THE EFFECT OF ENVIRONMENTAL EDUCATION ON VARIABLES INFLUENTIAL TO ENVIRONMENTALLY FRIENDLY BEHAVIOR

by

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ABSTRACT

The Effect of Environmental Education on Variables Influential to Environmentally

Friendly Behavior

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Using variables first proposed by Harold Hungerford and Trudi Volk (1991), a case study of the Drops and Watts educational field trip was conducted at the WET Science Center in Olympia, WA. Pre- and post-participation surveys, as well as participant observation, were used to conduct the evaluation. The program had the most influence over environmental attitude (as measured by the New Ecological Paradigm) and students' knowledge of the connection between water and electricity. This connection led to a wider variety of benefits recognized by students as well as an increase in the conservation behaviors they were aware of. It was observed that the most effective way to encourage conservation behavior was connecting the reasons for conservation to the benefits perceived by the students. This was only effective if the benefits were direct to the individual rather than altruistic in nature. The results of a multivariate regression indicated that the observed variables did not have a significant effect on student self-reported behavior. It is recommended that the WET Center use this data to perform long term research on how repeated participation in their various field trips might have an additional impact on these variables.

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Chapter 1: Introduction

1.1: History of Environmental Education

Since the mid-1970's, many environmental education (EE) programs have been implemented with the goal of encouraging environmentally friendly behavior (EFB). Two conferences were influential in placing emphasis on EE to encourage a more knowledgeable and capable public with regard to the growing number of environmental problems facing our world. The Belgrade Charter (1975) was a result of the International Environmental Workshop held by the United Nations Education, Scientific, and Cultural Organization (UNESCO). The charter serves as a goal statement for EE, and the conference served as the first formal attempt to define, and establish basic objectives for, EE (Athman & Monroe, 2001). The Tbilisi Declaration (1977) was the result of another UNESCO conference and added to the Belgrade Charter by providing a framework of principles and guidelines for environmental education at all levels, both formal and informal (United Nations Educational, 1978). Both of these conferences served as stepping stones in emphasizing the importance of EE, and it has been a growing field ever since.

1.2: Changing Learner Behavior Through Environmental Education

Promoting EFB is a primary goal if EE programs, and a common set of variables most influential to changing EFB needed to be established in order to maximize the effectiveness of programs. Using the Tbilisi Declaration as a guide, Harold Hungerford and Trudi Volk proposed a set of variables influential to changing learner behavior, and

recommendations on how they could be incorporated into EE programs. There are three main sets of variables, all with their own subsets, that serve to influence EFB in various ways. These variables will be further elaborated upon in later chapters and described in detail. Hungerford and Volk theorized the significance of each variable, some being a prerequisite to others, some being not nearly as influential, and some that were thought to be reinforced, but not directly affected by, environmental education (Hungerford & Volk, 1990).

Subsequent studies utilizing these variables as metrics have found that they cannot uniformly be used to predict EFB. The variables have varying degrees of influence depending on the particular behavior being studied (McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995). Motivations for performing a behavior such as utilizing public transportation are vastly different than those for turning off the lights when leaving a room (McKenzie-Mohr et al., 1995). These discrepancies prevent establishing uniform models of influence for these variables among different behaviors.

With specific regard to resource conservation, influencing EFB through EE depends heavily upon the local context in which the behavior is presented (Cary, 2008). Conserving resources requires a knowledge of local ecosystems and the importance of said resource to the community. Since resource utilization does not occur in a vacuum, the most effective resource conservation EE programs should incorporate local knowledge that expands to a regional level (Fernandez-Juricic, 2000). Context specificity provides the best opportunity for EE programs to affect behavioral change, but this local focus also presents other challenges.

Widespread and effective evaluation of conservation based EE programs is lacking, leaving gaps in the research regarding the influence of variables key to promoting conservation behavior. Since conservation education is specific to the context of the program, evaluations must also be specific to the program being evaluated, making evaluation time consuming and expensive (Tao, 2012). Even when evaluations are carried out, they are often times too narrow in scope and focus on a single variable, rather than attempting to gauge how numerous variables work together (Athman & Monroe, 2001). These gaps in the research due to limited evaluation leave the influence of EE programs on specific variables related to EFB largely unknown.

1.3: Rationale of Study

The Water, Education, and Technology (WET) Center in Olympia, WA is dedicated to promoting water conservation behaviors through a number of avenues. One way this is accomplished is through field trips offered to schools in Upper Thurston County. These field trips are organized into different programs. This study will focus on a single program entitled Drops and Watts. The program was chosen for it's emphasis on promoting water and energy conservation, highlighting the connections between the two. The program utilizes many elements that are thought to be necessary for effective EE such as local focus, hands on learning, and interdisciplinary curriculum (Athman & Monroe, 2001). This program presents an opportunity to observe how the variables related to EFB can be influenced by EE, specifically with regard to resource conservation.

The study will look at the various educational curriculum and its implementation within the program to assess how it serves to influence the different variables presented by Hungerford and Volk. It will provide access to a sample group of local middle school students to see if the program reinforces these variables, and to what degree. A follow up activity will be offered in an attempt to assess the most influential variables in promoting conservation behaviors, and completion of the activity will be compared to responses on pre, post, and retention surveys. Results of the study will provide the WET Center with valuable information regarding the effectiveness of the Drops and Watts programs and provide recommendations for any modifications that will make the program more effective.

The study will also contribute to gaps in the research regarding how influential the observed variables are at promoting everyday water conservation behavior. Since the program focuses on everyday behaviors that are accessible to most middle school students, it will provide generalizable data with regard to how the program influences the observed variables. The results can help to structure future evaluations of resource conservation education, as well as provide recommendations of effective curriculum and which variables should be emphasized over others.

1.4: Chapter Descriptions

Chapter 2 (Literature Review) begins by introducing theories regarding the primary motivators of EFB. Current theories are evaluated and contrasted to present the variables that are thought to be most influential to encouraging EFB. It then transitions into how these variables can be incorporated into EE programs. Previous studies that

investigated the influence of educational programs on these variables are presented and their findings discussed. Current educational theory is also presented, and aspects of effective EE programs are outlined. Finally, the chapter concludes with the most effective evaluation strategies that can be incorporated into studies that seek to evaluate the effectiveness of EE programs.

Chapter 3 (WET Center) introduces the Water, Education, and Technology (WET) Center that is the focus of this study. A brief overview of the WET Center is given, and its primary objectives are outlines. The chapter then moves into the educational programs that are offered to middle school students of North Thurston County. The Drops and Watts program is then described in detail as it is the main focus of this study. The program is outlined from start to finish, giving an overview of all the activities the students are engaged in on the field trip.

Chapter 4 (Methods) reviews the methodology used in this study. It describes how a case study was adopted and developed based on recommendations from previous research and effective evaluation methods. The survey development is detailed and other methods of gathering data (participant observation, interviews) are presented. This chapter also presents the various analysis used with the data, from statistical methods of comparing matched pairs data, to the coding process used for open ended survey responses.

Chapter 5 (Results) details the findings from the survey responses. It goes through each question based on the variable it is designed to measure and presents a comparison of the pre and post-survey results. The responses that displayed a change

from pre to post are evaluated based on how those students may have responded on other questions to draw connections between the different variables.

Chapter 6 (Discussion) presents the findings from the comparisons made in the results section. The findings are discussed based on how the different variables are thought to interact with one another and outlines the variables that were most influenced as a result of exposure to the Drops and Watts program. Individual level responses are evaluated based on how answers may have changed from pre to post-survey and theories as to why the change may have occurred are presented. Theory presented is largely based on direct observation of the program, interviews with the lead educator of the program, and previous research that has been conducted. The results of this study are also compared to findings from similar research that observed the same variables.

Chapter 7 (Conclusion) details the main findings of the study and the importance they have to the literature as a whole. Limitations of this particular study are discussed and methodological improvements are suggested. Recommendations for how the WET Center can improve or change their program to be more effective are also presented. This chapter concludes with recommendations for future research to further clarify questions/gaps in the research.

Chapter 2 Chapter 2: Literature Review

2.1: Introduction

In a world of increasing environmental concern, the study of what influences Environmentally Friendly Behavior (EFB) has become increasingly important. Over the past four decades, studies regarding the primary motivations for EFB have increased and evolved as new understanding is gained. Early theories of behavioral change pointed to a simple, linear relationship between knowledge gained and changes in behavior (Hungerford & Volk, 1990). However, research has since shown that factors influencing behavior cover a wide array of variables including knowledge of issues, attitudes, intention to act, social motivations, feelings of control, and many other aspects. Because of the large number of variables, studying the most effective methods to change and influence behavior is a difficult and complicated task. Especially with regard to EFB, behavior is often inextricably linked to local issues concerning ecosystems and human interactions with the environment. Using a standardized form of testing is therefore an inefficient method of evaluation, given the variety of influencing factors and context specificity.

Environmental Education (EE) has become one of the most popular methods of influencing behavioral change, beginning with the Tbilisi declaration in 1978 (Hungerford & Volk, 1990). Education has many different outlets including schools, community programs, governmental organizations, non-profits, and non-governmental

organizations. All of these outlets seek to inform behavior in different ways, and as knowledge of behavioral motivation develops, educational programs become more and more interdisciplinary. Hungerford and Volk, in 1991, presented a theory of the significant variables that education should target in order to effectively influence EFB. Many educational programs now incorporate curriculum that seeks to influence these different variables, but their effectiveness in doing so is still largely unknown because specific goals for EFB are hard to quantify (Marcus, 2012). Quantifying goals for wildlife conservation or preservation of endangered species, may be as simple as measuring the number of animals present in an ecosystem; resource conservation goals can be measured by the quantity of a resource that has been consumed or saved, but how can these end goals be tied specifically to educational influences? It may never be possible to point to general education as influencing conservation goals simply by studying an end result or number - the educational programs themselves must be studied to see what, if any, effect they have on the most prominent variables that inform EFB.

This does not present a simple task. Many educational programs are specific to their location and community, and seek to influence behaviors that matter the most in a local sense (Fernandez-Juricic, 2000). Since the goals and education methods are locally specific, so must be the evaluation that would gauge their effectiveness. Many current evaluations of EE programs are performed to determine funding levels and focus on one specific variable, such as academic improvement, rather than a variety of elements (Tao, 2012). This narrow focus means many variables are not studied and the full effectiveness, or lack thereof, is never gauged. There is a strong need for in-depth, specific evaluations of how EE affects the variables that influence EFB.

In this literature review, I will cover research relating to what informs behavior and move specifically into the motivations behind EFB. I will then demonstrate how education can serve as a primary source of influence over EFB, and identify the specific variables that EE can influence to significantly effect behavioral change. Previous studies on EFB will be compared and contrasted to determine which variables have been shown to be most significant regarding resource conservation. Gaps in research are identified as they relate to the relationship between EE and EFB, and the reasons for these gaps identified.

