neutral carbon footprint.

Indoor Environmental Quality - Overall, this category is the same as the LEED category for IEQ.

Energy - This category ensures minimum energy performance standards set by ASHRAE, utilizes an energy management system, and provides training to school staff regarding high performance features.

Water - This category aims to reduce the amount of rain and water runoff while reducing the usage of water systems throughout the building such as landscaping and sewage.

Sustainable Sites - This advocates site selection and possible negative impacts the site may have on the surrounding environment.

Materials and Waste Management - allows points to be awarded for recycling materials used and utilizing materials that are renewable or rapidly renewable.

Operations and Maintenance - This category measures the policies put into place for green cleaning methods, no idling for all school buses, and indoor environmental management plans. (CHPS, 2011)

The section for *Integration* also includes criteria for utilizing the building as a teaching tool. This criterion specifically includes the following guidelines:

- Educational Display - the buildings must provide a permanent education display in prominent school location
- Enhanced Integrated Design - Implement integrated design team meetings to discuss high performance school features and implementation within the buildings by those occupying the facility
- Demonstration Areas and Staff Training - Provide at least three education demonstration areas for students, staff, and the community
- School Garden - Provide infrastructure for a school garden

While there are some differences in the criteria and the rating systems, the LEED and CHPS are similar in the overall structure. Note Table 1, below for a side-by-side comparison of LEED and CHPS criteria.

Table 1 - LEED Criteria versus CHPS Criteria

LEED Criteria	**CHPS Criteria**
Sustainable Sites	*Sustainable Sites*
Water Efficiency	*Water*
Energy & Atmosphere	*Energy*
Indoor Environmental Quality	*Indoor Environmental Quality*
Materials & Resources	*Materials and Waste Management*
Innovation and Design	*Operations and Maintenance*
Regional Priority	*Integration*

Energy Star.

Energy Star certified facilities must meet strict energy performance standards set by Environmental Protection Agency (EPA). They have also been noted for less energy usage, lower operational costs, and lower production of greenhouse gas emissions than non-certified facilities (Energy Star, 2012b). To qualify for the Energy Star, a building must earn a 75 or higher on EPA's 1-100 energy performance scale. This indicates that the facility performs better than at least 75% of similar buildings nationwide (Energy Star, 2012b). The performance scale accounts for differences in operating conditions, regional weather data, and other important considerations. As part of the certification process, schools develop a comprehensive energy management program by evaluating current energy performance of their facilities. Once evaluated, Energy Star provides ideas for improvement through a rubric that assesses all aspects of the facility (Energy Star, 2012a). The following guidelines are part of the implementation of energy management in earning an Energy Star certification: commitment to energy management

and conservation, initial and frequent performance assessment, create performance goals, develop and implement an action plan to improve energy performance, continuously evaluate progress, and recognize achievements (Energy Star, 2012a).

Current Research on Green Schools

There are currently five studies related to Green Schools that have been published since 2006. Three of the studies are dissertations that include LEED schools in the United States (LaBuhn, 2010; Oetinger, 2010; and Bruick, 2009). Edwards (2006) was the earliest study and compared student achievement of Green and non-Green Schools in the United Kingdom. The most recent study by Issa, Rankin, Attalla, and Christian (2011) was conducted in Canada. The following is a brief summary of each of the above referenced studies, beginning with the most recent.

Issa, Rankin, Attalla, and Christian (2011) conducted a study that investigated the possible relationship between the performance of students in Green Schools and non-Green Schools, and assess teacher's satisfaction with different aspects of the school's indoor environment.

The New Brunswick Construction Engineering and Management Group partnered with the Toronto District School Board to conduct this study that included students in 33 of the Toronto schools. The sample of schools consisted of 10 conventionally built (non-Green) schools, 20 schools that were energy-retrofitted, and three Green Schools. Green Schools were identified using LEED standards and certified by the Canada Green Building Council (Issa et al., 2011). For this study, conventional schools that were renovated with lighting and mechanical updates that made them more energy efficient were classified as energy-retrofitted schools (Issa et al., 2011).

Two types of quantitative data were collected in this study. The first type of data were obtained from the individual schools. These data included demographic information about students, staff, and teacher population from the past five years. It also included a sample of attendance data for students, staff, and teachers from the same three-month (September through December) period of each school year. Lastly, data were collected from student assessments for math, reading, and writing for third and sixth grade students. The assessment data were collected through the Education Quality and Accountability Office, which assesses the student achievement for all Ontarian public schools (Issa et al., 2011).

The second types of data entailed both quantitative and qualitative data obtained through surveys completed by school teachers from the schools used in the sample. The survey was a post occupancy evaluation for teachers working in the schools studied. "Of the entire population of approximately 600 school teachers, 150 were surveyed, to ensure a 95% level of confidence and a 7% confidence interval. The teachers were selected randomly and surveys were anonymous with a response rate of 69%" (Issa et al., 2011, p.3).

"The survey consisted of 14 questions: 10 qualitative (opinion) questions and three quantitative ones. Ten of the 14 were closed-ended (multiple choice, Likert scales)" (Issa et al., 2011, p. 3). The survey asked questions regarding the teacher's satisfaction with the physical conditions of the school which included: classrooms, workspaces, lighting, heating ventilation and air conditioning, and indoor air quality and acoustics.

Issa et al. (2011) examined the "relationships between school type category, absenteeism of students, staff and teachers; students' grades, and teachers' satisfaction with different aspects of the schools' indoor environment were statistically tested using a multiple analysis of covariance (MANCOVA) test" (Issa et al., 2011, p. 5). The test further controlled for the

following variables: school building age, ratio of floor area to occupant, and the average income for surrounding neighborhoods where the schools were located. If the school category type was statically significant with an alpha level of $p < .05$, the analysis of covariance (ANCOVA) test was used to examine the effect separately on each dependent variable (Issa et al., 2011, p. 5). "If the effect was significant, then correlation (R) and determination (R2) were calculated. A post hoc Tukey test was used to examine the statistical significance of the difference between every two means for that effect" (Issa et al., 2011, p. 5).

Non-parametric tests were utilized to rank possible problems that may be a result of confounding from each category of school data collected. The Kruskal-Wallis test was used to examine the overall effect of school category on the ranking each potential problem. If the effect was significant, then a multiple comparison of means test was completed to evaluate the differences in the means between each category. The Friedman test was used within every school category to test overall differences in the ranking of problems. Kendall's coefficient of concordance (CC) was also used to examine how much teachers in every school category agreed on the problems facing their schools. "If the Friedman test showed a statistically significant difference (at $p<0.05$), then the Wilconon Matched Pairs test was used to test the statistical significance of the difference between the ranking means of every two problems" (Issa et al., 2011, p. 5).

The analysis of data revealed that school category had a statistically significant effect on teacher satisfaction with the physical conditions of the school, after controlling for effects of age and floor area compared to the number of occupants ($p=0.00$). School category also had a significant effect on every dependant variable separately when controlled for building age and floor area (p between 0.00 and 0.01). Although, not significant, there were associations found

with respect to school category and teachers' satisfaction with each aspect of the schools' overall physical condition (R between 0.32 and 0.43, and p=0.00 for all). The only exception was use and availability of space (R=0.23, p=0.06).

Classrooms, personal workspaces, lighting, and thermal comfort all showed that school category had a statically significant overall effect on teachers' satisfaction after controlling for building age and floor area (p=0.00). After controlling for the effects of school age and neighborhood income level, it was found that absenteeism was statistically significant (p=0.00). Tests also showed teacher absenteeism was significant (p=0.00), but not students or other staff (p=0.18 and p=0.06, respectively). The Tukey test revealed the only statically significant difference in teacher absenteeism is between energy-retrofitted and conventional schools. It should also be noted that, while not statistically significant, Green Schools absenteeism was lower than conventional schools by 4% for students, 2% for teachers, and 7.5% for other staff (Issa et al., 2011).

While students' grades were higher for those attending energy-retrofitted and Green Schools, overall student performance did not show a statistically significant effect on students grades (p=0.73 for both retrofitted and Green Schools). It is important to note that students in grade 3 and 6 in Green Schools scored 2.5-17.5% higher in all tests than students' in energy-retrofitted schools, and 8-19% better than students in conventional schools (Issa et al., 2011). Absenteeism rates decreased by 2-7.5% for Green Schools when compared to retrofitted and conventional schools, respectively. The decrease in absences was not found to be statistically significant (Issa et al., 2011). The researcher noted a small sample size as a limitation for the study and hypothesized that a larger sample size may have resulted in statistically significant results (Issa et al., 2011).

While this study examined an in-depth analysis from one school district in Canada, the following study by LaBuhn (2010) takes a different approach by including several regions across the United States. While this method helps in generalizing the findings, it does not produce the consistency in data collection that Issa et al (2011) provides.

LaBuhn (2010) conducted a study that tested the impact of design elements of Green Schools on students' health, attendance, and academic achievement when compared to non-Green Schools. LaBuhn (2010) compared four elementary schools that were LEED Gold certified, from four regions of the United States, with non-green elementary schools from the same respective school district (LaBuhn, 2010). The regions selected included Iredell County, NC (a rural and suburban district outside of Charlotte, NC), Monmouth County, NJ (a suburban region of central NJ), Montgomery County, MD (a large urban district outside of Washington, D.C.), and Portland, OR (a large urban district in the Pacific-Northwest).

LaBuhn sought to answer the following research questions:

1. Do students who attend LEED certified schools report fewer health problems than student who attend non-certified schools?
2. Do students who attend LEED certified schools have better attendance rates than students who attend non-certified schools?
3. Do students who attend LEED certified schools perform better on standardized tests than students who attend non-certified schools? (LaBuhn, 2010, p. 8)

Data for student achievement, attendance, and student health were collected from each school district. Each state utilized a different assessment for student achievement and, therefore made it difficult to compare between districts. Since the population consisted of LEED Gold

schools from different states the data gathered were compared with non-Green Schools within the district, rather than across the districts (LaBuhn, 2010). Attendance data were also collected and compared within districts. Attendance data were also controlled by student's race/ethnicity and socioeconomic status at each school (LaBuhn, 2010). Student health data were collected for only two districts since there was no standard set collecting this data across the four districts used in this study. LaBuhn (2010) utilized a case study method to compare the health history of students from the Montgomery County, MD and Portland, OR school districts. The data from each school division was similar in format and allowed for analysis of the type and frequency of clinic visits of students for the schools that were utilized in the study. The data consisted of student health information from following school years; 2006-2007, 2007-2008, 2008-2009, and 2009-2010 (LaBuhn, 2010).

The sample population of LEED Gold elementary schools used in the study were compared to other non-green elementary schools within the same district or geographic locations. A cohort was created within each district or geographic area with which to compare the dependent variables (academic achievement, attendance, and student health). The following data for each school were collected for each school: enrollment, gender, ethnicity, English as a primary language, socioeconomic status and mobility rate. The research does not indicate that schools were matched based on this data to control for confounding. Student achievement data from the respective state's standardized tests in math and reading were also collected for third, fourth, and fifth grades (LaBuhn, 2010).

Student achievement data were measured utilizing standardized test scores for reading and math in third, fourth, and fifth grades from each school. Science test scores were not utilized in this study because students were not provided a standardized assessment for science at each of

the grade levels (LaBuhn, 2010). A linear regression model was used to analyze both standardized tests and student attendance rates for students. LaBuhn notes that the data from each district varied in detail, so the regression model utilized different dependent and independent variables to help control for the differences in data. Cumulative school year data were analyzed from 2006-2007, 2007-2008, and 2008-2009. The student achievement for math and reading scores and student attendance was also analyzed cumulatively from third to fifth grades. It was explained that this would allow for a simpler design and more efficient comparison between schools within each district (LaBuhn, 2010).

The findings for this study were reported for each category: academic achievement, attendance, and student health for each LEED Gold elementary school compared to the cohorts from their district or geographic location. All statistical analyses were completed using the Statistical Package for the Social Sciences (SPSS) with an alpha level of $p>0.05$. Standardized test scores in reading and math (grades 3, 4, and 5) were collected for three school years, from 2006-2007 to 2008-2009, and used as the dependent variable in the linear regression model. Outcome data scores (B) for Green Schools were set at 0 in order to compare to the other schools within the cohort. "A positive (B) score and a (p) score of .05 or lower represents test scores or attendance rates that are significantly better than the Green School cohort" (LaBuhn, 2010). For example, a cohort school with a (B) of .400 and a (p) of 0.01 would indicate that the school significantly outperformed the LEED school. Conversely, if the students in the non-Green School scored ($B=-.400$, $p<.001$), then it would indicate that students in the LEED school significantly outperformed the non-Green School within the cohort (LaBuhn, 2010).

In the cohort of schools from Montgomery County, MD LaBuhn reported that Great Seneca Creek Elementary (the LEED Gold elementary school) was significantly outperformed

by Darnestown (B=.099, p<.001), Ronald McNair (B=.083, p<.001), and Spark Matsunaga (B=.073, p<.001) with subject and grade level as the independent variables. Overall performance placed the LEED Gold school in the middle of the cohort of schools that it was compared against (LaBuhn, 2010).

In Iredell, NC Third Creek Elementary was the LEED Gold school in the cohort study and yielded the lowest performance in the cohort with school and subject as the independent variables. The LEED Gold school was significantly outperformed by Sharon Elementary (B=.246, p<.001), Celeste Henkel (B=.133, p=.024), and Scotts (B=.138, p=.019). A secondary analysis was conducted using socioeconomic status as an independent variable which indicated a strong predictor of test scores (B=-.963, p=.001) (LaBuhn, 2010). However, no information is provided in the study to indicate which schools in the cohort had the highest representation of students with low socioeconomic status.

Rosa Parks Elementary is the LEED Gold school used in the Portland, OR cohort. Academic achievement in this cohort indicated three schools (of the seven in the cohort) where students significantly outperformed Rosa Parks. These schools were Buckman (B=.256, p<.001), Chapman (B=.249, p<.001), and James John (B=.011, p<.001). While there was not a significant difference in student's scores, Rosa Parks did outperform one school in the cohort, Sitton (B= -.189, p=.887) (LaBuhn, 2010,). A second regression was run using economically disadvantaged as an independent variable, however, the analysis did not indicate this was a significant predictor of academic achievement (B=1.33 E-05, p=.744).

In the New Jersey cohort, Summerfield Elementary (in Neptune Township) was the LEED Gold school compared to non-Green School from that district. While student performance for Summerfield was in the middle of the cohort, it was significantly outperformed

by only one school, Shark River (B=13.272, p=.008). Student achievement was significantly higher than Midtown Elementary (B= -12.756, p=.010). When a second regression was run controlling for economically disadvantaged students at each school, there were no significant differences reported (LaBuhn, 2010).

Attendance data were collected from each school district and state education websites. It was noted that each state reported attendance data in different categories. For example, Montgomery County Schools reported overall attendance and separated by subpopulations. Iredell-Statesville schools only reported cumulative attendance for each school campus. In Montgomery County Schools, a linear regression was run using overall attendance percentages from grades 1-5 as the dependent variable with four independent variables (school, school year, percentage of teachers with 5 years of teaching experience, and average class sizes) (LaBuhn, 2010, p. 70). This analysis reported that student attendance from the LEED Gold school, Great Seneca Creek, was significantly lower than Ronald McNair (B=.007, p<.001) and Spark Matsunaga (B=.009, p<.001). A second regression for student attendance was run with student with free and reduced meals as the dependant variable. This analysis yielded similar results with significantly lower attendance than Ronald McNair (B=.007, p=.040) and Spark Matsunaga (B=.014, p=.002). There were no significant differences when a third regression was run using the percent of Limited English Proficient students as the dependant variable (LaBuhn, 2010).

Since Iredell-Statesville, NC reported attendance collectively, the average attendance, average class size, and years of teacher experience were used as independent variables with a dependent variable of average percent attendance for all students. In this analysis, Third Creek (the LEED Gold school) had the worst attendance of the cohort with significantly lower student attendance than Scotts (B=.007, p=.039) and Sharon (B=.009, p=.020). It was also noted that

Third Creek had the highest percentage of new teachers (0-3 years teaching experience) and the second lowest percentage of teachers that were fully licensed (LaBuhn, 2010).