2.2: Environmental Education as a Mode of Behavioral Change

In 1977 the Tbilisi Intergovernmental Conference on Environmental Education was held. This conference, held by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) was summarized with the Tbilisi Declaration (United Nations Educational, 1978). The declaration stated the importance of environmental education for a sustainable future and outlined five categories of EE objectives: awareness, knowledge, attitudes, skills, and participation (UNESCO, 1978). Harold Hungerford and Trudi Volk used this declaration, as well as previous research of motivations for EFB, to identify the main components that would comprise a successful EE program.

From the Tbilisi Declaration, it was apparent that EE had to go above and beyond what is considered a basic education. Environmental Education had to encompass not only knowledge, but attitudes, values, and social involvement as well. The traditional model of knowledge leading to awareness, or attitudes leading to behavioral change was far too

simple and insufficient to explain changes in EFB (Hungerford & Volk, 1990). This supports other research into influences of general behavior, but the study also goes further in depth in an attempt to identify the full range of variables that serve to primarily influence EFB. Hungerford and Volk used previous research into EE and determinants of EFB to identify three main categories of variables that primarily influence EFB: entry-level variables, ownership variables, and empowerment variables (Hungerford & Volk, 1990). Each category of variable has a variety of sub-categories that are identified as either major or minor variables in determining behavior.

Table 2.1: Variables presented by Hungerford & Volk and their theorized significance

Entry Level Variables	**Ownership Variables**	**Empowerment Variables**
Major Variable	**Major Variables**	**Major Variables**
Environmental attitude	Knowledge about issues	Knowledge of and skill in using action strategies
	Personal investment	Locus of Control
		Intention to act
Minor Variables	**Minor Variables**	**Minor Variables**
Knowledge of Ecology	Knowledge of consequences of behavior	In-depth knowledge about issues
Androgeny		
Attitudes toward pollution technology, and economics	Personal commitment to issue resolution	

Of the entry-level variables, the most significant is environmental sensitivity, or how empathetic an individual is towards the environment (Hungerford & Volk, 1990). This can also be viewed as a correlate of an individual's environmental attitude; a pro-

environmental attitude would denote a higher degree of environmental sensitivity than would a less environmentally oriented worldview. One minor entry-level variable, knowledge of ecology, is thought to be a precursor to sound decision-making with regard to the environment (Hungerford & Volk, 1990). *Knowledge of ecology* is defined here as a conceptual basis for decision making, meaning the decision maker has an understanding of basic ecological processes such as succession, homeostasis, and nutrient cycling. While this conceptualization does not directly lead to EFB, awareness of these ecological concepts has proven important in the decision-making process regarding what behaviors are performed (Hungerford & Volk, 1990).

The next class of variables presented by Hungerford and Volk are ownership variables, defined as characteristics that make environmental issues personal to the learner, giving them a sense of ownership. There are two such variables: in-depth knowledge and personal investment (Hungerford & Volk, 1990). Providing in depth knowledge is an easy concept for educators to grasp. The difficulty is in understanding the level of knowledge that needs to be gained and the most effective methods of providing this knowledge. Presenting knowledge in a manner which facilitates intention varies depending upon the topic and behavioral change that is desired. In-depth knowledge should not just be limited to the ways in which ecosystems function, but how they are affected by human actions as well. Involving human impact helps to promote the second ownership variable, personal investment.

Personal investment implies that the learner feels a certain proprietary interest in the behavior being studied (Hungerford & Volk, 1990). For example, a student who learns about the benefits of water conservation might feel they have an economic interest

in water conservation; it might save them or their family money if they use less water. Economic interest is, however, only one form of personal investment. If a person has an understanding of how water conservation helps reduce demands on local watersheds thereby helping to retain and/or restore ecosystem functioning, this can also be seen as a benefit to the individual, provided they are ecologically sensitive and feel it is important to maintain ecosystem services.

The final class of variables is empowerment. Empowerment variables act to give an individual confidence to perform actions that will have a significant impact (Hungerford & Volk, 1990). Action strategies are one important empowerment variable. In order to effectively change behavior, an individual must know what actions can be utilized in order to achieve a desired outcome. Coupled with this, and almost more important, is the perceived skill in using these action strategies. A person must not only know what actions can be taken but also have confidence that they have the power to use these action strategies and make a difference (Hungerford & Volk, 1990). Locus of control is a variable that describes how a person might feel reinforced for performing a certain action. An internal locus of control implies the individual believes he/she has the ability to bring about change through their own individual actions (Hungerford & Volk, 1990). This can be contrasted with an external locus of control, meaning an individual feels that change is affected only by chance or by a greater, external force, rather than their own actions. Internal locus of control leads to behavior change, whereas an external orientation tends to discourage it (Hungerford & Volk, 1990). People who are more confident in the effects of their own actions are more likely to perform said actions. This particular variable is most effectively influenced by repetition of behavior that results in

success rather than from learning in a traditional classroom setting, but can be improved through learning about action skills (Hungerford & Volk, 1990). It is therefore imperative that environmental programs reach out beyond just a traditional classroom setting in order to affect the most change. The final variable is intention to act. It may seem simplistic but behavior increases significantly in cases where there is an active intention to act in a particular way (Hungerford & Volk, 1990). If an intention exists it helps to eliminate split second decision making and increase the chances that an action will be carried out. Intention to act is thought to be strongly predicated on an internal locus of control (Hungerford & Volk, 1990). It is also very likely that a necessary precursor to intention is having knowledge of action skills. It is difficult to form an intention to act in a certain way if the results of that action are unclear or poorly understood (Hungerford & Volk, 1990).

All of these variables interact in a variety of ways and share a synergistic connection to one another. The interaction between them is largely dependent on the context of the behavior and the nature of the behavior itself (Hungerford & Volk, 1990). Some serve as antecedents to other, and some cannot necessarily be directly affected by EE so much as reinforced. Given the theoretical nature of these relationships, it is important to compare these variables to other theories regarding motivation for behavioral change.

2.3: Behavioral Studies

The variables outlined by Hungerford and Volk to be influential in affecting EFB come from a long line of theories regarding influences of general behavior. In *The Theory of Planned Behavior*, Icek Ajzen offers a similar set of variables that serve to best predict the way a person is going to act. Ajzen determines that the best way to predict behavior is by behavioral intention, so he seeks to identify intention's primary influences. The variables presented by Ajzen to influence behavioral intention closely resemble those proposed by Hungerford and Volk (Ajzen, 1991). Building off of the earlier *Theory of Reasoned Action*, Azjen gives three main perceptions that inform intention: attitude towards the behavior, subjective norms, and perceived behavioral control. The three relate closely to variables proposed by Hungerford and Volk, lending credit to their theory regarding the most significant influences behind EFB.

Paul Stern presents his own research of what influences EFB and a framework for studying it. The product of this research is the Value-Belief-Norm (VBN) theory (Stern, 2000). This theory proposes that values lead to specific beliefs that, in turn form the basis for personal norms. These norms are what ultimately determines the way an individual acts (Stern, 2000). In this theory the values form a causal chain, with each variable directly affecting the next. Variables may also exert influence over others that are further down the chain (Stern, 2000).

Stern's theory builds upon that presented by Hungerford and Volk by elaborating upon the significance that each variable might have to a given behavior. In VBN theory, the significance of each variable in determining behavior is dependent upon the context of the behavior itself (Stern, 2000). Environmental behaviors are divided into three main categories: environmental activism, non-activist behaviors in the public sphere, and

private-sphere environmentalism (Stern, 2000). Environmental activism is defined as active involvement with environmental organizations and demonstrations. Non-activist public sphere behavior comes mainly in the form of support for public policies such as environmental regulations or higher taxes for environmental protection (Stern, 2000). Finally, private-sphere environmentalism encompasses those behaviors that relate to the purchasing, consumption, and disposal of products that have an environmental impact (Stern, 2000).

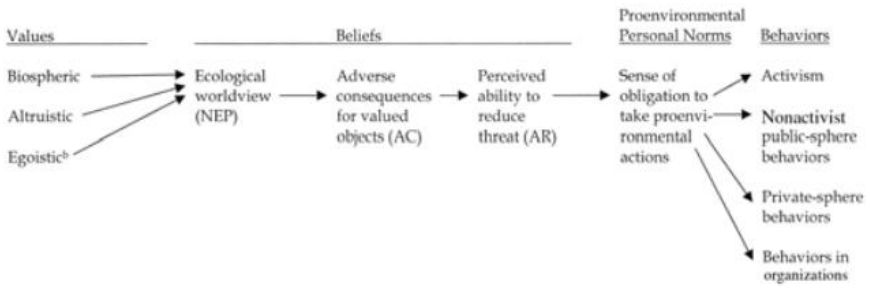


Table 2.2: Demonstrating relationship of variables in Value-Belief-Norm Theory

Further studies have compared Stern's VBN theory to Hungerford and Volk's. Looking at each theory and the variables involved reveals a large amount of overlap between the two, though the differences in language used make it difficult to draw direct comparisons (Monroe, 2003). The biospheric and altruistic values presented by Stern seem to correlate to the variable of environmental sensitivity proposed by Hungerford and Volk. The beliefs of adverse consequences of actions and the ability to reduce threat correlate to knowledge of issues and internal locus of control respectively (Monroe, 2003). Both theories also identify knowledge of action strategies as a significant

variable. This comparison reveals agreement within behavioral studies regarding the variables most significant to affecting change.

While the suite of variables is consistent in research, there is some disagreement as to what variables are the most influential in determining behavior. Azjen's *Theory of Planned Behavior* emphasizes that attitude is the most significant in determining behavioral intention (Ajzen, 1991). VBN theory claims that attitude can be the most significant predictor of behavior but the context (activist, non-activist, private-sphere) in which the behavior is presented will ultimately determine the most significant variable to illicit change (Stern, 2000). So while there is agreement as the the suite of variables that serves to influence behavior, there is not agreement that all of these variables carry the same level of significance in every situation. Since there is so much disagreement, a look into what research has found when studying these variables is necessary for further understanding.

Empirical research shows that, while there are some continuous variables that influence most forms of behavior, there is not a standardized set that can be equally applied to all forms of EFB in all circumstances (McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995). Certain primary aspects - behavior, intention, and value orientation - all have significant influence on almost any EFB, but the ways they are mediated by other factors can vary widely depending on the specific type of behavior and the context in which it is studied (McKenzie-Mohr et al., 1995). While the aspects presented by Azjen are necessary to study, it is unclear how significant each variable will be in a particular context or setting. This demonstrates the need for specific, context-based studies to be carried out in order to gauge how different variables influence EFB in a given situation.

Other studies have supported this claim as well. In one such study, it was shown that ecological beliefs (as measured by the New Ecological Paradigm) and values served to influence a host of other variables, which - in turn - informed EFB (Lopez & Cuervo-Arango, 2008). This study worked contrary to the VBN Theory that beliefs serve to directly inform personal norms instead finding belief influences a variety of other, mediator variables that lead to the development of norms (Lopez & Cuervo-Arango, 2008).

With different studies resulting in different findings regarding the primary informers of EFB, a generalized framework to predict or influence all EFB is not a practical or effective method. Nevertheless, it is important to understand the core variables that have varying degrees of influence over specific behaviors so that these variables can be targeted by EE programs. Focusing on a specific type of EFB, in the case of this thesis, resource conservation behavior, can help to inform EE programs as to what variables should be focused on even if the particular context and setting of the program still has a significant effect on promoting EFB.

2.4: Conservation Education

Resource conservation is one of the most important aspects of a sustainable lifestyle, especially when the resources are finite. With this in mind, one of the primary focuses of EE is the conservation of natural resources. The variables theorized to influence EFB can be affected by conservation-based EE programs, as has been demonstrated in previous research (Cary, 2008) (Zint, Kraemer, Northway, & Lim, 2002) (Schelly, Cross, Franzen, Hall, & Reeve, 2012) (Marcus, 2012). In order to effectively

promote conservation behavior, it is determined that both internal and external factors of influence must be accounted for. The context in which the behaviors are taking place is also significant when developing programs aimed at promoting conservation behavior through an educational model (Cary, 2008).

With specific regard to water conservation behavior, the elements of effective change correlate strongly with those presented by Hungerford and Volk, but the research is limited. Completed studies lend credibility to the influence of these variables in effectively influencing behavior (Cary, 2008). In one study on Australian water consumption, variables identified as strongly influencing water conservation behavior are behavioral intention, individual capacity to respond, anticipated outcomes of behavior change, attitude toward water conservation, a positive emotional reaction within the individual, and social norms (Cary, 2008). These show commonality with the Hungerford and Volk (H&V) variables – intention to act, knowledge and skill in action strategies, and internal locus of control. The study was conducted in Australia, so generalizing for American youth may be limited, but it still serves as a guidepost of what holds the highest influence over water conservation behavior.

In an evaluation of the Chesapeake Bay Foundation's conservation education field trips, pre, post, and retention surveys were administered to examine how the field trips affect the H&V variables in youth aged 10-18 (Zint et al., 2002). The field trips varied in length from 1 day to two weeks. In all cases, the field trips were shown to make improvements with regard to knowledge of issues (Zint et al., 2002). Four of the five field trips were shown to improve skill in actions, while only three improved knowledge of ecology and intention to act (Zint et al., 2002). Improvement of the metrics decreased

with the length of the field trip; the two week trip showed the greatest improvement and the scores decreased with the length (Zint et al., 2002). In one surprising result, personal responsibility was shown to only be influenced by one and three day trips. The researchers hypothesize this is due to lack of emphasis in the two week program but call for more research into the H&V variables (Zint et al., 2002). Internal locus of control was the only variable that did not show improvement in any field trip (Zint et al., 2002), reinforcing the theory presented by Hungerford and Volk that it is necessary for change in EFB, but unlikely to be directly affected by EE. It was concluded that EE programs can affect the desired variables but they need to be focused and offer multiple experiences over an extended period to be most effective (Zint et al., 2002). This study looked at general conservation behavior rather than specifically water conservation, but the sample population was age appropriate as to provide results relevant to this thesis.

Another study examined the importance of local and regional approaches and how this focus can help improve influence over the variables relevant to EFB. EE programs that have a local focus show a larger impact on individual's locus of control, reinforcement of social norms, and promoting ownership and personal investment in issues (Fernandez-Juricic, 2000). This is due to local programs focusing on an issue as it relates to the specific community where it takes place. Programs emphasizing the local impacts of targeted behaviors, while at the same time showing why it matters in a larger context, are shown to be the most effective at influencing key variables of EFB (Fernandez-Juricic, 2000). Local initiatives geared toward issues relating to their specific location are better positioned to impact these variables than those that take a more general or standardized approach.

2.5: Effective Environmental Education for Influencing EFB

In addition to the variables presented by Hungerford and Volk, and the importance of programs specific to their location, other elements are also important to effective environmental education. The information presented to students and the methods by which this information is administered are important components to any EE program. Elements such as positive psychology (Zufiaurre, Albertin, & Belletich, 2014), connection to learners' everyday lives (Athman & Monroe, 2001), interactive and/or hands-on activities (Newton, 2001) (Hudson, 2001), involvement of community and stakeholders (Athman & Monroe, 2001) (Hudson, 2001), and implementation at an early age (Zufiaurre et al., 2014) must all be incorporated to achieve maximum effectiveness.

Positive psychology is an important factor for promoting key elements of behavioral change, such as personal investment, perceived skill or knowledge of action strategies, and locus of control (Zufiaurre et al., 2014). When education takes a positive outlook on human ability to solve the environmental challenges facing our world, it eliminates the psychology of despair that can lead to apathy and inaction. By promoting positive, solution-based strategies, EE programs can effectively serve to build confidence and a positive outlook on the future.

The desired changes in behavior must make some sort of connection to the learner's everyday lives (Athman & Monroe, 2001). EE most effectively and influences behavior change when the targeted behaviors are those that can be performed routinely and have a direct application to the individual's life. This allows the learner's personal experience to become an active part of their education (Athman & Monroe, 2001).

Related to this concept are hands on activities and interactive learning. Especially with younger learners, classroom instruction that is supplemented with an opportunity to interact in a tactile and meaningful way with their surroundings facilitates better retention of knowledge and concepts (Athman & Monroe, 2001). Hands-on activities offer a chance to implement and enhance problem-solving skills learned in the classroom, as well as introduce students to new technologies (Hudson, 2001).

Involvement of stakeholders and the community is a necessary component of successful EE programs to promote social norms and reinforce program objectives (Athman & Monroe, 2001) (Zufiaurre et al., 2014). An active community interest in the studied EE program reinforces the behaviors as social norms, increasing the likelihood of the targeted behavior. Involving stakeholders at all levels of implementation helps to keep goals focused and provides a consistent learning experience for all who engage in the programs (Athman & Monroe, 2001). Involvement also keeps up with demographic changes that occur within the specific community, and encourages a diverse and interdisciplinary curriculum by allowing various viewpoints to be incorporated into the learning experience (Hudson, 2001).

Finally, the effectiveness of influencing behavior through education is tied to early introduction of concepts (Zufiaurre et al., 2014). When concepts are introduced at ages 10-18, it allows reinforcement of behavior over a longer period of time, establishing these behaviors as routine. This is especially effective when the desired behaviors are reinforced through continuing education at various levels. Programs are much more effective when they are supplemented by continued education presented through subsequent years (Marcus, 2012). If a stand-alone EE program is administered, it is more

effective when supplemented by further instruction through formal education outlets such as elementary and/or middle schools. If EE is incorporated into a school's curriculum in one year, it should be reinforced with instruction in subsequent years.

2.6: Need for Evaluation

The primary variables that influence change in EFB are identified and supported by empirical research, therefore, many EE programs are beginning to design their curriculum in a way that promotes these variables. EE programs now more than ever go beyond the retention of scientific knowledge about issues and also seek to empower students with the confidence and support to carry out the desired behaviors. This type of interdisciplinary programming can be difficult to assess because of the sheer amount of variety within the material. Despite the increasing complexity, in depth, external evaluations are rare in conservation-based, EE programs (Kleiman et al., 2000).

Through meta-analysis of published reports on EE programs, as little as one third of programs were shown to have incorporated formal evaluation of objectives and effectiveness influencing EFB (Tao, 2012). Evaluation of educational programs is a necessary step to insure that the stated goals and objectives are being met (Busch & Dayer, 2007). Evaluation also plays a major role in adapting and refining educational strategies used, including what is incorporated into the curriculum and the specific methods of delivery employed (Kleiman et al., 2000). Since effective behavioral change is dependent, not only on the specific variables identified in previous research, but also on the specific context in which they are presented and taught, successful evaluation

specific to the targeted EE program is necessary to ensure effective programming and implementation (Heimlich, 2010).

There are a variety of reasons for the lack of regular evaluation of EE programs. Limited resources are one such reason. Many EE programs operate on limited budgets and are offered either as part of a school curriculum or as free educational programs offered to the public (Tao, 2012). Limitations on resources make extensive evaluation difficult. Even in the case of internally conducted evaluations, programs are staffed by educators who are limited in the time available to conduct the kinds of comprehensive evaluations needed (Kleiman et al., 2000). In the case of externally conducted evaluations, budgetary constraints prevent hiring an evaluator from outside the program (Crohn & Birnbaum, 2010). When evaluations are conducted, they are often summative, or occur once a program has run its course with the aim of making funding decisions (Athman & Monroe, 2001). When the goal of evaluation is to determine future funding for programs, it can be seen as punishment, or as a result of perceived failure on the part of the EE program being evaluated (Tao, 2012). If evaluation did not carry with it the objective of determining funding, and was focused instead on identifying the objectives of the program and measuring effectiveness, these barriers disappear and evaluation serves the purpose of strengthening EE programs.

Lack of evaluation can work as a positive feedback loop; if evaluations are not a regular part of the program, educators resist them out of a fear of change (Kleiman et al., 2000). Complacency is the result when there are no incentives for evaluation and no consequences as a result of avoiding it (Tao, 2012). Evaluations that do occur often lack the substance required to effectively measure program objectives, and focus on a single

variable rather than a number of variables and the interactions between them (Heimlich, 2010). Too often, evaluations of EE programs focus simply on the retention of scientific knowledge or facts, a result of poorly defined program objectives (Ardoin & Heimlich, 2013). These kind of evaluations are focused on scientific learning objectives. While these learning objectives may be one desirable outcome of EE programs, they are rarely the sole purpose behind them.

This lack of research and evaluation of EE programs leads to large gaps in the research regarding the effectiveness of current programs and strategies. Evaluation must become a regular part of EE programs to fully understand the relationship between education and EFB. Evaluations should seek to improve programs, not punish them monetarily based on narrowly defined performance indicators. Programs should be designed with incorporated evaluations to budget resources and provide a level of comfort to educators that the evaluation works towards their goal and outcomes rather than as an adversary. Evaluations are a necessary step to understanding the influence of EE on EFB. Only once this influence is better understood can EE programs achieve maximum effectiveness.

2.7: Effective Evaluation of Environmental Education Programs

There are many different methods to evaluate EE programs, and the proper method of evaluation should be determined by the objectives of the program being studied, as well as the goal of the evaluation. Evaluations can be focused or general, internal or external, and have a number of different objectives, but not all of them are going to be as effective as one another. Even though the best method of evaluation will

depend on on the specific program being studied, there are some general aspects that lead to more effective evaluation in general.