Rosa Parks Elementary in Portland, OR utilized the most comprehensive regression analysis with the following independent variables: school, academic year, average years of teaching experience, socioeconomic status, and average class size. The dependent variable was the percentage of attendance for all students. This analysis found Rosa Parks to have the highest student attendance in the cohort, however, it was only significantly higher than Sitton (B= -.018, p=.037) (LaBuhn, 2010).

The attendance data from Neptune Township, NJ reported the percentages of all students and all grade levels collectively. Years of teacher experience was not available for this cohort, instead this data was substituted with data for the percentages of teachers with undergraduate, graduate, and post graduate degrees. The regression analysis was run using the percentage of student attendance as the dependent variable and the following independent variables: school, average class size, and teachers with a BA or BS. This analysis did not report any significant findings for student attendance between schools. Further, level of teacher education and class size did not have a significant effect student attendance (LaBuhn, 2010).

LaBuhn (2010) reported that data pertaining to student health variety greatly in complexity between each of the four districts. Since there was no uniformity in the data, a case study design was utilized to compare student's health histories for two of schools (Great Seneca Creek Elementary in Montgomery County, MD and Rosa Parks Elementary in Portland, OR. Montgomery County provided the researcher with health data from 2009-2010 for all schools in the county. The data provided allowed LaBuhn to analyze the number of and cause of visits to the clinic and compare this data to the other schools in the respective cohort. Similar data were

received from Portland School District and included the school years 2006-2007, 2007-2008, 2008-2009, and 2009-2010 (LaBuhn, 2010).

The data for clinic visits in Montgomery County were narrowed to the following ailments that could be contributed to poor indoor air quality: allergies, asthma, nebulizer treatment, inhaler use, upper respiratory, nasal congestion, shortness of breath, wheezing, headache, and not feeling well. The data were sorted and tabulated by school and frequency for each of the above mentioned ailments. Overall, for the Montgomery County cohort, visits to the clinic were highest for asthma, inhaler use, headache, and not feeling well. Of the six schools represented in the cohort, Great Seneca Creek had the second highest rate of visits to the clinic for three of the four categories represented (asthma, inhaler use, and headache). However, Great Seneca Creek had the second lowest percentage of visits when not feeling well was listed as the category (LaBuhn, 2010).

Data provided from Portland Public Schools did not document a detailed symptom log as was noted in Montgomery County Schools. The district did record collective data on student visits, documented visits with asthma related symptoms, and severe allergies. Data in an Excel spreadsheet were provided for the schools in the Portland cohort for the school years 2006-2007, 2007-2008, 2008-2009, and 2009-2010. Rosa Parks reported the second lowest rate of complaints associated with asthma within the cohort. In the category for severe allergies, five of the seven schools reported complaints below five percent, with Rosa Parks being among the lowest over the four years. However, while Rosa Parks reported lower rates of visits to the clinic for asthma and severe allergies, it was among the highest in the cohort for overall visits to the clinic. Over the four years, Rosa Parks had the third highest rate of visits to the clinic. LaBuhn

noted that the high percentage of students eligible for free or reduced lunch at Rosa Parks (96.7% in 2009) may have been a confounding factor.

While the study did not find supporting evidence that Green Schools produce higher student achievement and attendance, it was noted that several limitations in the study. LEED Gold schools were used as a measure of Green Schools compared to non-Green School. However, the sample provided a broad range of populations from different regions in the United States, this made it difficult to match schools and control for confounding. Further, since each district utilized different assessments to measure student achievement, the results could not be compared between groups, only within the group cohorts. It was also noted that student attendance data was not uniform from each district. Lastly, each school division was distinctive in their setting (rural, suburban, urban, etc) and population which also makes comparison between groups difficult and affects external validity and reliability. The analysis and design were appropriate in attempting to predict the effects that Green Schools have on student achievement and attendance when compared to non-Green Schools. However, this design is limited in that it provides correlation between variables, and not causation. If the study were to be replicated, it would be interesting to see if a matched pair for each school yielded different results using an independent sample t-test to directly compare each of the outcomes (student achievement and attendance).

Also conducted in 2010, Oetinger utilized a mixed-methods design comprised of quantitative and qualitative data that compared Green and non-Green Schools across the United States. Quantitative data consisted of a survey sent to LEED Certified and Energy Star Certified school facility personnel. Additional quantitative data were obtained by collecting district testing data to determine if students in the new or renovated facilities achieved at a higher rate

after occupying the sustainable facility. The researcher collected qualitative data through face-to-face interviews with two professional architects (Oetinger, 2010).

The study involved recently renovated and newly constructed facilities from across the United States. During the time of the study there were ninety-eight LEED certified school facilities completed. Of the LEED certified schools, 21 were not sampled during the study because they do not have annual yearly progress statistical data. Ninety-eight Energy Star school facilities were also selected for the study. Surveys and interviews were used to collect data along with test scores from state-wide student assessments. The survey was disseminated to obtain data regarding the following: project planning, size, cost, financial benefit, and staff and student attendance. The student assessment data were collected from the school districts' standardized reading scores to determine if students scored higher in reading after moving into the sustainable facility (Oetinger, 2010).

In considering the scope of the study and the research questions, the mixed-methods design was an appropriate method of study design. Quantitative data were collected through a survey that was sent to school facility personnel at LEED Certified and Energy Star Certified schools. Additional data were obtained through district student achievement testing. The student achievement data were utilized to determine if students in the new or renovated facilities had higher achievement on district tests after occupying the green facility. Qualitative data were collected through personal interviews with two professional architects (Oetinger, 2010).

The results of the survey data were sorted into the two groups: LEED certified and Energy Star certified facilities. Oetinger reported;

> Survey responses were then categorized by the following: (a) completion date, (b) project team composition, (c) project timeline, (d) type of facility constructed or renovated, (e) total cost of project, (f) size of facility after the project was complete, (g) 51 student population, (h) utility cost prior to the project and after completion, (i) student attendance prior to the project and after completion, and (j) staff attendance prior to the project and after completion. Figures were developed to show the number of responses to each survey question. Similarly, Adequate Yearly Progress (AYP) data were presented with respect to LEED certified and Energy Star certified school facilities. (Oetinger, 2010, p. 49)

The interviews were used to support information gathered from the survey results and student test results. Open-ended questions were used to allow the participants a greater degree of expression on their opinions and perspectives. "A data coding system was established to ensure responses remained confidential. Responses were categorized to determine common ideas and themes" (Oetinger, 2010, p. 51).

There was no statistical analysis completed for this study. The study compared percentage of increase and/or decrease in the student's reading test results, attendance for students, and attendance for staff for LEED and Energy Star for each survey question and test data.

Survey results reveled that, "LEED certified school facilities constructed or renovated during the timeframe from 2001 to 2008 increased 2,900%, and 1,400% for 82 Energy Star certified facilities over the same timeframe" (Oetinger, 2010, 81). The planning team for these schools consisted of a variety of school and community stakeholders as part of the planning team and the majority of the projects took six to nine months to plan. Stakeholders included central

office administration, staff members, community members, and school board members. Nearly half of LEED and Energy Star projects were elementary schools. Project cost ranged from one and ten million dollars and the majority of LEED projects were between thirty thousand and seventy thousand square feet. The projected student enrollment ranged from three hundred to five hundred students. The Energy Star certified projects were between one hundred thousand to one hundred and fifty thousand square feet with a projected capacity of five hundred to seven hundred and fifty students. Utility costs for both types of facilities decreased by 19% or more. Overall, student attendance percentage increased by 1.91% for LEED certified facilities and 1.27% for Energy Star facilities. The overall percentage of staff attendance increased by 1.71% for LEED certified facilities and 1.16% for Energy Star. Student performing rated at proficient or above increased by 2.25% in LEED certified facilities and 2.16% in Energy Star certified facilities (Oetinger, 2010).

Some of the limitations of this study are as follows:

- Only used 98 LEED facilities, which were the only educational facilities building with LEED certification at the time of the study.
- Green construction is relatively young and this limited the number of facilities available from which to collect data.
- Renovations vary from building to building based on the individual needs of the building.

The data were good; however, no statistical analysis of the data were reported or retrieved from the testing results in order to identify significant findings for student achievement for students in LEED and Energy Star facilities. Overall, the study found favorable results for green buildings for reduced utility cost, attendance, and student achievement. However, the study

did not identify a population that the data were compared. The variables were only compared against other - LEED versus Energy Star (Oetinger, 2010).

Since state-wide assessments were utilized, how were the differences in assessments controlled for from state-to-state? Also, with regard to utility cost, the study reported a 19.41% and 20.62% decrease in cost for LEED and Energy Star, respectively. However, the study does not give a base measure from which to make comparisons.

While LaBuhn (2010) and Oetinger (2010) conducted studies that included Green Schools from across the United States, Bruick's (2009) study included only four schools from one school district in Arkansas. While confined to one school district, Bruick did match Green with non-Green Schools based on similar demographic populations.

Bruick (2009) conducted a study that examined the relationship of school buildings constructed with Leadership in Energy and Environmental Design (LEED) certification may have on student achievement, student attendance, and the teacher's perceptions when compared to non-LEED schools. The study included four schools in Arkansas's Bryant School District that were matched with similar demographics. Two elementary and two middle schools were selected from the district. One elementary and one middle school were identified as being LEED certified by USGBC.

Public domain data were collected from the Arkansas State Education and Bryant School District websites which consisted of scores from state-wide assessments for Math and Literacy in grades 3-8 and overall daily attendance for each school. Secondly, a survey was sent to teachers from a broader pool of school teachers using the USGBC's membership list of LEED certified projects. Matching teachers, in non-LEED buildings, were also selected from the same school

districts as those in LEED school buildings. Survey participation was voluntary and anonymous. A total of 731 teachers responded to the survey reflecting 49% response rate. "Of the 731 participants, 149 taught in LEED schools, 363 taught in non-LEED schools, and 219 were unsure if their building was a LEED school. Those responses were excluded from the study" (Bruick, 2009, p. 48).

The quantitative design utilized Green Schools, school level (elementary or middle), and grade level as the independent variables. The dependent variables were math and literacy scores from state-wide assessments, attendance percentage, and results from teacher perception surveys. "Student assessments from benchmark data were analyzed using a hierarchical multivariate analysis of variance with Green Schools, school type, and student grade level as the independent variables. The dependent variables were math and literacy percentage scores for 2007-2008 (Bruick, 2009). "Grade level was nested under type of school, and type of school nested under green. Attendance data were analyzed using a one-between one-within design" (Bruick, 2009, p. 53). The school type of green was measured as the between variable and attendance rate as the repeated measure since data were measured for all four consecutive quarters (Bruick, 2009). The analysis found no statistical differences between the students test scores for LEED and non-LEED schools, or for student attendance.

Responses of teachers to surveys were evaluated within three categories (air quality, daylighting, and acoustics). A one-way ANOVA was used to analyze the data to identify any differences in those categories. A multivariate analysis of variance was conducted using a composite score to examine the independent variables of the responses of LEED and non-LEED teachers. Lastly, effect sizes were interpreted using Cohen's criteria. The "effect size was large

(=.12), (standardized coefficients r = .75, r = -.03, r = -.41 for air quality, daylight, and acoustics, respectively)" (Bruick, 2009, p. 60).

The teacher perception survey, teachers in LEED buildings revealed a statistically significant difference on the composite score [F (511) = 70.69, p < .001]. "The higher the centroid for the non-LEED teachers (.24 for non LEED as opposed to -.58 for LEED teachers) was associated with low scores on the composite, particularly the air quality component and to a lesser degree acoustics" (Bruick, 2009, p. 60). The survey contained questions from three LEED categories: Indoor Air Quality, Daylighting, and Acoustics. The sample size was 512 teachers from across the United States where 149 teachers were from LEED schools and 363 teachers were from non-LEED schools. Overall, the mean and standard deviation of teachers from LEED schools was higher than teachers from non-LEED schools. Teachers from LEED schools rated acoustics highest (M = 21.48, SD = 3.79), followed by air quality (M = 17.17, SD = 2.71), and daylighting (M = 13.40, SD = 2.15) (Bruick, 2009).

Overall, this was a useful study. However, data could have been expanded to include more LEED and non-LEED schools within the state as long as the schools were matched with other schools that included similar demographics. Further, more school districts from the state could have been included to allow for larger sample sizes to increase external validity and the likelihood of finding a statistical significance between student achievement and attendance for LEED schools. One element of the study that is difficult to control for is the effect of teacher quality and school leadership on student achievement. Each of these variables could produce possible confounding factors for student achievement; however this would be a difficult variable to control for in this type of study design.

All of the above referenced studies included LEED schools as part of the study's Green School population. However, Edwards (2006) conducted a study that examined the impact of Green Schools on student achievement, and student and staff absenteeism when compared to non-Green Schools. The study consisted of fifty four Green Schools from two counties, Essex and Hampshire, in the United Kingdom. Green Schools were identified using criteria that included twenty indicators that were subdivided by four characteristics of the school:

1. Resource-efficient, particularly in the terms of energy use.
    a. Low-energy design (in construction and occupation)
    b. Exploits renewable energy.
    c. Puts energy controls in the hand of the occupants (with appropriate education).
    d. Conserves water.
    e. Local sourcing of construction materials.
2. Healthy, both physically and psychologically.
    a. Minimum internal pollution.
    b. Uses natural materials.
    c. Exploits natural light and ventilation.
    d. Addresses psychological welfare.
    e. Accessible to all.
3. Comfortable, responsive and flexible.
    a. Attractive and responsive internal environment.
    b. Sheltered, sunny external environment.
    c. Noise-free.
    d. Controllable environment.

    e. Glare-free.

4. Based upon ecological principles.
    a. Exploits recycling.
    b. Life-cycle impact.
    c. Makes nature visible.
    d. Designed upon ecological principles.
    e. Uses ecological accounting (eco-footprint). (Edwards, 2006, p. 18)

Each school was identified as green, if it included at least fifteen of the twenty criterion. The Green Schools were matched with non-Green Schools that had similar characteristics, such as geographic proximity, building size, grade level, and socio-economic conditions. Socio-economic information included the percentage of bilingual students, special needs students, and free lunch programs.

Data were collected on five indicators of performance. The first were assessment results from the National Curriculum assessment, commonly referred to as the SAT. Results were gathered from the SAT Key stages 1 and 2, which assesses students nationally at age seven and eleven, respectively (What are SATS, n.d.). The second indicator is student satisfaction as measured by absenteeism (authorized and unauthorized) and bullying. The study did not indicate how data for bullying was gathered. Teacher satisfaction was measured through data collected on teacher turnover and teacher absences due to illness. Qualitative data were gathered from literature on school environment documented by the Office of Standards in Education (OfStEd) and interviews with teachers and administrators. The study did not indicate the instrumentation, if any, used in the qualitative data collection.

The study employed a mixed-methods design that compared qualitative and quantitative data from schools in Essex and Hampshire counties in the United Kingdom. The study utilized,

> A triangulation of statistical data (mainly OfStEd) covering educational attainment, exclusions and teacher turnover is employed to evaluate school performance against Local Education Authority (LEA) and national averages. (Edwards, 2006, p. 17)

While the study reports findings that suggest "at SATS Key stages 1 and 2 the green primary schools in Hampshire provide an environment which leads to enhanced performance by pupils" (Edwards, 2006, p. 21). The mean scores for each Green School and its paired non-Green School were reported in the study, however, no in-depth statistical findings were presented for any portion of the study. It is reported that "the level of improvement of about 3-5 percent is consistently displayed by all but one Green School in Hampshire and is reflected in the LEA school rankings" (Edwards, 2006, p. 21). Five of the six Essex schools earned higher national ranking than the non-Green School it was paired with. Regarding student attendance, Green Schools in Hampshire showed lower absences due to illness while findings for Essex were reported as neutral among the paired schools. Edwards speculates that;

> taking SATS results, LEA school rankings, absenteeism figures and teacher turnover together, a picture emerges to suggest that productivity is higher in the green primary schools examined in Hampshire and to a lesser extent in those examined in Essex. This may be a result of design rather than green variables, since the Hampshire schools attracted more design awards and coverage in the architectural press that their counterparts in Essex. As a local education authority Hampshire believed that the messages which accompanied good design have a beneficial effect upon pupils and teachers. (Edwards, 2006, p. 23)

The researcher acknowledged that several limitations exist and included several problems reported through the qualitative process. Typical problem areas that were commonly identified in Green Schools were that windows were oftentimes too high to open or could not be manually opened. It was noted that south-facing windows lacked sufficient solar shading or that sunlight would reflect onto computer screens, making it difficult to see clearly. Lastly, while trying to maximizing daylight into classrooms (for energy efficiency) temperatures were sometimes too low in the winter and too high in the summer, which may add to student and staff stress. Edwards (2006) also noted that the design of the building may have been a confounding factor with respect to the Green Schools used in the study.