Regarding the question of internal or external evaluation, each can have its particular benefits. Internal evaluation carries with it the ability to be conducted by someone who has great familiarity with the program, including its mission objectives and the methods with which the curriculum are implemented (Athman & Monroe, 2001). This can be a benefit but can also lead to conflicts of interest. Internal evaluations run the risk of being confounded by the interest and bias of the evaluator. If the evaluator has a vested interest in the success or failure of a program, the results can be affected by a desire for positive results (Kleiman et al., 2000). An external evaluation does not suffer from the same constraints; they are not influenced by any risk that might be involved in the success or failure of a program (Kleiman et al., 2000). When evaluations are completed regularly, it would make sense to have a member of the staff dedicated to evaluation on a full time basis; one that does not hold a vested interest in the curriculum or implementation of the program. If the evaluations are not incorporated into the regular programming, using an external agent makes the most sense to insure the objectivity of the evaluation (Heimlich, 2010).

Regardless of who is conducting the evaluation, it must always be driven by the mission goals of the EE program itself (Tao, 2012) and serve to move the program towards accomplishing specific conservation goals (Heimlich, 2010). If the program being evaluated does not have explicitly stated goals or objectives, the evaluator must work closely with the educators to define what the measure of success will be (Athman & Monroe, 2001). This will ensure the evaluation is relevant to the program studied.

With regard to resource conservation, education outcomes are hard to measure in end use statistics. Therefore, evaluation must be done in a way that can measure progress toward these goals, rather than the ultimate achievement of a conservation goal (Kleiman et al., 2000). Measures of progress can include attributes such as the development and knowledge of skills, intents, and behaviors as they relate to the conservation goal at hand (Ardoin & Heimlich, 2013). These recommended attributes of evaluation correlate closely with the variables that influence EFB (Hungerford & Volk, 1990).

Many EE programs have goals beyond the dissemination of information and evaluations must be organized in a way that measures variables beyond retention of knowledge (Athman & Monroe, 2001). Organizing evaluations in such a way insures they evaluate the interdisciplinary nature of EE programs while still maintaining the goals of the program as the basis of measurement. Evaluations must be geared toward the specific program that they seek to measure, rather than rely on a standardized form of evaluation.

When the evaluation takes place is also an important consideration to make. Summative evaluations, or those that are conducted once the program is finished, lack the holistic nature necessary to measure success (Crohn & Birnbaum, 2010). Formative evaluations, those conducted while the program is ongoing, offer a better chance to incorporate the end result of a program and the instruction itself (Tao, 2012). Formative evaluations give an opportunity to study the interaction of learners with various aspects of the program and offer a chance to understand how each part of the program leads learners to the desired outcomes (Kleiman et al., 2000).

The focus and scale of the evaluation are also important to consider. An evaluator may want to look at a specific aspect of an organization that is dedicated to EE, rather than looking at the organization as a whole. Defining the scale and focus will help organize evaluation to be effective (Kleiman et al., 2000). Scale is determined primarily on the EE program studied and the resources available to the evaluator. Formative evaluations can have a narrow focus and time scale that offer recommendations to improve the program while it is still taking place (Heimlich, 2010).

Ultimately, the aspects of a successful evaluation are going to depend on the program being studied, the goals of the program, the goals of the learners, and the objective of the evaluation. Successful evaluation involves the stakeholders and educators either directly informing the evaluation or specifying objectives of the program (Kleiman et al., 2000). A successful evaluation is the result of careful planning and organization, and provides meaningful results for the program in question (Stokking et al., 1999). Informing further evaluations of the program, and providing recommendations on conducting future evaluations are also key outcomes (Stokking et al., 1999).

There is a clear need for EE programs, specifically those that attempt to influence EFB and move organizations and communities toward sustainability goals and outcomes. Conservation education programs are identified as one of the best ways to influence the variables that influence EFB, but their effectiveness has gone largely undocumented. The need to evaluate these programs is significant to determine their effectiveness and make any necessary changes. It is not enough for the programs to operate on theory alone, they must incorporate evaluation to measure the success in achieving mission

goals and objectives. These evaluations should be based on the objectives of the examined programs and take an interdisciplinary approach incorporating more than the retention of scientific knowledge. Environmental education can successfully influence EFB in the form of conservation behavior, but must be evaluated in order to gain an understanding of the most effective methods of doing so.

2.8: Conclusion

EE is positioned with the ability to have a major impact influencing EFB. More specifically, resource conservation behavior. As awareness grows for the importance of sustainable actions, EE programs must begin to emphasize such behavior. Education should be looked to as a resource, guiding individuals toward the most effective means to accomplish sustainability goals. To have the most effective impact, education must develop interdisciplinary curriculum that goes beyond the retention of scientific knowledge.

The literature reviewed identifies variables key to influencing EFB through education. However, large gaps in knowledge still exist regarding how these variables can be incorporated successfully into EE programs to illicit the desired behavior change. Research demonstrates varying degrees of success measuring the effects of EE on these variables. The influence of these variables over EFB and one another depends largely on the context in which the behavior and education take place. Therefore, the most effective research methods will be in depth and focused, relating to specific programs and behaviors.

Effective evaluation of EE programs' influence on EFB is a necessary component to gaining a better understanding of the variables involved and their interactions. These evaluations must be conducted in a positive manner, seeking to inform the programs how to improve their effectiveness, rather than threatening continued operation and funding. Since evaluations of this kind are lacking, there is an opportunity to establish a solid knowledge base through future research. Evaluation of individual programs identifies the most influential variables to specific behaviors and increases effectiveness of future evaluations. Only through this kind of mindful research can the influences of specific EFB be identified and emphasized.

Chapter 3 Chapter 3: The WET Center

3.1: Introduction

The Water Education and Technology (WET) Center in Olympia, Washington is an educational center designed to teach citizens about their water resources. It was established by the Lacey, Olympia, Tumwater, and Thurston (LOTT) Clean Water Alliance; a non-profit corporation responsible for managing the waste water in the region. The WET Center was established to promote certain goals for LOTT, such as water conservation, support for reclaimed water, public understanding and interest in the health of Puget Sound, and to educate people about the utility in general.

The WET Center serves as the main educational hub for the LOTT Clean Water Alliance. It consists of an educational gallery with interactive displays regarding the importance of water and the water cycle, as well as conservation strategies, and stewardship ideas. There is also a classroom in the center used for hands-on activities and classes that help to supplement the displays in the gallery and allow students to process what they have learned at the Center. An interdisciplinary framework is used in which the students learn about biology, ecology, how a community manages resources, skills to take action, green building, and career opportunities. The WET Center strives to make all these connections within participants through a number of different ways. The center is free and open to the public, citizens can take advantage of the gallery at any time they wish during normal operating hours. Special events are also organized for teaching the community about water technologies and facts, and usually take place on the weekend. Finally, the WET Center offers educational field trips which consist of a tour

of the treatment plant, educations presentations, and hands on learning. It is one of these field trips that is the focus of the present study.

The educational field trips are offered by the LOTT Clean Water Alliance to North Thurston School District. Transportation fees are included to help get students to the Center from their schools, and the field trips are provided free of charge. The field trips share a common goal of promoting water conservation but do so through various methods and draw different connections from everyday life to water conservation. There are two main field trip programs, Wastewater Treatment and Drops and Watts, offered to middle schools from North Thurston School District. This study focuses on the Drops and Watts Program.

3.2: Drops and Watts Program

The Drops and Watts program is designed to teach students about the connections that exist between their water and electricity resources. It also emphasizes the ways water is used in almost every aspect of everyday life, from food production to the manufacturing of clothing. Through revealing these connections, various strategies of conserving water and energy are presented to encourage students to think carefully about their daily use of water and power. There are three main components of the field trip: a classroom presentation, a tour of the WET Center building, and a scavenger hunt in the exhibit gallery. Students are given a journal to complete throughout the entirety of the trip.

3.3: Classroom Presentation

The first part of the field trip is the classroom presentation. This presentation is a combination of short videos, a visual presentation, teacher instruction, and student participation. The student journal for this portion contains fill in the blank questions that are answered in the various short videos, a diagram of the urban water cycle that the students use to identify where electricity is used, and partner questions that call on the students to identify water and electricity saving strategies they can use in their own homes.

The presentation begins with a video that introduces students to water resources on planet earth. It details the percentage of water on our planet that is potable compared to our overall water resources and gives statistics of average water use by the United States, Europe, and Africa. The video also gives an overview of how fresh water supply is shrinking and demonstrates how much water goes into the production of food and other common items. The journal section that corresponds to this video asks students to record the average daily use per person for the three countries listed as well as the average amount of water used to make a cheeseburger.

The next part of the presentation presents students with the connections between water use and electricity use, first through a demonstration of the urban water cycle. Students are shown a cross sectional above/below ground illustration of Olympia that shows how water is pumped from aquifers to wells and water towers. This cycle is explained to students and they are asked to put stars over the areas where energy is used

to transport and clean the water. The illustration serves the purpose of identifying how electricity is required to transport water to and from homes as well as where Olympia residents get their water from and what happens to it after it leaves their homes. Water treatment is identified as a point where a large amount of energy is used to clean water so it can be pumped into Puget Sound or used as reclaimed water. Giving students an understanding of this urban water cycle is one of the primary components of the Drops and Watts program. Students are then asked to talk with one of their peers for a few minutes about ways they can reduce their water use at home in order to conserve energy and are given an opportunity to share their ideas with the rest of the class.

The next part of the presentation covers how water is used in generating electricity. Another short video is used to cover the history of the steam powered turbine used to generate electricity. A history of steam generation is presented along with how steam is still used to generate the vast majority of electricity today. This video also covers how water is used, not only to generate the electricity, but to cool and condense the steam back into water. A breakdown of the various freshwater uses in the United States is given, demonstrating how electricity production accounts for 40% of freshwater use, agriculture is responsible for another 40%, and the final 20% is used in homes, business, and industry. Once the video has concluded, a graph is shown that illustrates how much water is used for a variety of different sources of energy. Another graph is shown, illustrating that direct water use per person, per day, is only about 10% of the water that is used for electricity and food production. Students are then asked to discuss with one or two classmates how they can reduce energy use in their homes in order to save water. Ideas are then shared with the rest of the class.

The next portion of the presentation shows how human population has been growing exponentially over the past 100 years and students are asked how this growing population will affect water and energy usage. It is explained to the students that both water and energy prices will both climb with the increased demand that results from a growing population. In addition to the water and energy conservation strategies already discussed, as well as renewable energy sources, green building is also offered as a way to reduce the demand for both water and energy. Average savings of green buildings are given and the students are asked to record these percentages in their journals. A brief overview of the Leadership in Energy and Environmental Design (LEED) program is given and the WET Center is provided as an example of a LEED Platinum building, the highest certification offered. A third video is shown that focuses on green building in the Seattle area to give students an idea of the many careers that are locally available for those with an interest in green building. These jobs are explained to be a way students can become actively involved in providing a more sustainable future for themselves and future generations. Once this video is concluded, the students split into two groups for the next portion of the field trip.

3.4: Green Building Tour

Once the students have split into two groups, half are taken on the green building tour and the other half remain in the exhibit gallery for a scavenger hunt. The green building tour goes through the WET Center building and offers examples of things that were incorporated into the building to make it more energy efficient and qualify for LEED Platinum certification. Exact details about the breakdown of how these implementations contributed to the certification are not offered. It is understood that the

students will receive further instruction in LEED certification through their science classes in school so it is not covered in depth during the field trip. The tour begins outside and continues throughout various rooms and floors of the WET Center before the students return to the exhibit gallery for the scavenger hunt portion of the tour.

There are 17 different elements of the building that are covered in the tour. Each student is given a small card with information on one of these elements to read during the tour. As the tour covers each component, the students are asked to read their respective cards and the teacher will then give a brief explanation of each. The different components covered in the tour are as follows:

1. Sustainable Transportation - Bike racks and an electric charging station are identified. Students are told how the WET Center provides bus passes for their employees so they are encouraged to take public transportation.

2. Reclaimed Water - A water fountain and water features on site use reclaimed water from the LOTT treatment plant. This demonstrates how the reclaimed water can be used for fountains and other public features without having to use clean water that could otherwise be used for drinking.

3. Outside Glass - The glass on the WET Center senses temperature and light to automatically raise and lower shades to help save energy use associated with heating/cooling as well as lighting.

4. Native Plants - Native plants are used to decorate the landscape so they can easily grow without people needing to water them. They also offer familiar plants for native pollinators.

5. High Efficiency Plumbing Fixtures - Toilets in the WET Center are low flow and use reclaimed water to conserve water resources.

6. High Efficiency Heating and Cooling Equipment - The WET Center uses high efficiency heating and cooling equipment that is powered by a co-generation plant that uses methane from the waste treated at the LOTT water treatment plant.

7. Concrete Floor and Low VOC Paint - The concrete floor and low VOC paint help to reduce contaminants to the indoor air quality.

8. Wood Ceilings - Ceiling and walls in the building are made from reclaimed wood taken from old warehouses that once occupied the site where the Hands On Children's Museum is now located.

9. Cork Flooring - Cork tiles are a sustainable source of flooring since the cork can be harvested without killing the tree and is rapidly renewable.

10. Recycled Carpet Tiles - Carpet tiles are made from recycled materials and can be replaced in sections in the event of damage or staining.

11. Green Elevator - A high efficiency elevator is powered by the same co-generators that power the heating and cooling systems, though employees are encouraged to take the stairs.

12. Green Roof - Parts of the roof provide habitat for native plants, which help to keep the building insulated and conserve energy related to heating and cooling.

13. Recycled Seat Belt Chairs - Chairs are made from recycled seat belts that would otherwise be thrown out to demonstrate how items that were once only waste can be re-purposed.

14. Lighting - Light fixtures use high efficiency bulbs and are automatically dimmed when there is natural lighting. They are also hooked to motion senors and automatically turn off if there is no movement for a period of time.

15. Ply-Boo Furniture and Bookshelves - Bookshelves and furniture in the offices and conference rooms are made from bamboo plywood. Bamboo is identified as a rapidly renewable resource.

16. East Bay Public Plaza and Hands-On Children's Museum - These areas are pointed out as examples of SITES certification. Similar to LEED but for outdoor public spaces.

17. Paperstone - Paperstone is used on the counters and table tops in the WET Center. Made from recycled paper, this product is not only renewable, but comes from Gray's Harbor, which is just a few miles from Olympia.

All of these aspects of the building contributed in some way or another to the LEED Platinum certification of the building. Students listen to their classmates explain one of the features and record details in the journal. Once the tour is concluded, students return to the exhibit gallery to begin the scavenger hunt while their classmates take the building tour.

3.5: Scavenger Hunt

The scavenger hunt offers a chance for the students to engage in the exhibits in the gallery to connect what they have learned in the classroom presentation with their everyday lives. It consists of eight different exhibits that are used to answer questions in the student journals. For each exhibit, there are from one to four questions in the journal and the students have a half hour to answer them all. Students are encouraged to work in groups of two to three to complete all exhibits in the time allotted. The different exhibits are as follows.

1. Water Drop Game - This game has students following a water drop from an aquifer through the urban water cycle. Students are awarded points for each stop the drop makes along the way and are encouraged to make as many stops as possible to get the maximum use from the water drop. The game ends with the drop being put into Puget Sound or used as reclaimed water.

2. Calculator - This calculator is a large, wall mounted display that allows students to add up the water use for a variety of daily activities to see how much water they use in a day. Certain assumptions are made about how much water is used for each activity. Once the students have added up their use and hit the equal button, empty gallon containers mounted on the wall light up to give a visual representation of the amount of water used. Students can then compare this to the average use in Thurston County, the United States, and worldwide.

3. Water Treatment at LOTT - This is a touch screen display that gives real time information about the amount of water treated at the treatment facility. It gives breakdowns of the amount of water passing through at various time intervals from daily to yearly. This gives students an idea of the local amount of water consumption and illustrates the need for treatment.

4. Treatment Process - The fourth station is a learning exhibit about the various chemical and biological processes that take place within the treatment facility. Students learn about different microbes that are used in the treatment process and how each is useful at breaking down the waste. This exhibit also gives a step by step time line of what happens to the water on its journey through the treatment process.

5. LOTT Career Game - A touch screen display offers students a chance to get an overview of various jobs available at the LOTT treatment center. There are xx jobs, (NAME JOBS) and each has a game associated with it that gives examples of the type of work that is performed in each job. Students are encouraged to choose a job that seems most interesting to them to record in the journal, along with the reason it was appealing.

6. Reclaimed Water - The reclaimed water exhibit gives examples of how reclaimed water is used and asks students to identify if reclaimed water or drinking water are most appropriate for a variety of different uses.

7. In Home Conservation - This exhibit offers examples of different ways to cut down on water use in the home. There is a faux kitchen/bathroom constructed with examples of how to cut down on water use as well as an interactive touch screen. The

touch screen has students select different rooms to see some common habits that are wasteful and gives recommendations on how to remedy them.

8. Co-generation - The final exhibit demonstrates how waste is used to create energy in the LOTT treatment plant through the use of co-generation. It is an interactive touch screen that gives an overview of the co-generation process and displays how much power the treatment plant has generated through this process. Students learn how this process is used to provide heat and electricity to the LOTT Regional Service Center and the Hands-On Children's Museum. Once students have completed all of the stations and filled out their journal, they are encouraged to explore other exhibits if there is still time. All students then return to the classroom for a short debriefing, and the teacher is given a gift bag containing five minute shower timers and a hot water sensing card. The shower timers are to help students remember to take shorter showers and the hot water card can be run under a hot water tap to see if students can have their parents lower the temperature on their water heater to conserve energy.

Chapter 4 Chapter 4: Methods

4.1: Case Study

For the purpose of this research, a case study was determined to be the most effective and useful method. This case study focused on the Water Education and Technology (WET) Center in Olympia, Washington, more specifically, their Drops and Watts field trip program for middle school students of Upper Thurston County Schools. This focused approach was determined to be the most useful to obtain in depth and extensive data on this particular program and the influence it has on variables that influence environmentally friendly behavior (EFB). Previous research shows that the most effective methods of evaluating EE programs are those that allow the researcher to focus on the specific program being studied, rather than take a more general approach (Monroe, 2003) (Kleiman et al., 2000).

This method was ultimately selected with the hope that it would provide the most useful and relevant information to the research question: What are the effects of a youth environmental education program on variables that influence environmentally friendly behavior? Several sub-questions are also addressed by this research: Does particular curriculum and implementation affect these variables in different ways? How do these variables interact with one another with regard to water conservation behavior? What are the most important variables that influence water conservation behavior?

A case study methodology was chosen over other methods that would look at numerous education programs, rather than focusing in depth on one particular program.

Looking at numerous programs would cause the evaluation to be generic in nature, and previous research shows this to be not as effective at gathering the rich, complex data necessary to properly evaluate EE programs (Zufiaurre, Albertin, & Belletich, 2014) (Athman & Monroe, 2001). A case study provides more complete and relevant information to the program being studied and is more conducive to effective methodologies identified from previous research (Zint, Kraemer, Northway, & Lim, 2002) (Smith-Sebasto & Walker, 2005).

This method was ultimately selected with the hope that it would provide the most useful and relevant information to the research question: What are the effects of a youth environmental education program on variables that influence environmentally friendly behavior? Several sub-questions are also addressed by this research: Does particular curriculum and implementation affect these variables in different ways? How do these variables interact with one another with regard to water conservation behavior? What are the most important variables that influence water conservation behavior?

There are several drawbacks to this type of focused research. The first and most obvious being that focused research on a single program offers limited generalizability to all EE programs that seek to influence EFB. Since only a single program was studied an attempt was made to connect water conservation behavior to specific variables. By identifying the variables most influential to water conservation behaviors in the observed middle school students, the results can be generalized to all of Upper Thurston County middle schools.

Separating the curriculum used by the WET Center from the implementation, or how it is presented to the students was more difficult. Since the presentation is specific to the educators and gallery exhibits of the WET Center, drawing general conclusions that apply to all EE programs was not possible. However, the results do provide other EE programs that seek to influence water conservation behavior with a model that can be useful to their own particular programs.

The population of the study is also limited when using case study methodology. The only students that participate in the Drops and Watts program are middle school students from schools in the Upper Thurston County School district. The results are therefore only applicable to this particular population rather than middle school students nationwide. While the results may not be generalized to wider populations, they can help to inform evaluations of other, similar EE programs.

There were several different forms of data collection utilized in this case study. The primary source of data was surveys administered to the students directly before and after participation in the program, and a retention survey provided a week or more after participation. Direct interviews with educators from the WET Center were also administered to get an overview of the desired objectives of the program. Participant observation was undertaken at the WET Center during the visits of the surveyed classes. An in home water audit was also provided by the researcher to students who were surveyed as an attempt to allow them opportunity to engage in a water conservation behavior after they participated in the Drops and Watts program.

4.2: Survey

A pre/post/retention model was adopted for administration of the survey, modeled after other research attempting to measure similar variables as a result of participation in EE programs (Zint et al., 2002) (Smith-Sebasto & Semrau, 2004) (Smith-Sebasto, 1995) (Kruse & Card, 2004). This model allows for information to be gathered directly (within 24 hours) before and after participation in the program (in the event that the field trip happened on a Friday, the survey was administered the following Monday), as well as at a later period to measure retention. The retention portion of the survey was given no less than one week after students completed the post-participation survey. There was insufficient response rate on the retention survey, so meaningful data could not be collected. Ideally, the retention test would be administered after a longer period of time, three to six months after participation. Due to the time-frame available to this research, this extended period was not possible.

A letter was sent out, via email, to teachers from Komachin, Chinook, Aspire, and Nisqually Middle Schools. Of these, all responded except for those from Aspire. Two classes from Komachin participated with a total of 38 students. From Chinook, numerous classes participated but communication was only conducted with the science teacher, Brandon D'Arcangelo. Chinook schools yielded 100 responses from students on the survey. From Nisqually, all communication happened through Brian Stave, the science teacher for the middle school. Nisqually Middle School yielded 148 responses. There is a potential bias since one of the schools was not represented in the survey though this was deemed minimal since they are all from the same school district.