This study carefully matched pairings of green and non-Green Schools. However, the study could have been more thorough with the incorporation of a statistical analysis that would enable Edwards to determine if there was a statistical significance for the outcomes reported in the dependent variables (SATS scores, student absenteeism, and staff absenteeism). An independent samples t-Test would have been the most appropriate analysis given the design of the study.

Synthesis

Research has shown that the quality of school facilities is associated with student and staff health, attendance, and performance. LEED design aims to improve elements such as lighting, acoustics, and indoor air quality. Further research is needed to investigate the impact of LEED building design on outcomes such as student achievement, student and staff attendance rates, and occupant satisfaction. The studies examined in this review all attempt to build a foundation of empirical evidence that supports the benefits of Green Schools regarding improved student achievement and decrease absences for students and staff (Issa, 2011; LaBuhn, 2010;

Oetinger, 2010, Bruick, 2009, and Edwards, 2006). Three of the studies reviewed utilized a collection of regional data from smaller samples sizes to compare student achievement and attendance in Green Schools with non-Green Schools (Issa, 2011; Bruick, 2010; and Edwards, 2006). The other two studies utilized a sample population from across the United States (LaBuhn, 2010; and Oetinger, 2010). While many of the studies did not find a positive relationship between Green Schools and student achievement and attendance that was statistically significant, the studies did show improvement in both dependent variables (Issa, 2011; Bruick, 2010; Oetinger, 2010, and Edwards, 2006). LaBuhn's (2010) study was the only study where Green Schools were significantly outperformed by non-Green Schools across many populations throughout the United States. However, it should be noted that the design did not utilize matched pairs when setting up the samples are part of the design methodology. Instead, the study compared Green Schools to non-Green Schools in the same district or geographic location and analyzed data using a simple linear regression (LaBuhn, 2010).

Issa (2011) utilized the most rigorous statistical analysis for the study to help control for confounding variables. The analysis involved a parametric and non-parametric test and continued further analysis depending upon the results from each of these tests. For example, parametric tests were analyzed with a MANCOVA test where statically significant findings were then analyzed using ANOVA to control for building age and socioeconomic status (Issa, 2011, p 9). LaBuhn's (2010) study compared Green Schools with non-Green School from separate regions and geographic populations across the United States. This limited the study because it was difficult for Green Schools to be compared between groups, only within geographic cohorts. This study was also limited in that it did not utilize a matched pairs design to help control for confounding variables. The linear regression analysis was utilized as a predictor for the effect of

socioeconomic status on student performance or attendance. It was not found to be a strong predictor in LaBuhn's study. The other studies (Oetinger, 2010; Bruick, 2009, and Edwards, 2006) simply compared mean scores between green and non-Green Schools. While each of those studies reported positive outcomes for student achievement and attendance for students that attended Green Schools, no further statistical analysis was conducted, or reported, to determine if results could be deemed significant.

Conclusion

Outside of the referenced research, there is still little empirical research related to Green Schools. Presently, there is no educational research that examines Green Schools as a teaching tool for environmental education or how this might affect student performance. As popularity of Green Schools continues to grow, it is important that the educational components of these facilities also grow in order to increase student, staff, and community understanding of the energy performance features and learning outcomes that are offered within these buildings. Students spend many years inside school facilities, as school divisions move forward with new construction, it is important that these facilities also serve to supplement the curricula and engage students, staff, and the community with regard to environmental education and sustainable practices.

The United States Department of Education (USED) developed a program in 2011, USED Green Ribbon Schools, that recognizes and honors "schools and districts that are exemplary in reducing environmental impact and costs; improving the health and wellness of students and staff; and providing effective environmental and sustainability education, which incorporates STEM, civic skills and green career pathways" (USED Green Ribbon Schools, 2013, np). According to the USED Green Ribbon, the recognition award is part of an effort to identify and inform the public about "practices that are proven to result in improved student

engagement, higher academic achievement and graduation rates, and workforce preparedness, as well as a government wide goal of increasing energy independence and economic security" (USED Green Ribbon Schools, 2013, np).

USED Green Ribbon criteria seems to further explain the criteria of both LEED and CHPS. USED Green Ribbon's aim is not only to construct buildings that are energy efficient and healthier for occupants, but also to educate students about sustainability and the responsibility that individuals have with respect to their impact on the environment. In the future, these programs may lead the way in developing standardized criteria for implementation of environmental education within schools, both new and old.

As more research is conducted to determine to what extent Green Schools yield positive outcomes for students and staff, future research might examine the specific features of Green Schools that have the greatest effect on performance. It is also important to consider how Green Schools implement environmental educational components which utilize the building as a teaching tool. For example, do Green Schools with a greater emphasis on daylighting have higher performance from students and staff satisfaction? Do Green Schools with improved indoor air quality, thermal comfort, and acoustics have a positive impact on student achievement? Is it the holistic design that interdependently impacts student and staff performance? Are there specific environmental education programs or curricula that assist in increasing student's environmental awareness of civic duty? Further research is needed to broaden the foundation of evidence and support possible relationships between these variables. With answers to these questions, school officials and architects may present a strong case for considering green construction to make the most of limited dollars and to create healthier environment for students and staff.

Chapter 3: Methodology

Chapter 3 outlines in detail the methodology for the research study. The chapter is separated into seven sections. The first section describes the population and sample that was included in the study. The second section describes what data are needed in order to conduct the research and answer the research questions. The third section describes the instrument that was utilized in gathering the data needed for the research study. The fourth section describes how the instrument used was validated for reliability. The fifth section describes how data were gathered from the sample population. The sixth section describes how the data were analyzed in order to answer the research questions. The final section provides a detailed analysis of the research questions and items in the survey instrument.

Population

The purpose of this study was to ascertain the educational practices implemented in Green School to meet the educational requirements for LEED and USED Green Schools certification. Therefore, the building population of the study were the school buildings that were certified as either LEED or USED Green Schools. The educator population was the principals and teachers who work in these buildings. There are 56 schools in Virginia listed in USGBC's project directory, but only 18 were fully certified as LEED by the USGBC as of November 12, 2013. According to USGBC's project directory, which can be found at http://www.usgbc.org/projects, there were 18 schools that were certified LEED in the Commonwealth of Virginia. Of these 18 schools, however, one school was a renewal/renovation, one school was a dedicated science building for a private boarding school, and two were private schools. Some of the schools were still under construction and not yet certified as a LEED building. However, many schools have completed construction but have not

completed the certification process through the USGBC. Of the 18 schools that were certified as LEED, seven of them have earned credit for using the building as a teaching tool.

The Commonwealth of Virginia also had four schools that have been certified as USED Green Ribbon Schools since 2012. Two schools, The Gereau Center for Applied Technology and Fishburn Park Elementary School, earned USED Green Ribbon status in 2012. Two schools, Stony Point Elementary School and Magna Vista High School, earned Green Ribbon status in 2013. The list of USED Green Ribbon Schools in Virginia can be found on http://www.doe.virginia.gov/support/facility_construction/healthy_buildings/green_ribbon/index.shtml.

USED Green Ribbon schools were included in the population of study because it is a federally recognized program that supports environmental education and sustainability in schools and measures implementation through an application process. The inclusion of USED Green Ribbon Schools in the population provided relevant data with regard to the implementation of environmental education into school curricula.

The study included all schools that were currently certified as LEED; schools that have completed construction, have been utilized for a minimum of one year, and were pending or completed certification from USGBC; and USED Green Ribbon Schools for the population. While not all LEED schools earned credit for using the building as a teaching tool, the building still features all of the sustainable designs and can be utilized as a teaching tool regardless of credit earned. It was also noted that principals and teachers may use the building to enhance the curricula and teach sustainability, however, they may not have attempted to earn the credit at the time of certification. As a LEED school, it is important to examine the extent to which buildings

are utilized to promote sustainable and environmental education regardless of earning credit for using the building as a teaching tool.

There were also several schools in the Commonwealth of Virginia that were built in the past year or two and were still pending final LEED certification. It was important to include these schools into the population of study to increase the sample size and return on data collected. A complete listing of the LEED and USED Green Ribbon schools in the Commonwealth of Virginia is contained in Appendix A.

The administrators and teachers in the schools mentioned above were the population of the study. The administrators serve as the instructional leaders for the school and, as such, hold the strongest influence over the culture and instructional programming that takes place within the school. Teachers were also included in the population as they possess the most direct influence regarding instructional delivery.

Data Needs

Two components of data were needed for this study. The first component of data included a list of schools in the Commonwealth of Virginia that are certified (or pending certification) as LEED or certified USED Green Ribbon schools. The second component of data was obtained through an open-ended survey instrument provided to school administrators and teachers in the LEED or USED Green Ribbon schools. To answer the research question concerning the educational practices implemented in the LEED and USED Green Schools, quantitative data were obtained from the participants of this study. To this end, the data collection came from a survey instrument that utilized both closed and open-ended questions regarding the implementation of environmental education programs, curricula, sustainable initiatives, and building usage of LEED schools. The purpose of the questions was to determine

the extent to which administrators, staff, students, were involved in actively utilizing environmental education and using green features of LEED buildings to support ways of teaching sustainability. Further, the answers to the questions determine what specific practices and strategies that were used to implement environmental education and how LEED schools in Virginia use the building components as a teaching tool.

Instrument Design

The principal instrument in this research study was an eSurvey. The eSurvey was provided to school administrators and teachers in LEED and USED Green Ribbon schools, and central office administrators that are involved in the implementation of environmental education for the respective school divisions.

The survey questions were developed from the research questions for this study and relevant questions from the USED Green Ribbon Schools application, which serve as a model for isolating environmental education components and curricula utilized by the schools and/or school divisions. The USED Green Ribbon application consisted of three goals: 1 - energy conservation and reduction, 2 - healthy school environments, and 3 - environmental and sustainable education. In the USED Green Ribbon application, the third goal had several questions that asked schools to specifically identify programs and practices used to implement environmental education. Those questions were utilized to assist in the development of the survey instrument. Those questions were related to the integration of environmental education throughout the curricula of the school, identifying specific programs and practices that were used to implement environmental education and professional development that supports environmental education.

The survey utilized both multiple choice and open-ended questions in a mixed-methods research study. Responses to the multiple choice questions served as the quantitative data. The responses to the open-ended questions served as the qualitative data. The survey was designed to collect descriptive data about Green Schools involved in the study and descriptive data regarding implementation of environmental education in Green Schools.

Instrument Validation and Reliability

This survey instrument was tested for content validly from three sources: an educational researcher, a current school principal, and a teacher from a Green School, not participating in the study's survey population. Each examiner was asked to review the research questions of the study and the survey instrument to determine whether or not the survey items relate to the research questions or assists in describing the study sample population. The survey examiners were also asked if they felt that the questions were appropriately phrased for clarity so that the instrument would measure what it was intended measure and assist in gathering data accurately. A copy of the instrument that was used to gather the needed data can be found in appendix C.

Consent

Prior to gathering data, a request for approval of research was requested by the Institutional Review Board (IRB). Once the study was approved through IRB (found in appendix D), approval to conduct research in each school division was requested by the researcher. Upon school division approval to complete research, principals from the selected population sample were contacted via email to request their participation, and invite the teachers from their school to participate in the study. Follow up contact was made via phone for those principals that did not respond to the initial email request. Once consent for participation was confirmed, principals were sent an email that included information regarding the purpose of the

study, time line for completing the survey, and the internet link to the eSurvey. The eSurvey included information for informed consent and provided all participate with a prompt to agree to consent prior to completing the survey. See appendix B for reference.

Data Gathering

Data were gathered using an eSurvey. The participants included teachers and principals currently working in LEED or USED Green Ribbon School in the Commonwealth of Virginia. All data from the survey instrument were submitted anonymously. Descriptive data such as school, position, and subject taught were collected in order to describe the characteristics of the sample population for this study. Specific school data were not disaggregated.

Data Analysis

Responses from the survey instrument were entered into a matrix using excel and sorted by survey item and school. Multiple choice survey questions served as the quantitative data for the research study. Quantitative data were examined to report descriptive statistics to provide parameters about the sample population. Categories were created from each survey item. The frequency and percentage from each category, mean, and mode were also reported from each survey item. For example, item number four from the survey instrument collected categorical data about the certification of the school building. Possible responses included: LEED, Green Ribbon, both LEED and Green Ribbon, or applied for LEED. These data were examined to report out the frequency and percentage of each category type, the mean, and the mode of the sample population.

Qualitative data were coded by each survey item and examined for common themes with regard to the following categories: implementation of environmental education, programs and

practices utilized by schools and school divisions, and LEED building usage as a teaching tool. Open-ended survey questions served as the qualitative data for this study. The qualitative data from each survey instrument item were coded and examined for common programs and practices utilized by schools and how schools carried out the implementation of environmental education. Participants were coded as R1 through R98 so that responses could be cited.

The study gathered data to answer one research question and five related sub-questions. The research question for this study was; "How do USED Green Ribbon and LEED schools in Virginia implement environmental education? As described in Chapter 1, the purpose of this study was to gather data related to the implementation of environmental education in Green Schools in order to build a framework for common practices. Currently, there is no set standard for implementation. A survey instrument was designed using the research question and section three of the USED Green Ribbon application to gather both quantitative and qualitative data related to common practices and programs that were utilized in the implementation of environmental education.

The first research sub-question; “How is environmental education included in the curriculum of the school division?" Items 5 and 7 from the survey instrument were utilized to gather qualitative data from the sample populations. Data were coded and examined for commonalities among schools and school divisions.

The second research sub-question; "How is the implementation of environmental education directed by individual classroom teachers?" Item 6 from the survey instrument was utilized to gather quantitative data from each school. The data were analyzed to report out descriptive statistics from the sample population.

The third research sub-question; "What specific practices and strategies are used to implement environmental education?" Items 8, 9, and 11 from the survey instrument were utilized to gather qualitative data. The data were coded and examined for common practices and strategies utilized by teachers, schools, and divisions.

The fourth research sub-question; "How are the practices used to implement environmental education formally evaluated?" Item 10 from the survey instrument was utilized to gather quantitative data from each school. The data were analyzed to report out descriptive statistics from the sample population.

The fifth research sub-question; "How do LEED schools in Virginia utilize the building components as teaching tool?" Items 12, 13, and 14 from the survey instrument were utilized to gather qualitative data. The data from these items were coded and examined for common themes.

Chapter 4: Findings

Introduction

Environmental education curriculum that is utilized within Green Schools was examined in this study. For this study, Green Schools were defined as schools with LEED certification or USED Green Ribbon recognition. Currently, there is no set standard for environmental education or for schools that are utilized as a teaching tool for students. The purpose of this descriptive study was to survey Green Schools in the Commonwealth of Virginia in order to better understand what programs and curricula are being utilized and what commonalities exist among them. The study examined the following research questions:

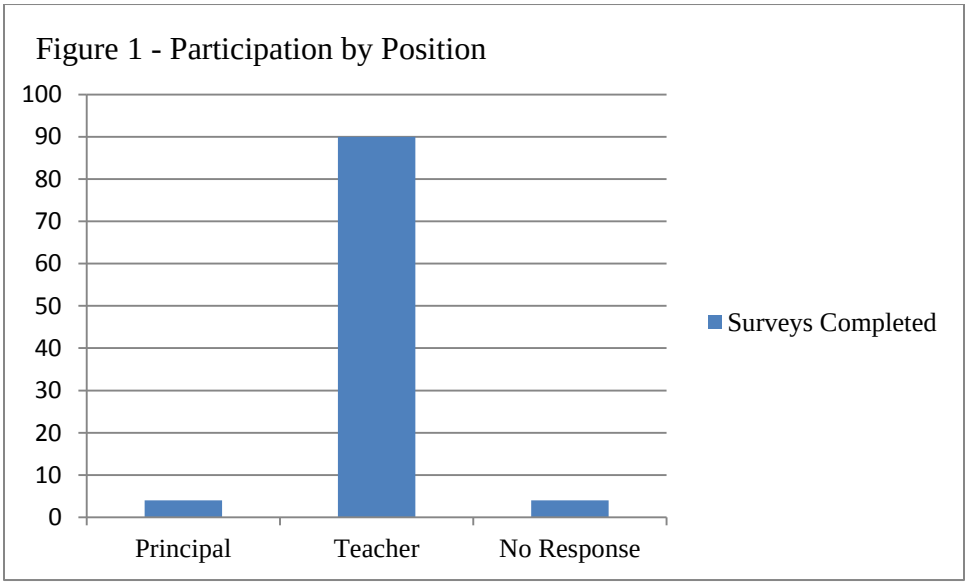
1. How do USED Green Ribbon and LEED schools in Virginia implement environmental education into the curriculum?
    a. In what way is environmental education included in the curriculum of the school division?
    b. To what extent is the implementation of environmental education directed by individual classroom teachers?
    c. What common practices and strategies are used to implement environmental education?
    d. What level are the practices used to implement environmental education formally evaluated?
    e. How do LEED schools in Virginia utilize the building components as teaching tool?