The survey was administered to the students by their teacher in a classroom setting. The researcher was not present for the administration of the survey. Initially the survey was developed as a hard format, pen and paper survey. A digital format was then developed after discussion with teachers regarding the most convenient administration for their students in the classroom. Digital format also allowed for responses to be instantly recorded and viewed by the researcher and saved time and money associated with delivering and retrieving hundreds of hard copies. Both formats were offered to teachers after the initial survey, and all chose the digital format.

The survey was developed as a way to gauge variables identified by Hungerford and Volk as being influential to EFB (Hungerford & Volk, 1990). The specific variables used in this study have been identified in previous research as being the most influential with specific regard to resource (water) conservation behavior. The variables identified were environmental attitude, knowledge of issues, knowledge and skill in action strategies, personal investment, locus of control, and behavioral intention (Zint et al., 2002) (Cary, 2008). The post-participation survey also included general information regarding the students' enjoyment of the field trip, what they found most engaging, and what they desire to know more about. These were included as a way of identifying which methods of instruction and/or hands on activities were most engaging to the students. The survey was a mix of 7 point Likert scale questions, open ended questions, and a question asking the students to illustrate their understanding of the urban water cycle.

Environmental attitude was measured using endorsement of the New Ecological Paradigm (NEP) revised for use with elementary and middle school students (Dunlap, Van Liere, Mertig, & Jones, 2000) (Manoli, Johnson, & Dunlap, 2007). The NEP was

chosen for its success gauging general environmental attitude in the past and research demonstrates this adapted version to be successful with the age range examined in this study. A general measure of environmental attitude was chosen as this particular variable is not specific to the EE program or behavior studies, whereas variables such as knowledge of issues or behavioral intention are more program and behavior specific. Other measures of general environmental attitude were looked at for suitability to this study but they were either too long (40+ questions), not age appropriate, or did not have the repeated, empirical success that the NEP offers.

This adapted NEP consists of ten, seven-point Likert scale questions. The Likert scale asks students to rate their agreement with statements by choosing one of seven responses: strongly disagree, disagree, somewhat disagree, neutral, somewhat agree, agree, strongly agree. In order to avoid possible bias due to suggestive wording, six of the questions are worded in a way that reflects endorsement of the NEP and four are worded in the reverse (Manoli et al., 2007). This revised NEP is designed to measure three areas of environmental worldview: rights of nature, human exemptionalism, and eco-crisis (Dunlap et al., 2000).

The answers were scored based on the level of endorsement and summed. The highest possible score is 70, showing strong endorsement of the NEP and a minimum score of 10 would show almost no endorsement of the NEP. Since the NEP has been used empirically with success, it is considered one of the foremost and accurate measures of environmental attitude available. The data was analyzed using matched pairs t-tests to compare the difference in mean score between pre- and post-participation NEP scores. The NEP was also broken down into the three factors it is meant to gauge to determine if

there is one factor that is more strongly affected after participation in the Drops and Watts Program.

To evaluate the variables influential to EFB, open ended questions were chosen for their ability to capture rich, contextual information. Previous studies of EE programs determined that this kind of information was most useful in determining the effects of a specific program on similar variables (Smith-Sebasto & Walker, 2005). The questions for use with the WET Center were adapted from other studies that sought to measure the same variables with regard to other EE programs (Smith-Sebasto & Walker, 2005) (Smith-Sebasto, 1995) (Marcus, 2012). Adaptation was a necessary step to make sure that the questions measured responses with regard specifically to student experiences at the WET Center and the behaviors promoted by the Drops and Watts program.

For the open ended response portion, two questions were designed to measure knowledge of issues, two for personal investment, two for knowledge and use of action skills, two for behavioral intention, and two for locus of control. The questions were drafted by the researcher and revised based on input from Amber Smith, the educational director at the WET Center. This collaboration ensured that the survey questions would be effective at not only measuring the desired variables, but was also useful in making sure the questions were age appropriate in terms of vocabulary and understanding of concepts. The open ended format allowed for connections to be made between the different variables measured and specific parts of the program. Since these connections could be drawn through the student responses, it allowed for better recommendations on how to improve the program by fine tuning specific parts to influence variables that were

not as affected. It was more effective at interpreting how different aspects of the curriculum influenced the different variables measured.

These open ended questions were analyzed by coding the responses and comparing the frequency and type of each code. All qualitative data analysis was performed using MAXQDA version 11 (release 11.1.0, build 150305). The knowledge of issues questions were looked at to see how an understanding of the issues was influenced after participation in the program. The water/energy connection was looked at to see if any new connections were made between the two resources and how the students viewed the connection. The personal investment questions were coded based on the type of benefit the student perceived from conservation behavior. Knowledge and skill in action strategies were analyzed by making a tally of the different actions listed and comparing the frequency and variety of actions between pre/post surveys. Behavioral intention was compared to the strategies listed to determine if there was a stronger intention to perform more behaviors after participating in the Drops and Watts program. The locus of control questions were analyzed based on what kind of locus of control was identified in the answers, internal, external, or group, and what barriers were perceived as preventing engagement in conservation behavior.

In some studies, these variables were all measured using Likert scale responses. These kinds of questions are more suited for a generic study and do not allow for the in depth data desired for the particular variables examined. Likert scale responses would not allow for the connection of responses to specific aspects of the program unless they were already implied within the questions. Since Likert scale questions ask to rate your

agreement with a per-determined statement, that kind of implication bias was avoided by allowing students to articulate their own responses.

4.3: Participant Observation

Aside from the survey, participant observation was also performed during the program. The observation involved the researcher being present during the field trips that the surveyed classes were attending. This presence allowed the researcher to not only observe how students interacted with the exhibits in the WET Center gallery, but also allowed for observation of the teaching methods and presentation. While the researcher was present during all aspects of the trip, he did not interact with the students so as to not introduce a bias that would potentially prevent the results from being applicable to other classes that were not observed or surveyed. Even though interaction was limited to prevent bias, the very presence of an observer could have introduced bias into the study but this risk was deemed minimal compared to the advantages participant observation offered.

During the presentation portion of the program, the researcher viewed the presentation and took notes. The primary purpose was to gather information regarding how the material is presented to students. Also noted from this observation was how engaged the students seemed in the presentation and material, how they responded to prompts from the teacher, and what opportunities they had to process and interact with the information that was presented. The researcher never took an active part in the presentation, and was instead a silent observer to avoid introducing any confounding variables.

During the second portion of the program, the classes are split up into two groups. One group goes on a tour of the WET Center building and the other completes a scavenger hunt in the exhibit gallery. During this portion, the researcher chose a group to follow through both the tour and scavenger hunt. The decision to follow only half of the students was made for the following reasons. First, there was only one researcher present, so it would have been impossible to gather data observing both portions of the trip at once. Second, it was determined that the most effective method of data collection would be to observe both the tour and the scavenger hunt in their entirety so both portions of the program got equal observation time. These aspects prompted the decision to follow one half of the students through the building tour and the scavenger hunt, rather than trying to split time between the two groups of students. A potential bias could arise if there were differences in the way the two groups interacted with the exhibits, though since they were from the same class, the potential for bias was determined to be minimal.

4.4: In Home Water Audit

To examine if any particular variables were more influential in promoting water conservation behavior, a voluntary in-home water audit was offered to students who participated in the Drops and Watts Program. The audit was offered as an opportunity to engage in a conversation oriented behavior that any student would be able to complete. Several other activities were considered such as organizing a stream clean, but ultimately it was determined that too many barriers existed for activities that would take place outside of the student's homes. The main barriers thought to exist are reliance upon parents for transportation and scheduling, and the need for adult supervision during the

activity. The in home water audit is something the students can complete on their own at their own pace with minimal adult help or supervision.

The audit was an existing activity that was created by the WET Center as a follow up activity. It is not given to every class that participates in the field trip, only offered as a follow up activity at the request of teachers. Responses were not tracked by the WET Center so previous data regarding the response rate for these audits was not available. The audits were given to the students by the researcher and it was made clear that they were not for credit of any kind related to their school work, but a completely voluntary activity to be completed if they wanted.

The actual results of the audit were not looked at or studied. The students that returned the audit were recorded, and their responses on the surveys were looked at for common variables. If there was a common variable more strongly identified in surveys of students who returned the audit, it was determined that variable showed a stronger influence over water conservation behavior.

Since the audit does not measure every behavior encouraged by the WET Center, it is limited in its ability to pinpoint a specific variable most influential to all of these behaviors. However, completion of the audit represents a commitment by the student to engage in water conservation and offers an action strategy to do so. Since observation of all the different behaviors promoted by the Drops and Watts program would be impossible for the scope of this research, this audit was considered the most effective way to observe participation in an actual behavior outside of participant self-reporting.

Only eleven students returned a completed water audit. Due to the low response rate, the results of the water audit were deemed inconclusive and specific ties between actual behavior and the influenced variables were not able to be made.

4.5: Analysis

4.5.1: NEP

For the NEP portion of the survey, a matched pairs t-test was performed on the composite scores. After the analysis was complete, the scores were sorted into the three categories the NEP is designed to measure:, eco-crisis, rights of nature, and human exemptionalism. Matched pairs t-tests were performed for pre and post-survey scores for each of the three categories. All statistical operations were performed with JMP statistical software version 11.2.0.

For all questions, the following codes were identified in direct response: yes, no, I don't know, did not answer. For 'yes' responses, the students most often just stated 'yes' and elaborated with reasoning, this was also the case with 'no' responses. 'I don't know' answers were sometimes directly stated and sometimes a decision was made to code an answer such as 'I think so but maybe not' as 'I don't know.' 'Did not answer' responses were coded most of the time when the question was left blank, or in the event of an answer 'I'm not sure what water conservation means'. This answer was coded as 'did not answer' rather than 'I don't know' since it reflects a lack of understanding regarding the concept in question. Others simply left the question blank, or, in some cases, answered with only a question mark. Out of these main codes came a variety of sub-codes for the

'yes' and 'no' responses, see Appendix II for tables of all the codes and sub-codes identified in the answers.

4.5.2: Is conserving water important?

Most of the codes for this question are self-explanatory in nature, though the difference between 'future use' and 'scarcity' may be unclear. Answers coded as 'future use' were worded in a way that identified future generations being able to utilize the resource due to conservation efforts in the present day, whereas 'scarcity' identified an understanding of the small percentage of water on earth that is drinkable, or the lack of access to clean water in certain parts of the world in the present.

4.5.3: Does your electricity use affect water use?

Once the responses were coded into the main response categories, sub-codes were created to identify what kinds of connections students believe to exist between electricity use and water use. Codes were also created to reflect why students believe no connection exists, though these answers were not very elaborate and mostly consisted of reasons such as 'they have nothing to do with each other'. Several of the 'did not answer' responses were coded due to answers that were seen as not serious such as, 'because I can't put a toaster in the bathtub.'

4.5.4: Do you benefit from conserving water?

Sub-codes for this question were identified based on what kind of benefit students perceived as a result of their conservation efforts. Sub-codes for the 'no' responses differed from pre and post-surveys. Aside from the 'no reason given' response, the only

code identified in the post-surveys was 'makes no difference'. In the pre-survey, there were two codes aside from 'no reason given'. 'Plenty available,' coded to reflect a response that indicated an unlimited supply of water, or indicating that the water cycle would constantly replenish the supply, and 'future generations' indicating that the student did not think they gained any personal benefit from conservation but that people in future generations would benefit from conservation efforts today.

The sub-codes derived from the 'yes' responses were straight forward and did not vary between pre and post-participation in terms of the specific sub-codes identified in the responses. The difference between 'more available to others' and 'future use' was determined by whether a student expressed that their conservation efforts would allow others access to water in the present day as opposed to an answer that demonstrated a need to conserve so we did not run out of the resource as quickly and were able to use it for a longer period of time.

4.5.5: Do you benefit from conserving electricity?

Coding for this question was extremely similar to the coding seen on the previous question regarding water conservation benefits. Sub-codes again differed for the 'no' responses from pre to post-participation. Pre-participation, only one code, 'unlimited supply', was identified aside from 'no reason given'. Post-participation, two additional codes were identified: 'nobody else conserves' was used for one student who thought they would not benefit if they were the only person conserving, and 'still using electricity' was used for two students whose answers revealed they felt they were not actually able to take meaningful steps to conserve electricity.

The sub-codes identified in the 'yes' responses did not change between pre and post-participation, and were also straightforward. The 'health benefits' code was used for responses that identified some kind of benefit to well-being provided by electricity, such as warmth or the ability to cook food. One additional code was identified on the post-participation surveys, 'conserving water', used when students demonstrated that conserving electricity also has the ability to reduce the amount of water used.

4.5.6: Are there actions you can personally take to conserve water?/Intention to perform water conservation actions

These two questions were coded based on the kind of action identified in the response. In order to gauge the effectiveness of the program at increasing the knowledge of, and intention to perform, the skills mentioned, the overall number of actions listed was counted and compared between pre and post-participation. Since students were allowed to list as many or as little actions as they were aware of or intended to perform, an average of the number of actions listed per student was also calculated. After it was found that the average number of actions per student increased between pre and post-participation, a matched pairs t-test was performed in JMP version 11.2.0 to determine if the increase in the average number of actions listed per student was significant.

'Conservative use' compiled from responses such as 'let rain water plants', 'don't use water if you don't need to', 'don't waste water', and other similar responses that were only given by 1-3 students each. The 'other' category differs in that it compiles specific uses that don't necessarily fall into the 'conservative use' category. These were actions such as 'don't play with water', 'reuse water bottles', 'encourage others', 'fill cup less', and similar responses that were only listed by 1-3 students.

4.5.7: Are there actions you can personally take to conserve electricity?/Intention to perform electricity conservation actions

These two questions were coded based on the kind of action identified in the response. In order to gauge the effectiveness of the program at increasing the knowledge of, and intention to perform, the skills mentioned, the overall number of actions listed was counted and compared between pre and post-participation. Since students were allowed to list as many or as little actions as they were aware of or intended to perform, an average of the number of actions listed per student was also calculated. After it was found that the average number of actions per student increased between pre and post-participation, a matched pairs t-test was performed in JMP version 11.2.0 to determine if the increase in the average number of actions listed per student was significant.

Actions were coded based on responses from students. Most were straight forward and reflect the wording as it appeared in the coded segment. 'Other' category is comprised of actions for which there were only around 1-3 responses and they were not distinct enough to merit their own category. Examples of codes compiled into 'other' include 'encourage others', 'use renewable sources', 'don't leave fridge open', 'recycle more', 'don't sleep with TV on'. Many of the 'other' codes appearing in the knowledge of skills responses did not appear in the intention responses. One code that was categorized as other that appeared post-participation and not pre-participation was that of 'turn down temperature on water heater'.

4.5.8: Are you performing all the water and electricity saving activities you are aware of?

Answers to this question were coded with the standard 'yes', 'no', 'I don't know', and 'did not answer'. Sub-codes were then identified with regard to each response. 'Yes' and 'I don't know' responses did not reveal any sub-codes as students did not give reasoning behind these responses. 'No' responses were coded to reflect the reason given for not performing conservation actions and these sub-codes were self-explanatory.

Once the reasons were identified, the locus of control (LOC) was determined based on the identified codes and sub-codes. For all 'yes' responses, an internal LOC was identified since these students were willing and also felt able to perform the stated actions. 'I don't know' responses were all coded as an external LOC because the students did not display a complete understand of their ability to perform conservation actions. 'Did not answer' were not coded to display an LOC as no response left it unclear as to what kind of LOC was demonstrated. For the 'no' responses, the LOC was determined from the sub-code identified in the response. If the code identified that the student was not interested in the activity, or simply didn't was to sacrifice their own comfort, it was deemed an internal LOC as the student was aware of the action and actively chose not to perform it themselves rather then recognizing an external barrier. This was the case with the sub-codes of 'comfort' and 'I don't care'.

In the event that a student did not give a specific reason they were not performing conservation actions, they LOC was coded as 'external'. This was an assumption made

based on non-performance but could have resulted in an inaccurate measure of true LOC since the reasoning could possibly have been more in line with an internal or group LOC. Other responses coded as external were 'forget', 'time', and 'too young', as these responses revealed that the student felt some external force was influencing their ability to perform these actions. If there were multiple reasons given on a response that resulted in conflicting LOC, the external sub-code trumped the internal. This decision was made based on the assumption that if even one barrier to their actions could be perceived as external it was a more meaningful result, even if there were other reasons given that may have been more internally motivated.

LOC was coded for 'group' when the responses indicated that a student was not performing these actions based on the activity of someone else. The sub-code associated with a 'group' LOC was most often 'family doesn't', when a student indicated their family wasn't performing these actions so they were not either.

4.5.9: Will your actions to conserve water and electricity have an impact?

Answers to this question were coded in a similar manner to the previous question. Responses were coded and sub-codes were identified based on the kind of benefit that students perceived as a result of their actions. Codes and sub-codes were generally straightforward with regard to this question. Sub-codes for 'no' and 'I don't know' responses were not identified outside of the LOC identified by the answers. 'Yes' responses revealed sub-codes relating to the kinds of benefits perceived by students. Students were allowed to list as many benefits as they were aware of.

Internal LOC was identified on responses that believed their actions would have an impact. The only time the coding deviated from this was if the student responded their actions would have an impact, but only if other people were performing similar actions. In this case, the LOC was determined to be group oriented.

'No' responses were coded as having external LOC except in cases where the student responded no and gave the reason that other people need to or other people are not performing these actions. A group LOC was recognized in these responses similar to the coding seen in the 'yes' responses. 'I don't know' were coded as external LOC because it revealed that students were not aware of any potential impacts of their actions and a key component in measuring LOC is the expectation of success or influence as a result of actions performed.

4.5.10: Multivariate Regression

A multivariate regression was used to determine the variables most strongly correlated with actual behavior. Since the in home water audit did not have a sufficient response rate to draw meaningful conclusions, self-reported behavior was used as the best available measure. Student responses to question ten asking if they were performing the conservation skills they are aware of were scored based on the response. *Yes* responses were given a '1' and any other response (*no, I don't know, did not answer)* was given a '0'.

The independent variables were primarily combinations of codes identified on other questions. The combinations used were importance of conservation (importance), perceived benefits (benefits), and the impact of actions (impact). The responses to these

questions were all compared to one another to create the categories: importance=benefit, importance=impact, and impact=benefit. Similar to the scoring of the self-reported behavior, if the codes for the two categories were congruent, the student was given a '1' for that category. If the combination of responses was anything else, it was scored as a '0'.

Other independent variables used were environmental attitude (as measured by NEP score), and the school which the students attended. NEP scores were divided into the three areas the modified NEP is designed to measure and scored a '1' if the area showed an increase in score from pre to post-participation and a '0' if the score stayed the same or decreased. Similarly for schools, if the student attended a particular school, the score was '1', otherwise it was a '0'.

Chapter 5 Chapter 5: Results

This chapter presents the results of the pre and post-participation surveys. The various questions are grouped by the variables that each was intended to measure and a summary of the results is presented. The responses are compared between pre and post-participation to examine if the responses changed, and also compared with one another to examine if students who changed their answer on one question consistently made similar changes with regard to other questions. 169 students completed the NEP portion of the survey both pre and post-participation, 176 students completed the open ended response portion of the survey for both pre and post-participation.

5.1: Environmental Attitude

	Mean Score Pre	Mean Score Post	Difference (Post-Pre)	Std. Deviation
NEP (Composite /70)	48.195	49.077	0.882	0.369
Rights of Nature /21	15.615	15.976	0.361	0.184
Eco-Crisis /28	20.29	21.154	0.864	0.239
Human Exemptionalism /21	12.29	11.947	-0.343	0.215

Table 5.1: NEP Results

The New Ecological Paradigm (NEP) was used to gauge general environmental attitude. 169 students completed the NEP portion of the survey for both pre and post-participation. Using a matched pairs t-test, a mean increase of 0.882 points was found between the pre and post-participation scores ($t_{(168)}$, std. dev= 0.369).

The NEP was then broken down into the three categories of environmental attitude it is meant to measure: rights of nature, eco-crisis, and human exemptionalism. In the section on rights of nature, a matched pairs t-test found a mean difference of 0.361

points from pre to post-participation ($t_{(168)}$, std. dev. = 0.184). The same test showed a mean difference of -0.343 in the human exemptionalism section ($t_{(168)}$, std. dev.= 0.215). This was the only area of the NEP that showed an overall decrease in the average score. The largest difference found in a matched pairs t-test came from the eco-crisis section ($t_{(168)}$, std. dev.= 0.239), with a mean difference in score of 0.864. So while overall the difference was substantial, the main difference between pre and post-participation came from the section relating to an impending eco-crisis, with the scores relating to human exceptionalism actually showing a decrease between pre and post-participation scores.

5.2: Knowledge of Issues

The following two questions were meant to gauge the variable *knowledge of issues*.

5.2.1: Is conserving water important?

Table 5.2: Frequencies of main codes for question 2

Code	Pre	Post
Yes	150	172
No	17	3
I don't know	4	0
Did not answer	5	1

The responses on this question show the vast majority of students came into the program demonstrating an understanding that conserving water is important. The program did appear to have an effect on this understanding in that only three students did not recognize the importance after the field trip and no students answered that they did not know if it was important or not. Since most of the students already came into the

program with this knowledge, this question could be modified to more accurately capture why conservation is important.