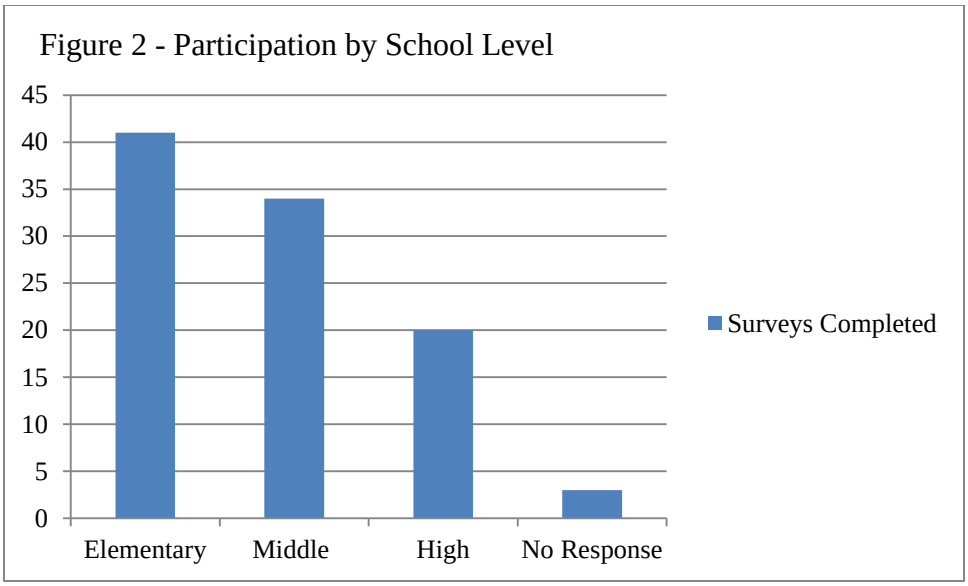
At the time of the study, there were 18 public schools in the Commonwealth of Virginia that were LEED or USED Green Ribbon certified. Of those schools, 14 agreed to participate in the study. The population of the study included all principals and faculty from the schools, and communication to invite participates was filtered through the principals of each school.

Findings

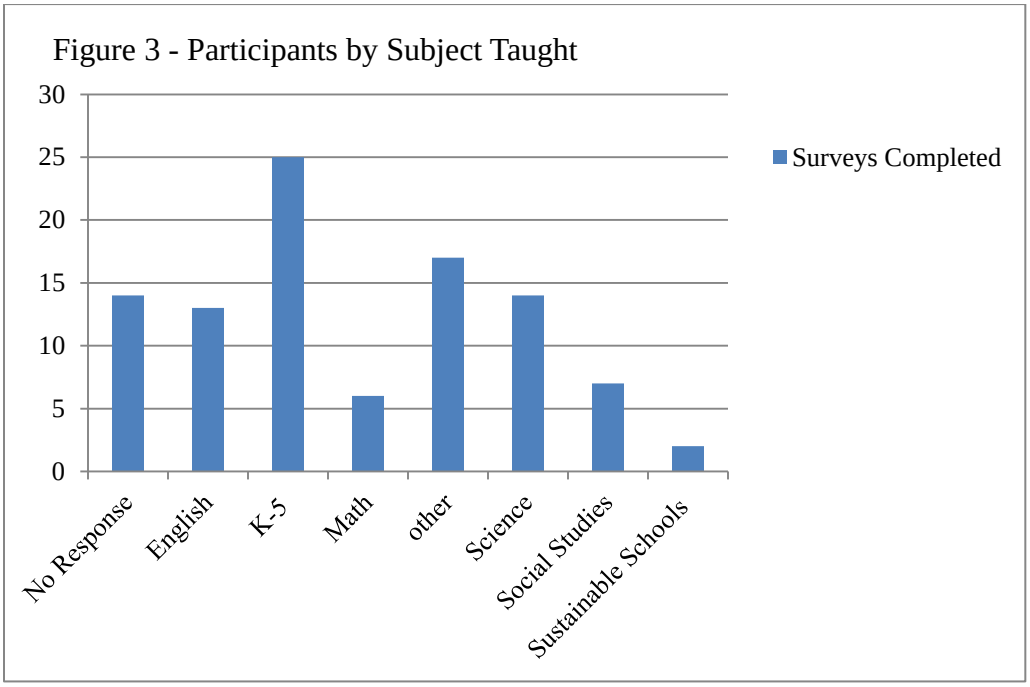
Description of the population. The Green School Survey was sent to principals and staff at 14 public schools throughout the Commonwealth of Virginia that were identified as Green Schools. All participants were provided a two week window to complete the eSurvey. After the data collection window closed, there were 98 participants from 14 schools that completed and returned the survey. The data collected from the survey instrument were categorized as they related to each sub-question of the study. The first four questions from the survey instrument were used to gather descriptive data about the population of the study.

The participants in the study included four principals, 90 teachers, and four participants who did not submit a response to the survey item. The majority of the participants, which consisted of 41 participants, were from the elementary school level. There were 34 participants from the middle school level, 20 from the high school level, and 3 participants who did not submit a response for this survey item. Refer to figures 1 and 2 for a description of the participants by position and school level, respectively.

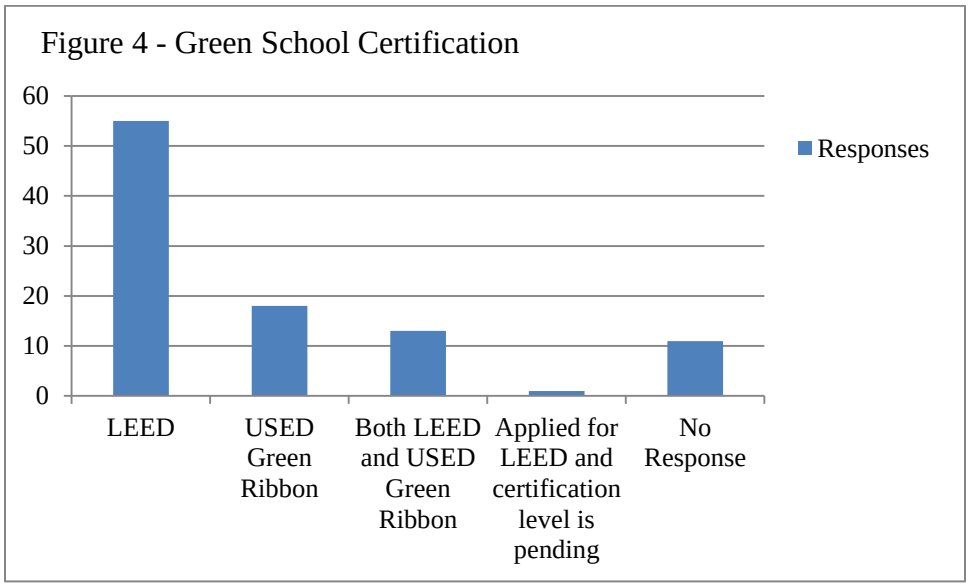




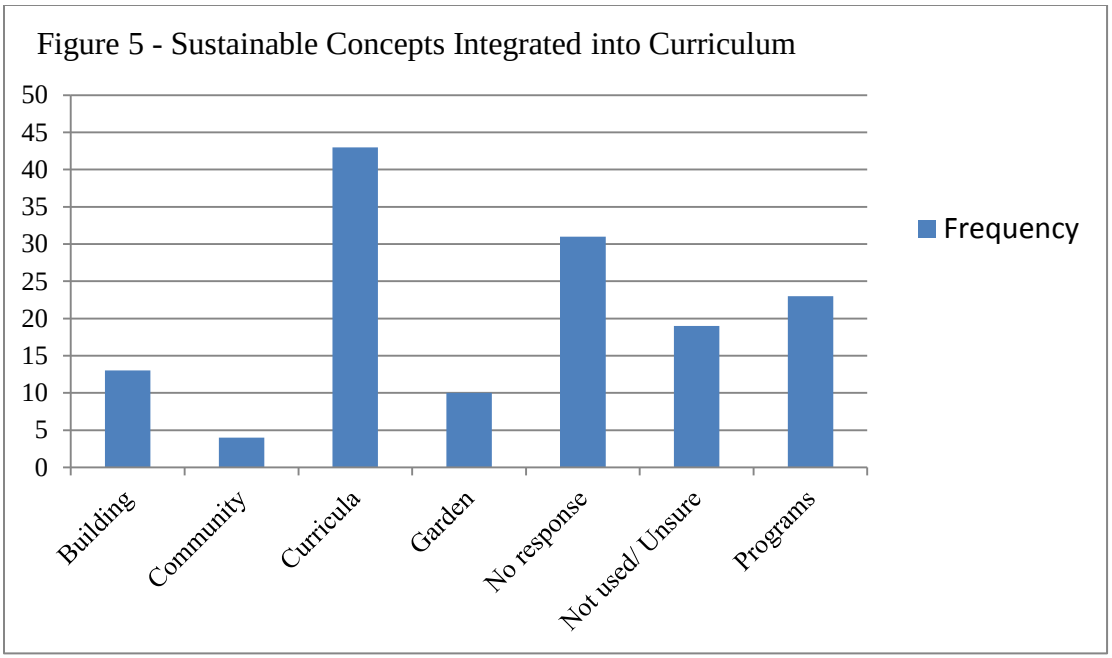
There were a variety of grade levels and subjects taught that were represented in the participants of the survey. This included 25 K-5 multidisciplinary teachers, 13 English/Language Arts teachers, 6 Math teachers, 14 Science teachers, 7 Social Studies teachers, 17 teachers listed as other, 2 Sustainable Schools Managers, and 14 participants who did not respond to this survey item. Refer to figure 3 for a graphical representation of the above data.



Lastly, in the description of the population, survey item number 4 collected data from the population regarding their Green School certification. There were 55 participants that worked in a LEED certified school, 17 participants that worked in a USED Green Ribbon School, 13 participants that worked in a school that was both USED Green Ribbon and LEED certified, 1 participant that worked in a school that was pending LEED certification, and 11 participants that did not response to this survey item. Refer to figure 4 for a graphical representation of Green School certifications.



Research question a. In what way is environmental education included in the curriculum of the school division? Items 5 and 7 from the survey instrument collected qualitative data related to the study sub-question a. In what way is environmental education included in the curriculum of the school division? Survey item 5 collected qualitative data about environmental and sustainable concepts that are integrated throughout the curriculum. The data were coded and seven common themes developed, which are represented in figure 5.



There were 31 responses that provided no response, 19 were unsure or did not utilized types of integration into the curriculum. Curricula were mentioned in 44 responses and school programs were mentioned in 23 responses. Other common answers provided were those related to the building with 13 responses, community partnerships with four responses, and outdoor gardens with 10 responses. Many responses overlapped and incorporated more than one common theme. One participant responded:

> The LEED-certified building addition houses science and math courses and the Division's Math, Engineering and Science Academy. The ductwork and plumbing systems are exposed so students can observe them. Signage throughout the addition describes the acoustical considerations, low/no VOC finishes and water efficient fixtures in the school. Waterless urinals and dual-flush fixtures were piloted at this school and were well received. The green roof system is [monitored] by a Hobo meter for soil moisture, air and substrate temperature, and relative humidity… The school site hosts an ambient air quality monitoring

> station operated by the Virginia Department of Environmental Quality. The station continuously monitors ozone and PM2.5 and allows students to operate the PM10 station. Science teachers have incorporated the facility into their lessons. (R60)

Participant (R32), stated; "…our building is…a zero net carbon and energy building that actually produces its own energy through solar rays and wind turbines. Students are involved in an energy engineering class which uses this building as a laboratory for sustainable energy." Participant (R34), stated; "…we have a garden and green roof to support real hands on opportunities for children. Children study water conservation and we have systems that collect and conserve water."

The following matrix in table 2 illustrates the common responses organized by the following themes: programs, curricula, building, community, and outdoors. A similar matrix organized by participant can be found in Appendix H.

Table 2 - Matrix of Common Responses by Theme

Themes	Responses
School Programs	• "…recycling… garden house projects, earth hour." (R1) • "…recycling program and give an environmental fact on the announcement several days a week." (R2) • "…6th grade class takes a field trip to a local lake and tests the water. As a group, we discuss the health of the lake, and what in the area could be affecting it." (R16) • "Recycle in Science and in clubs" (R31) • "…recycling…" (R32) • "...recycling program." (R61) • "…recycling is done in the cafeteria and copy paper that is only printed on one side is used by keyboarding and art." (R96) • "…afterschool Nature Club." (R33) • "…all students compost lunch leftovers including our biodegradable trays…We recycle weekly as a 5th grade responsibility…Second grade raise trout for release in a local stream as a project with the state." (R47)

Curricula	• "Used to support all areas of study…" (R1) • "We have integrated environmental concepts into our curriculum…" (R2) • "Science Curriculum contains several standards related to the environment and sustainability…alternative energy sources… pollution, and renewable vs. nonrenewable resources." (R16) • "...concepts are discussed...with hands on activities in my classes…6th and 7th grades are attending interdisciplinary training and implementation of environmental awareness…" (R18) • "…science courses teach sustainability…model it…survey our students and teach about our footprint… stream study…a 'pond' in my classroom to teach…about ecology." (R30) • "Recycle, reduce, reuse in Science …Teaching garden." (R31) • "Students are involved in an energy engineering class which uses this building as a laboratory for sustainable energy. Also, 1 day a week we have STEM classes that all students are involved in that concentrates on Problem based learning." (R32) • "...outdoor classroom…is used across the curriculum…" (R33) • "Children study water conservation and we have systems that collect and conserve water." (R34) • "We are working at 6th grade level to create more lessons across the curriculum…" (R44) • "…raised bed garden as a part of the curriculum…We teach across the curriculum monthly in different groups for 'earth hour'…various academic cross-curricular activities called Earth Week." (R47) • "We do units that include learning about renewable energy options and analyzing the viability for renewable energy in VA. We have also supported research projects where students study the long term advantages of the Edison2 electric car…" (R48) • "Science teachers have incorporated the facility into their lessons." (R68) • "…integrated in each unit if possible…for instance we are talking about heat so that naturally ties into climate change, the ability of water to maintain a temperature because of its specific heat, geothermal is added into the curriculum." (R61) • "We used to have a LEED lesson for every grade … Example: Recycling, Water Conservation, LEED building…" (R92)
Building	• "…announcements several days a week." (R2) • "...first Passivhaus designed school building in the country. It is a zero net carbon and energy building that actually produces its own energy through solar errays and wind turbines…" (R32) • "…2 interior courtyard gardens--a well-established Japanese Garden and a math garden (in progress)." (R33) • "…green roof…systems that collect and conserve water." (R34) • "The ductwork and plumbing systems are exposed so students can observe them. Signage throughout… describes the acoustical considerations, low/no VOC finishes and water efficient fixtures… Waterless urinals …green roof system is monitored by a Hobo meter for soil moisture, air and substrate

	temperature, and relative humidity… school website hosts an ambient air quality monitoring station operated by the Virginia Department of Environmental Quality…" (R60) • "…LEED lesson for every grade level …LEED building…" (R92)
Community	• "VDOE's Watershed Academies for the James and Rappahannock Rivers… participating in the James River Academy…" (R18) • "...field trip to the river this semester with both of my ecology/environmental science classes where we will survey the stream for health indicators and do chemical and biological (microbiological) analyses." (R30) • "… voluntary creek cleanup." (R33) • "...partnership sponsored by the Chesapeake Bay Foundation." (R44) • "…students collect then organize used school materials to send to Belize with a local group." (R47) • "…study the long term advantages of the Edison2 electric car, the long term effects of the CAFE Standards, and the viability of coal plant replacement in VA." (R48) • "...parents to some plantings about the school around the drainage ponds." (R96)
Outdoors	• "Composting…garden work, green house projects…" (R1) • "…6th grade class takes a field trip to a local lake and tests the water." (R16) • "Teaching garden. Planting for school grounds improvement." (R31) • "Each grade level has an outdoor garden space… outdoor nature trail through woods, which leads to a spring-fed creek and outdoor classroom." (R33) • "…garden…" (R34) • "…raised bed garden…large permaculture garden …green house and observations in our ponds. Second grade raise trout for release in a local stream as a project with the state…" (R47) • "The green roof system is monitoring by a Hobo meter for soil moisture, air and substrate temperature, and relative humidity." (R60) • "An outdoor classroom has been built…" (R96)

There were also responses that indicated that Green School programs had diminished over time. Participant (R92), stated; "We used to have a LEED lesson for every grade level during the first year in the core classes." Another participant, (R79) stated; "The first year our school opened we did incorporate the LEED curriculum. Since then we have not."

Survey item 7 collected qualitative data regarding school division resources provided for environmental education curriculum and instructional resources. The data were coded into three common themes which are represented in table 3.

Table 3 - Division Resources for Environmental Education

Response Type	Survey Response %
Resources are provided	47
Resources are not provided or Unsure	30
No Response	23

Among those participants that responded positively about school division resources also provided a variety of resources from their respective school division. One participant stated; "[TC] is our environmental person. About once a year he tries to meet with the Sustainable Schools Liaisons to see how things are going." (R24). Similarly, participant (R76) stated; "…we have a sustainability chairperson and she is very involved in helping us to integrate strategies into daily living…" Another participant (R61) mentioned; "Data contacts and operator for the air quality monitoring station information available for teachers. Curriculum links for NEED.org available to teachers. Resource list and sample curriculum (kits, books) made available to teachers for the Division's Renewable Energy Resource Center."

Other school divisions appeared to provide fewer resources, but utilized programs to help create awareness, for example, participant (R55) stated; "We have some books dealing with environmental issues, and some lessons are provided within the curriculum. Every year the division holds a poster contest for which water conservation is the subject."

Research Question b. To what extent is the implementation of environmental education directed by individual classroom teachers? Item 6 from the survey instrument collected quantitative data related to the study sub-question b. To what extent is the implementation of environmental education directed by individual classroom teachers?

The majority of responses indicated that environmental education was implemented by individual classroom teachers (49%) and as a school-wide process (31%). Refer to table 4 for responses to the level of implementation.

Table 4 - Level of Implementation

Level of Implementation	Survey Responses **%**
School-wide process	31
Takes place by grade or departmental	8
Takes place by individual classroom teachers	49
No Response	4
Other	8

The eight responses for 'other' varied and included; "Not sure" (R78), "Not much" (R85), "…individually by department and other teachers in module classes" (R69), "I doubt there is much environmental ed at all." (R84), "I don't know" (R91), "I believe the Science Department may address this topic." (R83), "Depends on the curriculum" (R68), and "As well as school wide." (R77)

Research Question c. What common practices and strategies are used to implement environmental education? Items 8, 9a, 9b, and 11from the survey instrument collected both quantitative and qualitative data related to the study sub-question c. What common practices and strategies are used to implement environmental education? When participants were asked what resources they used to develop or enrich their curriculum with environmental education, eight themes were identified: none or unsure, internet, multimedia, outdoor garden or classroom, project based learning, community partnerships, books, or no response provided. Several of the responses included more than one of the resources mentioned above. However, internet (21%)

and project based learning (20%) were the most common responses among participants. Some of the more innovative and in-depth responses are included in the following matrix in table 5.

Table 5 - Innovative resources to enrich curriculum with environmental education

Participant	Response
R18	"I use a water management module in my STEM lab and am taking students on two field trips where we will be assessing stream health water test kits and gathering benthic bug samples and analyzing the data."
R51	"I have used the book 'Dumpster Diver' to help teach reusing. I have the students make paper from recycled newspaper using window screens. I have also used Discovery Ed Streaming to find video about deforesting. I have also used the teaching garden at our school."
R65	"One of my favorites is the 'Save our Streams' website and 'Good Harmony' and 'I love Mountains.' I love the Tree books offered by the VA Dept of forestry. We have a greenhouse so that is an amazing resource. We also have nearby trails, creeks and garden sites and of course our CEED building so the environment IS our resource! For years we have partnered with local business."
R17	"The sixth grade team has worked with the Culpeper Soil and Water Conservation District. The sixth grade team has also been accepted as part of a grant to create cross curricular projects with several different programs. The grant is offered by NOAA, partnered with Project WET, VRUEC, Green Adventure Project, and many others."
R30	"…we complete an in-class project about energy conservation. I also provide each student an opportunity to enter a poster in the James River Association's poster contest titled 'What a Healthy River Means to Me.'"
R44	"Weekend training opportunities with the Chesapeake Bay Foundation on Virginia Watersheds."
R48	"Field trips to local camps enrich the curriculum."
R77	"The internet - during January, we tracked family recycling, and I gathered statistics, images, and information to share with our own results."
R59	"We gathered school heating and cooling data from the county's environmental compliance manager to study the current efficiency of managing the school's temperature using Newton's Law of cooling."
R66	"…past years we monitored the weight of paper collected from each source within the school and created displays of the data using Excel spreadsheets, formulas and graphics. This monitoring encouraged participation by teachers."
R33	"…monthly service projects related to the environment…"
R47	"Created videos about 'Our Green School.'"
Note. The term CEED is an acronym for Center for Energy Efficient Design.	

Survey item 9a and 9b collected both quantitative and qualitative data regarding specific programs, practices, and/or strategies that are utilized to implement environmental education. Item 9a offered several programs and allowed participants to select all that applied. These choices included: Teaching Garden, Recycling Program, Sustainable Education embedded within the curriculum, Project based learning opportunities that support environmental education, Community/Civic Outreach, Community Partnerships, and Learning green technologies and career pathways. Table 6 provides the frequency for particular programs.

Table 6 - Programs and practices utilized to implement environmental education

Programs	Frequency	Percent
Community Partnership/Outreach	60	22
Learning green technologies and career pathways	15	6
Other	10	4
Project Based Learning	45	17
Recycling Programs	70	26
Sustainable Education embedded within the curriculum	31	11
Teaching Garden	36	14

Item 9b allowed participants an opportunity to expand on their previous answer and describe programs or practices that may be specific to the individual or the school. Only 32% of the participants expanded on their previous responses to item 9a and 7% responded with "unsure" or "no." Some of the more descriptive responses included;

> Recycle: Each class assigned a representative or "green student" to empty trash from small classroom recycle trash cans to larger cans placed in the hall. This is done school wide 10 minutes prior to dismissal. Gardens: Each grade level has been assigned a space to use to support the curriculum as needed. Systems: The big idea for grade 2 in

> Virginian Beach is Systems. The grade level studies various systems in our building. (R38)

Another participant stated; "Our fishing field trip is a catch and release day with pre-event lessons on caring for the environment (damage plastic bags and monofilament line does)." (R37). One participant described changes in student behavior; “I think the most unique practice I've seen at this school is how most of the kids and staff (most of them) will automatically pick up a bug and take it outside, rather than squish it." (R30).

There were some responses that supported a level of pride for the school and/or programs implemented. These responses included;

> In my opinion, we are the most unique school with the state. Our ability to have an on campus laboratory specifically built and designed for environmental studies puts The Gereau Center/CEED on the cutting edge of environmental education. This in unison with our new data dashboard which can give up to the second data stream of energy production and water management makes us a leader in the state if not the country. (R31)

Another response included; "We have a wonderful horticulture program that teaches sustainable farming." (R42) There were also responses that were unsupportive. One participant stated;

> It is a shame we don't have much time to implement Green strategies in our school. There is so much curriculum packed into our county pacing guides that we don't really have enough time to incorporate practices and strategies that could help our environment. As a science teacher I do feel the implementation of green strategies would be informational to our students. (R79)

Another stated;

> It is my understanding that with LEED certification our school is to be recycling paper, aluminum and plastics, as well as compositing leaves and grass clippings. The only program we actually implemented is paper recycling. I find this discouraging. (R63)

Item 11 from the survey instrument collected data regarding professional development opportunities in environmental education and sustainability. Overall, 21% of the participants responded that professional development was offered. However, 33% of participants responded 'no,' 15% responded 'unsure,' and 31% of the participants did not respond to this item on the survey instrument.

Research Question d. What level are the practices used to implement environmental education formally evaluated? Item 10 from the survey instrument collected quantitative data related to the study sub-question d. What level are the practices used to implement environmental education formally evaluated? The majority of participants responded that the implementation of environmental education was evaluated at the school level (40%). The other areas of evaluation were much smaller with school division level (4%), outside agency (2%), and two or more (8%). No response to the survey item consisted of 25% of the participants. Lastly, 21% of the participants responded with 'other.' Those participants provided the following types of answers; "part of PLTW exam" (R67), "no," "No evaluation," "Not sure," "I don't know," and "None of the above."

Research Question e. How do LEED schools in Virginia utilize the building components as teaching tool? Item 12, 13, and 14 from the survey instrument collected

qualitative data related to the study sub-question e. How do LEED schools in Virginia utilize the building components as teaching tool?

There were seven themes that developed from the responses to the three survey items. These themes include: lighting, water reduction, learning garden, signage, building monitoring system, building design and energy savings, and community involvement. Survey item 12 collected data regarding aspects of the school's design that encourage students to learn about their school building and sustainability. Samples of responses for item 12 are listed in table 7 by theme.

Table 7 - Responses to Item 12 by Theme

Theme	Responses
Lighting	• "…lighting is adjustable…" (R22) • "…motion sensor light switches." (R38) • "…daylight harvesting…" (R78) • "…motion sensor lighting…" (R50) • "…light harvesters…special lights…" (R8) • "The enormous windows-natural light." (R7) • "Lights turn off when there isn't movement in the room. Lots of windows for natural light." (R52) • "…light sensors, open spaces and skylights." (R6) • "…light (natural) in classrooms…dimmable/automatic shut off lights…" (R53)
Water Reduction	• "Automatic faucets and flush toilets…" (R22) • "…Solar Hot water…and storm water management techniques…" (R78) • "Low flush restrooms…" (R50) • "The design of the new bathrooms-water usage." (R7) • "The water saving devices in the bathroom - automatic faucets, water saving toilets…" (R6) • "…rain water collection." (R79)
Learning Garden	• "…2 interior gardens give students hands-on experiences with the plants and natural materials being within our daily environment." (R13) • "Students also have access to a rain garden outside the school." (R36) • "We have a green house, raised beds, a garden." (R73) • "LifeSkills classes use the interior patio of the classroom wing to place a greenhouse and grow plants for sale for summer gardens." (R49) • "We have students involved in projects within the

	agriculture…horticulture…" (R40) • "We recently built a greenhouse and started an agriculture class." (R21)
Signage	• "There are plaques featuring a specific fact about the LEED building." (R36) • "…informational signs placed throughout the school on the buildings efficiency." (R50) • "Signage supports and explains some of the environmental features such as low flow toilets and sinks." (R57) • "There are plaques throughout the building that tell students about the sustainable features of the building, and small plaques at every classroom door with names and pictures of flora and fauna indigenous to the Tidewater region, with QR codes that link to websites about them." (R80) • "I like the signage that describes the environmental educational concepts of the building. For example the green roof." (R1) • "The school has signs throughout the building informing students and guests of all the green features. These signs are placed in locations to draw attention to the school's sustainability." (R60) • "We have information area the building teaching the students how they are a part of a "Green Environment" their school building." (R64) • "There are plaques on the walls, but I bet it's been a long time since anyone read them." (R68) • "This is a fabulous beautiful school. There are signs all about put in by the contractor denoting all the green aspects of the building." (R58)
Building Monitoring Systems	• "The green roof system is [monitored] by a Hobo meter for soil moisture, air and substrate temperature, and relative humidity. The school site hosts an ambient air quality monitoring station operated by the Virginia Department of Environmental Quality. The station continuously monitors ozone and allows students to operate the PM10 station. Science teachers have incorporated the facility into their lessons." (R4) • "Energy checks and motion sensor light switches." (R38) • "Each group of students in my class learns about the alternative energy resources and the design and what makes it special." (R28)
Building Design & Energy Savings	• "Our rainwater is filtered and used to flush toilets. We have a 'green' roof, and solar collectors…and small plaques at every classroom door with names and pictures of flora and fauna indigenous to the Tidewater region, with QR codes that link to websites about them." (R80) • "We have the coolest school ever! Our CEED bldg is the first Passivhaus school in the country and our students have had input from the very start." (R28) • "The ductwork and plumbing systems are exposed so students can observe them. Signage throughout the addition describes the acoustical considerations, low/no VOC finishes and water efficient fixtures in the school. Waterless urinals and dual-flush fixtures were piloted at this school and were well received." (R4) • "I do an in-house field trip for students to show areas designed for sustainability as shown to me by the building project head." (R17)

	• "Automatic faucets, and flush toilets, the lighting is adjustable, the color coding, the narrowing of the hallways to use space most effectively." (R22) • "Geothermal HVAC system, Solar Hot water, daylight harvesting and storm water management techniques…" (R78) • "Open spaces, light harvesters, connecting rooms, special lights and plumbing." (R8) • "The green roof and design plans for energy and water conservation." (R3) • "Students use the outdoor learning commons for lessons, reading, lunch with their teachers." (R84) • "The water saving devices in the bathroom (automatic faucets, water saving toilets, light sensors, open spaces and skylights). For many students, this is their first exposure to these types of devices." (R6)
Community Involvement	• "CEED building and its benefits for the community." (R25) • "The school has signs throughout the building informing students and guests of all the green features." (R60) • "Features are not really discussed with students, but we do describe the building's features with new families." (R83)
Note. The term CEED is an acronym for Center for Energy Efficient Design.	

There were also several participants that varied with respect to positive or negative responses. Some of the positive responses included: "I like the signage that describes the environmental educational concepts of the building." (R1). "We have the coolest school ever!" (R28). "This is a fabulous beautiful school. There are signs all about put in by the contractor denoting all the green aspects of the building." (R58). "The water saving devices in the bathroom (automatic faucets, water saving toilets, light sensors, open spaces and skylights). For many students, this is their first exposure to these types of devices." (R6). While some of the negative responses included: "I haven't noticed anything about it that encourages them." (R18). "There are plaques on the walls, but I bet it's been a long time since anyone read them." (R68). "The school is not kid-friendly - the students can't see these aspects so they don't understand." (R88).

Survey item 13 collected data regarding how the school utilized the LEED building design and components as teaching tools for environmental education and sustainability. The same themes from survey item 12 emerged for survey item 13, which include: lighting, water reduction, learning garden, signage, building monitoring system, and building design/energy savings. Table 8 below provides a sample of responses by themes.

Table 8 - Responses to Survey Item 13 by Theme

Theme	Responses
Lighting	• "The children are all aware of our lighting, design by all teachers" (R11) • "Natural light is available in every classroom." (R37)
Water Reduction	• "In kindergarten, we use the solar panels as an example, as well as the collection and reuse of the rainwater." (R58)
Learning Garden	• "They then tour the grounds to grade the school on weathering and pollution found. The sixth grade students then spend time determining the health of the school ecosystem, and the impact on the local waterways." (R17) • "We have an outdoor garden that we use in the science departments." (R13) • "A small garden project." (R72)
Signage	• "Signage throughout building; individual teachers incorporate into learning as desired." (R68) • "There are signs throughout the building that explain what some things are and how they are used." (25) • "Our students have the information posted for them around our building showing that they are a part of a 'Green Building' that shows them how important it is to take care and conserve resources in our world." (R24) • "Signage throughout the school identifies LEED building components and why they are important." (R10)
Building Monitoring System	• "We do measure usage, but have a pretty old set of buildings." (R56)
Building Design and Energy Savings	• "Science classes." (R9) • "They are a natural fit for energy education and other areas in science. It is a model for students to understand how we can change the way we build infrastructure so we use less energy and minimize our negative impact on the environment. I like to think it inspires students to realize it is up to them to create new ideas for what they want the future to look like and they can do that…" (R70) • "Some of the environmental science classes may better use the green roof." (R49)

Survey item 14 collected data regarding specific features of the building that were considered valuable teaching tools. The same themes from survey items 12 and 13 emerged for survey item 14, which include: lighting, water reduction, learning garden, signage, building monitoring system, and building design/energy savings. There were seven participants that responded 'no' or 'unsure' to this survey item. There were 41 participants that did not respond to this survey item. Table 9 below provides a sample of responses by theme.

Table 9 - Responses to Item 14 by Theme

Theme	Responses
Lighting	• "Daylight Harvesting throughout the school." (R13) • "Finally, the students have learned about the importance of turning off lights, and dimming them, as needed to conserve energy." (R17) • "…solar ability…" (R24) • "…the large and sunny windows." (R39) • "The rooms with skylights that can be opened and shut allow only natural lighting to be used rather than the energy consuming lighting. Love them when I had a room with them!" (R40) • "Solar panels…" (R56) • "Light harvesting tiles…great use of windows for optimal light." (R63) • "Lots of windows for natural light…" (R64) • "Natural light in all rooms with coated glass on all exterior windows. automatic light shut-offs." (R68) • "Solar orientation… daylighting, low e glass… different types of solar panels…" (R70) • "Motion Lights…" (R80) • "Building orientation, external sun visors for south side of building…" (R96) • "Canned lights in innovation lounge, lights in room." (R2) • "Available light…" (R47) • "The windows…" (R59)
Water Reduction	• "Rainwater harvesting used to flush toilets…Cool roof system." (R13) • "…all restrooms use either low flow toilets or waterless urinals." (R42) • "…water saving…" (R80) • "High efficiency bathroom fixtures and waterless urinals." (R25) • "…water system…" (R32) • "…rainwater collectors." (R55) • "…water efficient fixtures…" (R62) • "…the water-saving bathroom devices." (R98) • "…water conservation." (R3)

	• "Waterless urinals." (R41) • "The retention pond." (85) • "…electric flush valves and low flow fixtures." (R68)
Learning Garden	• "…catch ponds for parking lot and surface water collection and filtration. 'Wetland' planting in catch basins." (R68) • "The courtyard, the outdoor pathways, the adjacent woods…" (R98) • "The 2 interior gardens…" (R39) • "…outdoor learning commons." (R64) • "It is our grounds that compromise the best teaching tools. We have and use rain barrels, two types of gardens, two ponds and 10 acres. In the building itself we have a green house." (R49) • "…grounds around buildings to explore…" (R60) • "Outside classroom." (R20) • "Our courtyard area." (R27) • "Our greenhouse…" (R36) • "Our courtyard is valuable but underused." (R94)
Signage	• "Signs." (R38) • "Informational plaques located around the school." (R48)
Building Design and Energy Savings	• "The site will manage a 100 year storm event. Geothermal heating and cooling supplies radiant floor heat. Solar hotwater. Rainwater harvesting used to flush toilets. Daylight Harvesting throughout the school. Vegetative roof. Cool roof system. Low VOC finishes. Green Cleaning supplies." (R13) • "The design…thermal mass…insulation principles, CO2 monitoring, use of local and recycled materials, solar hot water and different types of solar panels to demonstrate how things change, water harvesting, green roof and surrounding gardens, trellis is an example of material that did not work as well, water flow interesting with aquifer so close to surface, wind generators and weather monitoring, CEED dashboard and teaching activities." (R70) • "Green roof, ambient air quality monitoring station…exposed ductwork." (R62) • "Building orientation, external sun visors for south side of building, part of the building is underground and the HVAC system is modern." (R96) • "The newest part that allows for full access to energy saving utilities. The rooms with skylights that can be opened and shut allow only natural lighting to be used rather than the energy consuming lighting. Love them when I had a room with them!" (R40) • "Access to the internet, classroom layout…collaborative teaching." (R60) • "The school uses sustainable supplies, showing students that large buildings don't need to devastate the land to complete construction." (R17) • "We have a green roof on top of a single floor edition that is visible from the second floor." (R42) • "Green roof…" (R32)

	• "The green roof and building plans for supporting water and energy conservation." (R57) • "…Two types of wind turbines…" (R56) • "Overall the building is designed to save energy. That is a powerful teaching concept in itself." (R11) • "The way the building I'd divided into regions. Open spaces allow for a more "real life" design allows for more collaborative teaching and group work." (R58)
Note. The term CEED is an acronym for Center for Energy Efficient Design.	

Summary

While all the responses of participants varied in detail, the data collected did provide useful information regarding the implementation of environmental education in Green Schools. According to the responses of participants, knowledge of environmental education and Green Schools varies from school to school and person to person. This was evident with the number of responses that included detailed information about the sustainable aspects of the school, environmental programs, and staff knowledge about curricula used to teach about environmental education and the building as a teaching tool. This was also evident with regard to the number of responses that included answers such as 'I don't know,' 'Unsure,' and no response at all for particular survey items. Chapter Five provides a summary of the findings, presents implications, discusses limitations of the study, and makes suggestions for future studies.

Chapter 5 - Summary of Findings

Introduction

Environmental education curriculum that is utilized within Green Schools was examined in this study. Currently, there is no set standard for environmental education or for LEED certified schools that is utilized as a teaching tool for students. The purpose of this descriptive study was to survey Green Schools in the Commonwealth of Virginia in order to better understand what programs and curricula are being utilized and what commonalities exist among them. The study included all public schools in the Commonwealth of Virginia that were certified LEED or recognized as USED Green Ribbon Green Schools. The study examined the following research questions:

1. How do USED Green Ribbon and LEED schools in Virginia implement environmental education into the curriculum?
    a. In what way is environmental education included in the curriculum of the school division?
    b. To what extent is the implementation of environmental education directed by individual classroom teachers?
    c. What common practices and strategies are used to implement environmental education?
    d. What level are the practices used to implement environmental education formally evaluated?
    e. How do LEED schools in Virginia utilize the building components as teaching tool?

At the time of the study, there were 17 public schools in the Commonwealth of Virginia that were LEED or USED Green Ribbon. Of those schools, 14 agreed to participate in the study.

The population of the study included all principals and faculty from the schools, and communication to invite participants was filtered through the principals of each school.

Summary of Findings

Research question a. In what way is environmental education included in the curriculum of the school division? Items 5 and 7 from the survey instrument collected qualitative data utilized to answer sub-question a of the research study. Almost half of the participants (49%) responded that environmental education was included in the curriculum of the school division. Nearly one-third (32%) of the participants responded that environmental education was not included in the curriculum, or they were unsure if it was included in the curriculum of the school division. Nearly one-fifth (19%) of the participants did not respond to this particular survey item. Since a non-response does not necessarily negate the inclusion of environmental education, it was coded separately. Refer to table 10 for the percent from participants.

Table 10 - Integrated throughout the Curriculum

Response	Percent
Yes	49
No or Unsure	32
No Response	19

Positive responses from participants varied and were coded according to common themes that developed: Building, Community, Curricula, Learning Garden, and School Programs. The two themes mentioned the most were curricula and school programs and many responses incorporated more than one theme. It was evident that there are many ways to incorporate environmental education into the formal and informal curricula that exists in Green Schools.

Research Question b. To what extent is the implementation of environmental education directed by individual classroom teachers? Almost half of the participants (48%) responded that implementation of environmental education occurs by individual classroom teachers initiative. Many participants (30%) responded that implementation was a school-wide process. While only 8% responded that implementation took place by grade level or department level.

When implementation takes place as a school-wide process, it also supports a culture of sustainability within the Green School. One participant stated, "I think the most unique practice I've seen at this school is how most of the kids and staff (most of them) will automatically pick up a bug and take it outside, rather than squish it." (R30). However, at the individual level, it may be difficult to establish and maintain a whole-school program over time. One participant stated, "…in past years we monitored the weight of paper collected from each source within the school and created displays of the data using Excel spreadsheets, formulas and graphics. This monitoring encouraged participation by teachers." (R66).

Research Question c. What common practices and strategies are used to implement environmental education? Items 8, 9a, 9b, and 11from the survey instrument collected both quantitative and qualitative data related to the study sub-question c. What common practices and strategies are used to implement environmental education? There were several resources, practices, and programs used to implement environmental education. The internet (21%) and project based learning (20%) were the most common resources provided in responses among participants. Other themes that developed from responses included multimedia, learning garden, community partnerships/field trips, and none. The most common programs utilized in Green Schools included recycling programs (26%) and community outreach/partnerships (22%). The

matrix below in table 11 illustrates common environmental education practices mentioned in qualitative responses.

Throughout the study, it was evident that teachers are employing practices that are consistent with current emphases on environmental education. This was evident by the response from (R59); "We gathered school heating and cooling data from the county's environmental compliance manager to study the current efficiency of managing the school's temperature using Newton's Law of cooling." Furthermore, participants seemed to show a sense of pride for the school and the sustainable programs that are implemented. One participant (R42) stated; "We have a wonderful horticulture program that teaches sustainable farming." Another stated; "In my opinion, we are the most unique school in the state. Our ability to have an on campus laboratory specifically built and designed for environmental studies puts The Gereau Center/CEED on the cutting edge of environmental education." (R31). However, overtime, if environmental education and sustainability were not part of a whole-school culture then practices and awareness were utilized less by teachers. This is evident from the response of participant (R68); "There are plaques on the walls, but I bet it's been a long time since anyone read them." Also, (R63) stated; "It is my understanding that with LEED certification our school is to be recycling paper, aluminum and plastics, as well as composting leaves and grass clippings. The only program we actually implemented is paper recycling. I find this discouraging."

Table 11 - Environmental Education Practices by School Level

School Level	Environmental Education Practices
Elementary	• Have discussions about natural resources/conservation and use examples of ways the school helps to use fewer resources. Further, discuss alternative energy and power sources such as wind and solar power.
	• Use an outdoor garden space at the school for each grade level. Students use the outdoor space to grow a choice salad food, to harvest and eat together as a class later in the spring or to grow indigenous plants.

	• Create Recycling Programs, Environmental Clubs, and community service projects
	• Create an overarching theme for grade levels to teach how systems work.
	• Utilize science units on the water cycle to discus and teach about conservation.
Middle	• Integrate concepts such as zero net carbon and energy building that actually produces its own energy through solar errays and wind turbines. Students are involved in an energy engineering class which uses this building as a laboratory for sustainable energy.
	• Use the science curriculum where several standards relate to the environment and sustainability. Have students cover alternative energy sources, point source and non-point source pollution, and renewable vs. nonrenewable resources.
	• Create Recycling Programs, Environmental Clubs, and community service projects
	• Utilize School Announcements.
	• Use the English research unit to focus on students selecting an environmental issue, researching it, and presenting pros and cons.
	• In Language Arts, use informational texts and fictional texts about the environment, pollution, and its effects.
	• Discuss renewable and nonrenewable energy resources and complete an in-class project about energy conservation.
	• Allow student to enter a poster in the James River Association's poster contest titled 'What a Healthy River Means to Me.'
	• Educate students about the cost of building and operating solid-waste facilities and the value of recycling different products.
High	• Utilize the science curriculum concepts that discuss reduction of materials, reuse of materials, and recycling.
	• Utilize units that include learning about renewable energy options and analyzing the viability for renewable energy in VA.
	• Use data contacts and operators for the air quality monitoring station and information available for teachers. Use curriculum links for NEED.org that is available to teachers.

	• Use science courses to teach sustainability, model it, and survey students and teach about our footprint. Incorporate stream study into the curriculum and create a 'pond in the classroom to teach concepts about ecology.
	• Use the engineering class to introduce concepts from the curriculum, especially those concerning energy and clean water.
	• Discuss current topics in other countries, which often deal with pollution and other environmental concerns (i.e., clean water).
	• Utilize the course on environmental science.
	• Use the STEM curriculum.

Note. STEM is an acronym for Science, Technology, Engineering, and Mathematics

Research Question d. What level are the practices used to implement environmental education formally evaluated? Almost half the participants (40%) responded that environmental education was evaluated at the school level. Evaluation at school division level (4%) and evaluation by an outside agency (2%) were much lower, however, and 8% percent of the teachers responded that there were two or more agencies that evaluated the program. Participants that selected two or more items included the following: two participants selected evaluation at the district level and by an outside agency; two participants selected evaluation at the school level and district level; three participants selected evaluation at the school level, district level, and by an outside agency; and one participant selected evaluation by an outside agency and other: Lynnhaven River Now for Pearl School recognition. No response to the survey item consisted of 25% of the participants. Lastly, 21% of the participants responded with 'other.' Those participants provided the following types of answers; "part of PLTW exam" (R67), "no," "No evaluation," "Not sure," "I don't know," and "None of the above."

Research Question e. How do LEED schools in Virginia utilize the building components as teaching tool? Items 12, 13, and 14 from the survey instrument collected

qualitative data related to the study sub-question e. How do LEED schools in Virginia utilize the building components as teaching tool? There were seven themes that developed from the responses to survey items 12, 13, and 14. These themes include: lighting, water reduction, learning garden, signage, building monitoring system, building design and energy savings, and community involvement. Community involvement was not included as a theme in survey items 13 and 14. While, many responses included various features of the LEED buildings, many did not provide specific details regarding how they used the building as a teaching tool. The researcher was able to extrapolate data related to building features from survey items 5, 7, and 9b which discussed the implementation of environmental education. These practices are listed below in table 12 and separated by school level.

It was evident that many participants utilize features of the building and share information about the sustainable features with students in their classes. This took place in both the formal and informal curricula of the schools. It was also evident that school staff took pride in teaching in a Green School. One participant stated; "We have the coolest school ever!" (R28). Another stated; "This is a fabulous beautiful school. There are signs all about put in by the contractor denoting all the green aspects of the building." (R58).

Table 12 - Environmental Education Practices that use the Building by School Level

School Level	Environmental Education Practices	Building as a Teaching Tool
Elementary	• Have discussions about natural resources/conservation and use examples of ways the school helps to use fewer resources. Further, discuss alternative energy and power sources such as wind and solar power.	• Use open spaces for class discussions to show how light harvesting tiles, special lights, use of windows for optimal light, and plumbing - toilets that use less water, waterless urinals, motion sensor facets, rain collection, and retention ponds conserve energy and utilize natural resources.

	• Use an outdoor garden space at the school for each grade level. Students use the outdoor space to grow a choice salad food, to harvest and eat together as a class later in the spring or to grow indigenous plants.	• Use interior and exterior gardens for hands-on learning and explain how natural materials are used for building.
	• Create Recycling Programs, Environmental Clubs, and community service projects	• Use recycling cans throughout the building, create various recycling programs, compost bins, learning gardens, and utilize informational signage throughout the building to teach about sustainability.
	• Create an overarching theme for grade levels to teach how systems work.	• Study and research how various systems in the building work - Wind Turbines, Solar power, rain collection, green roof, etc.
	• Utilize science units on the water cycle to discus and teach about conservation.	• Discuss how solar panels and rainwater collectors help conserve resources. Also, use plaques throughout the building that tell students about the sustainable features of the building, and small plaques at every classroom door with names and pictures of flora and fauna indigenous to the region, with QR codes that link to websites about them.
Middle	• Integrate concepts such as zero net carbon and energy building that actually produces its own energy through solar errays and wind turbines. Students are involved in an energy engineering class which uses this building as a laboratory for sustainable energy.	• Use the design, solar orientation, daylighting, solar hot water and different types of solar panels to demonstrate how things change. Discuss how low e glass, insulation principles, CO2 monitoring, use of local and recycled materials, water harvesting, green roof and surrounding gardens, and wind generators and weather monitoring, information kiosk dashboard help monitor our energy usage.

	• Use the science curriculum where several standards relate to the environment and sustainability. Have students cover alternative energy sources, point source and non-point source pollution, and renewable vs. nonrenewable resources.	• Have students tour the school and discuss the green features. They then tour the grounds to evaluate the school on weathering and pollution found. The school uses sustainable supplies, showing students that large buildings don't need to devastate the land to complete construction. The school also uses less water and electricity, but is still able to perform as a normal school.
	• Create Recycling Programs, Environmental Clubs, and community service projects	• Use recycling cans throughout the building, various recycling programs, compost bins, learning gardens, and informational signage throughout the building.
	• Utilize School Announcements.	• Provide information about the building and sustainable features and concepts.
	• Use the English research unit to focus on students selecting an environmental issue, researching it, and presenting pros and cons.	• No specific response included.
	• In Language Arts, use informational texts and fictional texts about the environment, pollution, and its effects.	• Use building signage that explains the types of recycling waste.
	• Discuss renewable and nonrenewable energy resources and complete an in-class project about energy conservation.	• Monitor the recycling program and discuss the use of natural light throughout classrooms.
	• Allow student to enter a poster in the James River Association's poster contest titled 'What a Healthy River Means to Me.'	• No specific response included related to the building.
	• Educate students about the cost of building and operating solid-waste facilities and the value of recycling different products.	• Monitor the weight of paper collected from each source within the school and created displays of the data using Excel spreadsheets, formulas, and graphics.

High	• Utilize the science curriculum concepts that discuss reduction of materials, reuse of materials, and recycling.	• Discuss signage that describes the environmental educational concepts of the building. For example, the green roof. Use the outdoor garden and compost bins. Discuss how the building is designed to save energy. That is a powerful teaching concept in itself.
	• Utilize units that include learning about renewable energy options and analyzing the viability for renewable energy in VA.	• Discuss the green roof and design plans for energy and water conservation.
	• Use data contacts and operators for the air quality monitoring station and information available for teachers. Use curriculum links for NEED.org that is available to teachers.	• Discuss how the green roof system is monitored by a Hobo meter for soil moisture, air and substrate temperature, and relative humidity. Discuss how the school website hosts an ambient air quality monitoring station operated by the Virginia Department of Environmental Quality.
	• Use science courses to teach sustainability, model it, and survey students and teach about our footprint. Incorporate stream study into the curriculum and create a 'pond in the classroom to teach concepts about ecology.	• Discuss various building materials throughout school and use signage to clarify.
	• Use the engineering class to introduce concepts from the curriculum, especially those concerning energy and clean water.	• Discuss the energy efficient building (new high school). Discuss various features such as films on windows, the white roof, thermal glass, automatic lights, and types of lighting.
	• Discuss current topics in other countries, which often deal with pollution and other environmental concerns (i.e., clean water).	• Discuss the water reduction features of the building - such as automatic faucets, and low flush toilets, and adjustable lighting.

	• Utilize the course on environmental science.	• Discuss and utilize the learning garden for hands-on activities.

Note. Many common responses were combined and some responses were edited for readability. As a result, specific participants are not noted in the responses.

Implications

Based on the data and the findings from this study, there are several recommendations that should be considered by educational leaders when implementing environmental education or developing Green School practices. Recommendations are reported by each sub-question from the study.

Research question a. In what way is environmental education included in the curriculum of the school division? The data from the survey instrument reflects that 49% of the participants responded that environmental education was included in the curriculum of the school division and 32% responded that it was not included or they were not sure if it was included in the curriculum. While a third of the participants felt that environmental education may not be directly included within each subject's curricula, there is ample opportunity to modify a lesson so that it incorporates environmental concepts into the learning process. Based on the findings, there are several examples, which include incorporating sustainability concepts into the formal curriculum through STEM, cross-curricular assignments, research assignments, using informational and fictional text, class debate/discussion on current events, field trips, outdoor classroom, learning garden, and class projects. There are also ways to include environmental education and sustainable practices informally into the curriculum. Some examples from the survey instrument include recycling programs, environmental clubs, civic and community service projects, fieldtrips, and by reducing energy usage.

There are many ways to create school-wide opportunities for students to learn about sustainability and the added benefit of school-wide programs is that it works to establish a culture of sustainable practices throughout the school.

Research Question b. To what extent is the implementation of environmental education directed by individual classroom teachers? Based on responses from the survey instrument, 48% of the participants felt that environmental education is implemented by individual classroom teachers, although, 30% of the participants responded that implementation was a school-wide process. As an instructional leader, it is important to consider how implementation should occur within the school. When implementation takes place as a school-wide process, it also supports a culture of sustainability within the Green School. However, at the individual level, it may be difficult to establish and maintain a whole-school program.

Research Question c. What common practices and strategies are used to implement environmental education? Implementation of environmental education does not occur overnight; instead it is a process that should be planned out with annual goals or benchmarks. For example, many of the Green Schools in Virginia incorporated a recycling program and/or community partnership/outreach as part of the environmental educational practices. A recycling program is relatively simple to start up and can include a variety of items (paper, aluminum, plastic, cell phones, batteries, etc) while including all staff and students. Community outreach/partnerships vary according to the location and geography of the school division. Some of the common activities included field trips and sponsorships through local environmental agencies such as, Save the Bay Foundation, James River Association, Culpeper Soil and Water Conservation District, and Virginia Department of Environmental Quality. Refer to table 13 below for common internet resources utilized by Green Schools in Virginia.

Table 13 – Common Resources for Environmental Education for Green Schools in Virginia

Internet Resources	• Virginia Department of Forestry - http://www.dof.virginia.gov/ • Virginia Resource Use Education Council (VRUEC) - http://www.dcr.virginia.gov/virginia_naturally/virginia-resource-use-education-council.shtml • National Oceanic and Atmospheric Administration (NOAA) - http://www.noaa.gov/ • Project Water Education for Teachers (WET) - http://www.projectwet.org/ • Green Adventure Project - http://greenadventureproject.org/Green-Adventure-Project/Home.aspx • National Energy Education Development (NEED) - http://www.need.org/ • National Geographic - http://www.nationalgeographic.com/ • Environmental Protection Agency (EPA) - http://www.epa.gov/ • Sierra Club - http://www.sierraclub.org/ • Project Learning Tree (PLT) - https://www.plt.org/ • Save our Streams - http://www.vasos.org/

Building a learning garden on the school grounds was another common qualitative response from the participants. This strategy can be utilized in a variety of ways while offering students hand-on learning experiences. Project-based learning activities were a common quantitative response and participants provided a variety of qualitative examples. These examples included: STEM projects; field trips to examine stream health; collecting and monitoring data on recycling, energy usage, and water usage in the building; and creating videos to advertise sustainable aspects of the building and programs.

The practices and strategies mentioned are valuable additions to the formal and informal curricula of the school. They incorporate real-world concepts and high engagement hands-on activities which assist in creating 21st century learning opportunities and authentic experiences

for students. These are aspects that all instructional leaders can find value. However, in LEED schools where the building is used as a teaching tool, it is important for educational leaders to consider ongoing staff development, so they are aware of the sustainable features and learning opportunities that exist within the building.

Research Question d. What level are the practices used to implement environmental education formally evaluated? School level represented 40% of the responses from the participants. As instructional leaders in the building, it is important for teachers to understand that they are the person responsible for the successes within the school. This should be a primary emphasis when it comes to establishing a Green School with a culture that supports sustainable practices.

Research Question e. How do LEED schools in Virginia utilize the building components as teaching tool? There is a large variety of activities in LEED schools that utilize the building components as a teaching tool. Many of the activities that incorporated the building components within the learning process were developed around conversations related to community service/clubs, conservation, recycling, natural resources, pollution, engineering, and alternative sources of energy. These topics were related to many different aspects of the building also. Many of the topics utilize the building signage are part of the lesson. Lessons related to conservation, recycling, reduction of energy often utilized aspects of the building such as various lighting features that save energy or support an increase of natural light within the building. Teachers also discussed components that reduced water and energy usage. Many of the community service projects and clubs took advantage of various types recycling and outdoor learning spaces such as courtyards, learning gardens, compost bins, and retention ponds.

While specific lessons were not provided within the data collected by the survey instrument, it was evident that many the participants actively utilized components of the buildings or discussed the features with students.

Suggestions for Future Studies

The purpose of this study was to examine and establish common practices that exist in Green Schools with regard to the implementation of environmental education and establish common practices for utilizing the building as a teaching tool for those Green Schools that are LEED certified. However, the population of this study was limited to those Green Schools within the Commonwealth of Virginia. Future studies should consider expanding the population to allow for greater generalizability in the findings. Furthermore, consideration should be given to the inclusion of CHPS and Energy Star buildings when developing a sample population of Green Schools.

Future studies may also consider modifying the survey instrument to include only those Green Schools that utilize the building as a teaching tool for those specific survey items. While there were only three schools that were not LEED certified it was evident that not all participants were knowledgeable with regard to the identification of LEED versus USED Green Ribbon. For example, participant (R63) stated; "I don't know what the LEED building design is. We know we are a green school and how to work to obtain and keep that classification BUT what is LEED. If you don't define it DON'T use the term."

Lastly, future studies may also consider incorporating focus groups and/or phone interviews as part of the data collection. This addition to the methodology would allow the researcher to ask follow up questions and expand on responses to help ensure clarity and data saturation for future studies.

Reflections

Overall, this was a successful study with regard to working with several school divisions across the Commonwealth of Virginia and several principals from all school levels. Many of the school divisions were supportive and interested in the study. However, because of the timing for the survey, there were some environmental factors that may have affected the number of participants that responded to the survey instrument. Many schools across the state of Virginia were closed for several days due to inclement weather on the first day that surveys were to be sent to teachers by the school principals. As a result, this required much more follow up on the researchers part to ensure that surveys were sent out in a timely manner and that all participants had an equal time to complete the survey.

One school division declined to participant in the study and cited that the school principals felt they did not have adequate training with respect to the LEED certification of their school. However, many schools that did agree to participate were helpful and responsive to my requests. Of those principals that the researcher spoke with via phone, there was a sense of pride for their building and the programs within their school that they wanted to share. This was also evident in responses from the participants too.

Overall, the research study was a positive experience and it was interesting to see how schools from a diverse population implemented environmental education and sustainability. However, responses did differ with respect to in-depth details. Some of the responses were quite detailed and utilized several aspects of the building as a teaching tool, for example, the building monitoring system was used by many to track and monitor energy usage. The researcher's assumption was that many participants would respond with familiar aspects of the LEED building such as informational signage and increased natural lighting.

Educational leaders should understand that the implementation of a Green School does not occur overnight; instead it is a process that should be planned out with annual goals or benchmarks. For example, many of the Green Schools in Virginia incorporated a recycling program and/or community partnership/outreach as part of environmental educational practices. A recycling program is relatively simple to start up and can include a variety of items (paper, aluminum, plastic, cell phones, batteries, etc). This can also be a school-wide program, which will support buy-in from all staff and students. Community outreach/partnerships vary according to the location and geography of the school division. Some of the common activities included field trips and clean up around the school grounds or nearby parks. Throughout the study, it was evident that teachers are employing practices that are consistent with current emphases on environmental education.

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Appendix A: Green Schools in Virginia

List of Green Schools

School	Division	Type of Green School
Albemarle High School	Albemarle County	LEED - Silver
Brownsville Elementary	Albemarle County	LEED - Gold*
Stony Point Elementary	Albemarle County	USED Green Ribbon
Fluvanna High School	Fluvanna County	LEED - Silver
Gereau Center/CEED	Franklin County	USED Green Ribbon
Glen Allen High School	Henrico	LEED - Gold*
Holman Middle School	Henrico	LEED - Silver*
Magna Vista High	Henry County	USED Green Ribbon
Sandusky Middle School	Lynchburg City	LEED - Certified
Locust Grove Middle School	Orange County	LEED - Gold*
Kettle Run Elementary	Prince William County	LEED - Silver
Piney Branch Elementary	Prince William County	LEED - Silver*
Fishburn Park Elementary	Roanoke City	USED Green Ribbon
College Park Elementary	Virginia Beach	LEED - Platinum
Hermitage Elementary	Virginia Beach	LEED - Certified
Virginia Beach Middle	Virginia Beach	LEED - Silver
Windsor Oaks Elementary	Virginia Beach	LEED - Silver*

Note. * indicates that the school earned a point on the LEED application for utilizing the building as a teaching tool.

Appendix B: Informed Consent and Survey Instrument

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Informed Consent for Participants

in Research Projects Involving Human Subjects

Title of Project: Green Schools – The implementation and practices of environmental education in LEED and USED Green Ribbon public schools in Virginia

Investigator(s): **Steve Marable** **Steve.marable@vbschools.com**

Name E-mail / Phone number

I. Purpose of this Research Project

The purpose of this study is to survey principals and teachers currently working in LEED or USED Green Ribbon schools in the Commonwealth of Virginia to gather data on the implementation of environmental education and sustainability. The results of this study was published in a dissertation and utilized to build data regarding the implementation of environmental education. The participants include building principals and teachers from each school that is recognized as a LEED or USED Green Ribbon School.

II. Procedures

As part of the study, you are asked to complete an eSurvey. Upon IRB and division approval, principals were contacted to request participation in the study. Building principals and teachers was invited to participate in data collection by completing the eSurvey. Participation is voluntary and will not affect your employment with your school division. The eSurvey should take about 15-20 minutes and may be completed at anytime during the data collection window.

You will receive an email from your building principal with a link to the eSurvey. If you agree to participate in this study, please select 'yes' for the informed consent and continue on with the survey.

III. Risks

There are no risks with this research study. Please know that survey data was submitted anonymously. The only identifying variables include: position, school level, and grade level/subject area. Specific school data will not be disaggregated.

IV. Benefits

Currently, there are no set standards for implementing environmental education within the

framework of Green Schools. Environmental education is a growing trend with LEED and USED Green Ribbon schools which can be used to support multiple curricula throughout many grade levels. It is important to examine how schools implement environmental education and sustainability practices so that common themes and best practices may be established for the future.

Please know that no promise or guarantee of benefits has been made to encourage you to participate.

V. Extent of Anonymity and Confidentiality

All data were collected anonymously. Informed consent data was the only identifiable information and, as such, was stored separately. The only identifying variables include: position, school level, and grade level/subject area. This data was used to describe the sample population and was coded to increase anonymity. Specific school data will not be disaggregated. At no time will the researchers release identifiable results of the study to anyone other than individuals working on the project without your written consent.

The Virginia Tech (VT) Institutional Review Board (IRB) may view the study's data for auditing purposes. The IRB is responsible for the oversight of the protection of human subjects involved in research.

VI. Compensation

Participation is this study does not include compensation. However, your valued time will add to the limited research regarding Green Schools and Environmental Education.

VII. Subject's Consent

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent. Choose 'yes' on the prompt above to grant consent and continue with the survey.

_____ Date_____

Subject signature

_____

Subject printed name

VIII. Freedom to Withdraw

It is important for you to know that you are free to withdraw from this study at any time without penalty. You are free not to answer any questions that you choose or respond to what is being

asked of you without penalty.

Please note that there may be circumstances under which the investigator may determine that a subject should not continue as a subject.

Should you withdraw or otherwise discontinue participation, you was compensated for the portion of the project completed in accordance with the Compensation section of this document.

IX. Questions or Concerns

Should you have any questions about this study, you may contact one of the research investigators whose contact information is included at the beginning of this document.

Should you have any questions or concerns about the study's conduct or your rights as a research subject, or need to report a research-related injury or event, you may contact the VT IRB Chair, Dr. David M. Moore at moored@vt.edu or (540) 321-4991.

Appendix C: Green Schools Survey

Choose 'Yes' to grant consent and continue with the survey.

a. Yes
b. No

1. What position do you currently hold?

    a. principal
    b. teacher

2. What grade level do you currently teach or supervise?

    a. Elementary School
    b. Middle School
    c. High School

3. If you are a teacher, what grade level or subject do you currently teach?

    a. K-5 (multidisciplinary)
    b. Science
    c. Math
    d. Social Studies
    e. English/Language Arts
    f. Other, please list.

4. What is the certification of your school?
    a. USED Green Ribbon
    b. LEED
    c. Both LEED and USED Green Ribbon
    d. Applied for LEED and certification level is pending

5. Are environmental and sustainability concepts integrated throughout the curriculum? Please explain.

6. At what level is environmental education currently implemented in your school?

    a. Implementation takes place by individual classroom teachers,
    b. Implementation takes place by grade level or departmental collaboration
    c. Implementation is a school-wide process
    d. Other, please explain.

7. Does your school division provide environmental education curriculum and instructional resources? Please explain.
8. What resources have you used to develop and enrich your curriculum with environmental education?
9. What specific programs, practices, and/or strategies are used to implement environmental education?

    a. Teaching Garden
    b. Recycling Program
    c. Sustainable Education embedded within the curriculum
    d. Project based learning opportunities that support environmental education
    e. Community/Civic Outreach
    f. Community Partnerships
    g. Learning green technologies and career pathways
    h. Other, please explain.

9b. Please use this space to further elaborate on any of the programs or practices listed above that might be unique to your school.

10. Are the practices and strategies used to implement environmental education formally evaluated?

    a. Evaluated at the school level
    b. Evaluated at the district level
    c. Evaluated by an outside agency
    d. Other, please explain.

11. Are teacher professional development opportunities in environmental and sustainability education offered to all teachers in your school? Please explain.

12. What aspects of your school's design encourage students to learn about their school building and sustainability?
13. How does your school utilize the LEED building design and components as teaching tools for environmental education and sustainability?

14. What are the specific features of the building that you consider valuable teaching tools?

Appendix D: Institutional Review Board Approval Letter

VirginiaTech

Office of Research Compliance
Institutational Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE: February 18, 2014

TO: Glen I Earthman, Steve Alexander Marable

FROM: Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)

PROTOCOL TITLE: Green schools: the implementation of environmental education in LEED and USED Green Ribbon schools in Virginia

IRB NUMBER: **14-182**

Effective February 18, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Exempt, under 45 CFR 46.110 category(ies) 2**
Protocol Approval Date:	**February 18, 2014**
Protocol Expiration Date:	**N/A**
Continuing Review Due Date*:	**N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Appendix E: School Division Approval

Albemarle County Public Schools

Steve,
Your research is approved to move forward. Would you like me to contact the principals of the three schools you have selected and make an introduction for you?
Thanks,
Chris

-----Original Message-----
From: Steve A. Marable [mailto:Steve.Marable@VBSchools.com]
Sent: Sunday, January 26, 2014 8:25 PM
To: Chris Gilman
Subject: RE: Request for Research Approval

Mr. Gilman,

I just wanted to follow up regarding my request for research approval.

Thank you for time and consideration,

Steve Marable

Fluvanna Public Schools

From: Gena Keller [mailto:gena-keller@apps.fluco.org]
Sent: Thursday, February 20, 2014 10:13 AM
To: Steve A. Marable
Cc: Chuck Winkler; Brenda Gilliam
Subject: Re: Approval for research

Good morning,

You may certainly include Fluvanna County High School in your study of LEED certified schools in Virginia. Please keep me abreast of any surveys and outreach efforts that you will need to include in your study. We will approve them through this office.

Take care and best wishes!

Ms. Keller

Gena Cook Keller
Superintendent
Fluvanna County Public Schools
14455 James Madison Highway
Palmyra, Virginia 22963
434 589 8208

Franklin County Public Schools

From: Work [mailto:sue.rogers@frco.k12.va.us]
Sent: Wednesday, February 26, 2014 8:36 PM
To: Steve A. Marable
Subject: Re: Research Approval Process

Yes you can move forward

On Feb 26, 2014, at 4:57 PM, "Steve A. Marable" <Steve.Marable@VBSchools.com> wrote:

Sue,

I just wanted to touch base with you regarding approval for research. I don't think I received an approval from your office, although, Matt has agreed to participate (see email below). A simple email reply is fine, I just need the documentation for my research.

Thank you again,

Steve

HCPS Henrico County Public Schools

Department of Research & Planning

February 20, 2014

Mr. Steve Marable
1961 Lemonwood Rd
Chesapeake, VA 223323

Dear Mr. Marable:

The Department of Research and Planning has reviewed and approved your research study entitled "Green Schools – The implementation and practices of environmental education". Your study was approved by the review.

Although your study has been approved, participation by individuals and schools is completely voluntary. Reports and publications generated from this study should not identify the individuals, schools, or the division and all research materials should accurately represent the party conducting the study. If there are changes to the methods or materials that you plan to use, you must submit the changes to our office for review prior to proceeding. It is our expectation that you will submit a final report upon completion of the study to the Department of Research and Planning.

Please contact Helen Whitehurst at hswhiteh@henrico.k12.va.us or (804) 652-3831 who will assist you in the process of beginning your research studies in the schools or offices that you have requested.

Thank you for your interest in Henrico County Public Schools.

Sincerely,

Tiffany Hinton

Tiffany Hinton, Ph.D.
Director of Research and Planning
Henrico County Public Schools

Helen Whitehurst

Helen Whitehurst, Ph.D.
Educational Specialist - Research
Henrico County Public Schools

Henry County Public Schools

-----Original Message-----
From: Jared A Cotton [mailto:jcotton@henry.k12.va.us]
Sent: Tuesday, February 18, 2014 1:01 PM
To: Steve A. Marable
Cc: Gracie Agnew
Subject: Re: Research Approval Process

Steve,

You can go ahead and contact Mrs. Agnew. I've copied her on this email.

Sent from my iPhone

On Feb 18, 2014, at 12:17 PM, "Steve A. Marable" <Steve.Marable@vbschools.com> wrote:

Attached is my IRB approval. I'm hoping to start making principal contacts and send out eSurveys in early March.

Is there anything further that you need from me, or may I go ahead and contact the principal at MVHS?

Thank you,

Steve

From: Jared A Cotton [mailto:jcotton@henry.k12.va.us]
Sent: Tuesday, January 28, 2014 11:29 AM
To: Steve A. Marable
Subject: Re: Research Approval Process

Steve,

I don't see an issue with MVH participating. I've copied the principal and will get back to you on this.

Hope all is well!
JCotton

Lynchburg City Schools

***** Lynchburg City Schools
***** 915 Court Street - Lynchburg, VA 24505
***** Mail Administrator - mail@lcsedu.net

Steve there is no other information required. I have copied the Principal and Asst. Principal at the school so they are aware of the research. Please contact them directly for further coordination.

Best of luck with the project and doctoral program.

Ben W. Copeland

Assistant Superintendent for Operations & Administration

Lynchburg City Schools

915 Court Street

P. O. Box 2497

Lynchburg, Virginia 24505

434-515-5070

Orange County Public Schools

-----Original Message-----
From: Yurasits, Jim [mailto:jyurasits@ocss-va.org]
Sent: Tuesday, February 25, 2014 10:56 AM
To: Steve A. Marable
Subject: RE: Research Approval Process

Steve,

I enjoyed talking with you today and hope that your efforts are successful. Here is Ms. Kim Crandall's email address:

kcrandall@ocss-va.org

Jim Yurasits
Director of Testing, Data, and School Improvement Orange County Public Schools
200 Dailey Drive
Orange, VA 22960
(540)661-4578

ROANOKE CITY
PUBLIC SCHOOLS
Strong Students. Strong Schools. Strong City.

February 27, 2014

Mr. Steve Marable
1961 Lemonwood Rd.
Chesapeake, VA 23323

Dear Mr. Marable,

Thank you for submitting your research proposal regarding *"Green Schools – The implementation and practices of environmental education."* I am pleased to inform you that your study has been approved and you may proceed with the various activities described. I understand that you wish to survey the principal and teachers at Fishburn Park Elementary School. Please feel free to contact the principal, Mrs. Judy Lackey (540-853-2931), to make arrangements to begin your research.

If you decide, in the course of your data gathering, that you wish to modify your study, please submit any proposed changes in writing for approval. Mrs. Lackey and I look forward to receiving a copy of your completed work and wish you success as you begin the collection and analysis of data.

Sincerely,

Jean Pollock

Jean Pollock
Director of Data and Analysis

cc: Mrs. Judy Lackey

P.O. Box 13145 Roanoke, VA 24031 540.853.2101 Fax: 853.2103 www.rcps.info

VIRGINIA BEACH CITY PUBLIC SCHOOLS
AHEAD OF THE CURVE

March 6, 2014

Mr. Steve A. Marable
1961 Lemonwood Road
Chesapeake, VA 23323

Dear Mr. Marable:

This letter serves as the Department of Planning, Innovation, and Accountability's approval for your research study entitled "Green Schools – The Implementation and Practices of Environmental Education." Your request to collect survey data from principals and teachers regarding the implementation of environmental education at Leadership in Energy and Environmental Design (LEED) and U.S. Department of Education Green Ribbon schools has been approved with the understanding that individual participation in this activity is voluntary. Additionally, your study was approved with the understanding that the school principals will disseminate the survey link to the teachers, if they choose to participate, and the names of the schools, individual participants, and school division will not be identified in any future reports. As always, the final decision to participate rests with the school principals, and you are expected to discuss your study with them prior to starting your research activities.

Our approval for your study will expire one year from the date of this letter. If there are any changes to your study, you must submit the changes to our office for review prior to proceeding. It is our expectation that you will submit an electronic copy of the final report upon its completion to the Department of Planning, Innovation, and Accountability. Please send the report to Shawn.Dickerson@vbschools.com. If you have any questions, please contact me at 263-1408.

Sincerely,

Shawn L. Dickerson, M.S.
Research Specialist

cc: Donald E. Robertson, Jr., Ph.D., Assistant Superintendent
Department of Planning, Innovation, and Accountability

Shirann C. Lewis, Assistant Superintendent, Elementary Schools
George Parker III, Ph.D., Assistant Superintendent, Secondary Schools
Krista Barton-Arnold, Director, Elementary Schools
James J. Smith, Ed.D., Director, Middle Schools
Department of School Leadership

Sandra R. Brown, Ph.D., Principal
Virginia Beach Middle School

Aimee S. Ferguson, Principal
Windsor Oaks Elementary School

Holly J. Coggin, Principal
Hermitage Elementary School

Sheila M. Wynn, Principal
College Park Elementary

Department of Planning, Innovation, and Accountability
2512 George Mason Drive • P. O. Box 6038 • Virginia Beach, VA 23456-0038
Office: 757.263.1030 • Fax: 757.263.1131

Appendix F: Sample Letter to Principals

Sample of cover letter that will be sent to principals describing the study

Principal _____,

I am currently working on a research study as part of the requirements for a doctorate in Educational Leadership with Virginia Tech. Recently, your school division and the Institutional Review Board (IRB) has granted me permission to conduct research for my study: Green Schools – The implementation and practices of environmental education in LEED and USED Green Ribbon public schools in Virginia.

As part of the study, I am surveying principals and teachers currently working in LEED or USED Green Ribbon schools in the Commonwealth of Virginia to gather data on the implementation of environmental education and sustainability. The study will be utilized to create a list of common programs and best practices of environmental education in Green Schools in Virginia. I would be grateful if you and your teachers would participate in this research study. Overall, participation will involve completion of an eSurvey, sending an invitation to the teachers in your building to participate in the survey, and forwarding the internet link for the eSurvey to your teachers. I will send an email with the link on Monday, March 3, 2014.

The survey consists of 14 multiple choice and open-ended questions, should take about 15-20 minutes, and can be completed at any time before the March 21, 2014 deadline.

Please know that survey data will be submitted anonymously. The only identifying variables include: position, school level, and grade level/subject area. Specific school data will not be disaggregated.

Consent for participation in the study will be requested at the beginning of the eSurvey. Since this is the only identifiable data, it will be stored separately to ensure anonymity.

Thank you in advance for your time and consideration.

Sincerely,

Steve Marable

Doctoral Candidate

Virginia Polytechnic Institute and State University

Appendix G: Sample Letter for Principals to send to Teachers

March 3, 2014

Dear Teachers,

I am sending this email on behalf of Steve Marable, a doctoral student at Virginia Tech. He is conducting a study on the implementation of environmental education practices in green schools. Our division has given him permission to conduct research and our school has been identified as a Green School.

The study entitled: "Green Schools – The implementation and practices of environmental education in LEED and USED Green Ribbon public schools in Virginia," is a component of his doctorate. Mr. Marable, and Virginia Tech, would like to invite us to participate in his survey to collect data regarding environmental educational practices and programs. Please know that your participation is voluntary and has no effect on your employment with our school system.

Please help support his efforts and contributions to environmental education in schools and spend about *15-20 minutes* to complete this survey using the link provided below:

(copy and paste the above link into your internet browser to access the eSurvey)

Lastly, I will send a reminder to everyone, however it is important that you complete the survey by the *March 21, 2014 deadline*.

Thank you all,

Principal

Appendix H: Matrix of Responses by theme for Item 5 of the Survey Instrument

Response	School Programs	Curricula	Building	Community	Outdoors
1	"recycling… garden house projects, earth hour."	"Used to support all areas of study"			"Compostin g…garden work, green house projects…"
2	"…recycling program and give an environmental fact on the announcement several days a week."	"We have integrated environmental concepts into our curriculum…"	"… announceme nts several days a week."		
16	"6th grade class takes a field trip to a local lake and tests the water. As a group, we discuss the health of the lake, and what in the area could be affecting it."	"Science Curriculum contains several standards related to the environment and sustainability… alternative energy sources… pollution, and renewable vs. nonrenewable resources."			"6th grade class takes a field trip to a local lake and tests the water."
18		" concepts are discussed...with hands on activities in my classes…6th and 7th grades are attending interdisciplinary training and implementation of environmental awareness…"		"VDOE's Watershed Academies for the James and Rappahannock Rivers… participating in the James River Academy…"	
30		"…science courses teach sustainability…		" field trip to the river this semester with	

		model it…survey our students and teach about our footprint… stream study…a 'pond' in my classroom to teach…about ecology."		both of my ecology/environmental science classes where we will survey the stream for health indicators and do chemical and biological (microbiological) analyses."	
31	"Recycle in Science and in clubs"	“Recycle, reduce, reuse in Science …Teaching garden."			“Teaching garden. Planting for school grounds improvement."
32	"…recycling…"	"Students are involved in an energy engineering class which uses this building as a laboratory for sustainable energy. Also, 1 day a week we have STEM classes that all students are involved in that concentrates on Problem based learning."	"...first Passivhaus designed school building in the country. It is a zero net carbon and energy building that actually produces its own energy through solar errays and wind turbines…"		
33	“…afterschool Nature Club."	" outdoor classroom…is used across the curriculum…"	"…2 interior courtyard gardens--a well-established Japanese Garden and a math garden (in	"… voluntary creek cleanup."	"Each grade level has an outdoor garden space… outdoor nature trail through woods,

			progress)."		which leads to a spring-fed creek and outdoor classroom. "
34		"Children study water conservation and we have systems that collect and conserve water."	"…green roof…systems that collect and conserve water."		"…garden…"
44	"...partnership sponsored by the Chesapeake Bay Foundation."	"We are working at 6th grade level to create more lessons across the curriculum…"		"...partnership sponsored by the Chesapeake Bay Foundation."	
47	"all students compost lunch leftovers including our biodegradable trays…We recycle weekly as a 5th grade responsibility…Second grade raise trout for release in a local stream as a project with the state."	"raised bed garden as a part of the curriculum… We teach across the curriculum monthly in different groups for 'earth hour'…various academic cross-curricular activities called Earth Week."		"…students collect then organize used school materials to send to Belize with a local group."	"…raised bed garden…large permaculture garden …green house and observations in our ponds. Second grade raise trout for release in a local stream as a project with the state…"
48		"We do a units that include learning about renewable energy options and analyzing the viability for renewable		"…study the long term advantages of the Edison2 electric car, the long term effects of the CAFE	

		energy in VA. We have also supported research projects where students study the long term advantages of the Edison2 electric car…"		Standards, and the viability of coal plant replacement in VA."	
60		"Science teachers have incorporated the facility into their lessons."	"The ductwork and plumbing systems are exposed so students can observe them. Signage throughout… describes the acoustical considerations, low/no VOC finishes and water efficient fixtures… Waterless urinals …green roof system is monitored by a Hobo meter for soil moisture, air and substrate temperature, and relative humidity… school website hosts an ambient air quality monitoring station operated by		"The green roof system is monitoring by a Hobo meter for soil moisture, air and substrate temperature, and relative humidity."

			the Virginia Department of Environmental Quality…"		
61	"...recycling program."	"integrated in each unit if possible…for instance we are talking about heat so that naturally ties into climate change, the ability of water to maintain a temperature because of its specific heat, geothermal is added into the curriculum."			
92		"We used to have a LEED lesson for every grade … Example: Recycling, Water Conservation, LEED building…"	"…LEED lesson for every grade level …LEED building…"		
96	"…recycling is done in the cafeteria and copy paper that is only printed on one side is used by keyboarding and art."			"...parents to some plantings about the school around the drainage ponds."	"An outdoor classroom has been built…"