Sub-Codes – 'Yes' Responses	Pre (n=150)	Post (n=172)	Changed to 'Yes' (n=23)
Conserving Electricity	1 (0.67%)	14 (8.14%)	4 (17.4%)
Economic Benefit	5 (3.33%)	15 (8.72%)	4 (17.4%)
Ecosystem Impacts	19 (12.7%)	16 (9.30%)	0 (0%)
Future Use	11 (7.33%)	22 (12.8%)	1 (4.34%)
Less Need for Treatment	0 (0%)	4 (2.33%)	0 (0%)
Scarcity	71 (47.3%)	84 (48.8%)	8 (34.8%)
Survival	28 (18.7%)	26 (15.1%)	4 (17.4%)
No Reason Given	11 (7.33%)	12 (6.98%)	2 (8.70%)

Table 5.3: Sub-codes for 'yes' responses to question 2

Looking at the reasons that were given for the importance of conservation, students that showed an increase post-participation more often identified 'ecosystem benefit' and 'conserving electricity' when compared to those who came into the program with this recognition. The increased frequency in recognition of an ecosystem benefit can be tied to a specific aspect of the Drops and Watts program, the focus on teaching about the urban water cycle. Educating children about where their water comes from and where it goes allows them to conceptualize their water use and understand the importance conservation can have on their local ecosystems. The urban water cycle is highlighted in both the classroom presentation and in station one of the scavenger hunt and ties water use directly to the surrounding ecosystem. Much of the program is focused on the demand human use places on resources but the urban water cycle incorporates the beginning and end points of water use to give students an orientation of their place in the overall cycle. The higher frequency of 'conserving electricity' can be explained by the large increase in recognition of the water and energy connection, as demonstrated by the

next question relating to this variable. This was not surprising given one of the main points of the program is illustrating this connection to students. The increased frequency does indicate that students are establishing this connection and applying it to other parts of their knowledge.

One student that identified a *yes* response pre-participation changed their answer to *no* on the post-participation survey. The specific line of coding on the pre-participation portion read, “yes, it saves you on bills in your home,” and on the post-participation survey their response read, “no, there is plenty of water in nature but it might be able to save you money at home.”

When comparing the responses of those students who identified a 'yes' response post-participation and not pre-participation with other questions, the frequency of the codes identified remained consistent with that of the overall sample.

5.2.2: Does your electricity use affect water use?

Table 5.4: Frequencies of main codes for question 3

Code	Pre	Post
Yes	63	161
No	58	10
I don't know	31	2
Did not answer	24	3

The second question related to knowledge of issues showed a large increase in the number of students who recognized a connection between water and energy use, increasing from 35.8% to 91.5% of the overall sample. There was little separation in the number of yes and no responses on the pre-participation survey (33% no response rate). The majority of students changed their response to recognize a connection between water

and energy use, which is not surprising given this connection is the emphasis of the program. The divided answers originally observed point to this knowledge as a good target of education if it can be shown to have an impact on behavioral change. The patterns revealed in the sub-codes can help to inform what components of this connection were most effective at reaching the student

Sub-Codes – 'Yes' Responses	Pre (n=63)	Post (n=161	Changed to 'Yes' (n=101)
Cleaning and Treatment of Water	5 (7.94%)	6 (3.73%)	3 (2.97%)
Generation	29 (46.0%)	93 (57.8%)	57 (56.4%)
Transportation of Water	8 (12.7%)	38 (23.6%)	24 (23.8%)
Water Heating	8 (12.7%)	16 (9.94%)	9 (8.91%)
No Reason Given	14 (22.2%)	20 (12.4%)	13 (12.9%)

Table 5.5: Sub-codes for yes' responses to question 3

Since the overall number of students who recognized this connection increased greatly from pre to post-participation, the majority of all of the responses for the sub-codes came from those students that changed their response. The connections identified for the overall sample of students compared to the students who changed their response to *yes* occurred at roughly the same frequencies, with the largest discrepancy being a 1.4% difference.

As was expected, *generation* was the sub-code most often associated with the connection between water and energy use. This is the main point of the classroom portion of the field trip and a substantial part of the presentation is dedicated to an in depth explanation of how water is used in the various stages of generating electricity. *Transportation of water* being the next most frequent code points, again, to retention of the urban water cycle. During this part of the presentation, students are asked to identify all the places in the cycle where electricity is used to transport water.

One unexpected result was only one more response revealing the connection of *cleaning and treatment of water*. The amount of treatment capacity, and the energy used during this process, is emphasized at various stages of the field trip. During the same urban water cycle demonstration as previously mentioned, students are asked to mark the LOTT treatment plant with a large star to signify the increased amount of electricity that used in this part of the water cycle. In another part of the classroom presentation a point is made to illustrate the monthly cost of energy used by LOTT to treat the water and how this cost is passed on to consumers through their water bills. The amount of water that passes through the treatment center is also the focus of station three during the scavenger hunt.

All of the students who initially identified a code of *I don't know* for this question identified a *yes* response on the post-participation survey except for 3 students who identified a *no* response. Two of these students identified the *no connection* sub-code as their reason and one did not give a reason. For the *no connection* sub-codes, one specifically stated, “there is no connection between my energy and water use,” and another stated, “electricity use does not affect water use, but using water will make the electricity bill go up.”

3 students who identified a connection between water and electricity use pre-participation changed their answers post-participation. 2 of these students did not answer the question on the post-participation survey, both of whom originally identified the *generation* sub-code as the connection. One of these students identified that there was no connection between water and electricity use, simply responding “no” to the question on

the post-participation survey. Originally, that student also identified the sub-code of *generation* as the connection between the two resources.

Examining the responses of students who recognized a connection between water and energy post-participation and not pre-participation to other questions in the survey, most responses occurred at the same relative frequencies as the overall sample. The one question that showed a noticeable discrepancy between the two groups was the question "Will your actions to conserve water and energy have an impact?" In this question 89.1% of students who recognized the water/electricity connection post and not pre-participation identified that their conservation actions will have an impact, compared to 83.5% of students on the general sample. Only 3% of students responded that their actions will not have an impact compared to 8% of students in the general sample. Looking deeper into the sub-codes, students who changed their answer to reflect a connection between water and electricity use were more likely to recognize an economic impact as a result of their conservation actions and less likely to consider their actions as resulting in more available for use.

5.3: Personal Investment

The following questions were designed to gauge personal investment in water and electricity conservation.

5.3.1: Do you benefit from conserving water?

Table 5.6: Frequencies of main codes for question 4

Code	Pre	Post
Yes	130	156
No	22	8
I don't know	9	9
Did not answer	15	3

Looking at how students viewed water conservation did not show a large increase in the number of students who felt they would benefit by conserving water. Most students (73.9%) already recognized a benefit before participating in the field trip. This result is comparable to question two regarding the importance of conservation when comparing the differences in responses from pre to post-participation.

Sub-Codes – 'Yes' Responses	Pre (n=130)	Post (n=156)	Changed to 'Yes' (n=33)
Conserving Electricity	1 (0.77%)	19 (12.2%)	6 (18.2%)
Economic	31 (23.8%)	63 (40.4%)	9 (27.3%)
Ecosystem	21 (16.2%)	22 (14.1%)	2 (6.06%)
Future Use	45 (34.6%)	35 (22.4%)	7 (21.2%)
Health	23 (17.7%)	6 (3.84%)	0 (0%)
More Available to Others	18 (13.8%)	31 (19.9%)	4 (12.1%)
No Reason Given	12 (9.23%)	22 (14.1%)	8 (24.2%)

Table 5.7: Frequencies of sub-codes for 'yes' responses to question 4

All students who did not answer this question pre-participation identified a benefit from conserving water post-participation except for one *no* response and one *I don't know*. The student that changed to *I don't know* responded that they use lots of water now and are trying to use less but don't know if they benefit as a result or not. The student

that changed their answer to *no* simply answered “nope” on the survey with no reason given.

Of the students who recognized a benefit from water conservation pre-participation, two did not answer post-participation, two identified the code *I don't know*, and three no longer recognized a benefit from water conservation. One student that changed to *I don't know* stated, “I kind of do, but kind of don’t”, looking at the code identified on their pre-test, they answered, “I kind of do” but gave no specific benefit. The other student that changed to *I don't know* simply answered “maybe” and also gave no specific benefit on the pre-test. One student that no longer recognized a benefit from water conservation had originally stated the benefit as, “I want to keep on living,” and for their reasoning of not benefiting they stated, “I never thought about it before, so I don’t.” Another student who no longer recognized a benefit originally identified *more available to others* as a benefit of conservation. Their reasoning for not benefiting was also “I don’t really think about it.” The final student who no longer recognized a benefit originally just said “yes, because it is important” and post-participation responded “no because it’s not bad.”

With regard to other questions, 100% of students who changed their answer to recognize a benefit from water conservation post-participation also answered that conserving water is important, though 97.7% of the general sample answered that way as well. The main differences appeared in the sub-codes given for the importance of water conservation. When compared to the general sample, students whose responses changed to identify a benefit from water conservation less often identified the sub-codes of

survival (6% compared to 15% from the overall sample) and *scarcity* (39.3% compared to 48.8%). These students more often did not identify a sub-code for the importance of water conservation (12.1% compared to 7%) The other sub-codes occurred at the same relative frequencies (within 3% of one another).

Count of Student	Benefit									
Importance of Conservation	Conserving Energy	Did Not Answer	Economic	Ecosystem	Future Use	Health Benefits	I Don't Know	More Available to Others	No	No Reason Given
Conserving Energy	4		6	2	2	1		1	1	
Did not answer			1					1		
Economic			10	1			1	2		2
Ecosystem	3	1	5	6	2	2	1	3		1
Future Use	2		6	3	8	1		2		3
Less Need for Treatment			3					1		
No Reason Given					2		2			9
Plenty Available									2	
Scarcity	6	3	36	13	19	1	3	21	4	6
Survival	5		7	4	3	5	3	3	2	2

Graph 5.8: Heat map comparing importance of conservation to benefits perceived

Since there was a discrepancy observed in what students perceived as the most important reasons to conserve water and the main benefits they perceived from conservation, a comparative analysis was done. The heat table demonstrates how often

students identified a similar code for both the importance of water conservation and their benefit, blank spaces indicate no responses with those variables overlapping.

There does appear to be a rift between what students feel is the most important issue relating to conservation and the benefits they perceive from it, as indicated by the most frequently occurring responses being *scarcity/economic*. It is interesting to see the next two highest benefits related to the *scarcity* code as being *future use* and *more available to others* since these codes are similar but also distinct. Since *scarcity* indicates students perceive an immediate shortage of water, which is most related to the benefit of *more available to others*, another comparison was made to see how the different benefits perceived by students related to them performing actual behaviors. In the absence of a suitable response rate for the behavior activity, a comparison was made to question ten regarding self-reported behavior and the reasons for not performing conservation actions (see section 5.6.1 for further analysis).

Comparing responses to the question, "Are you performing all the water and electricity conservation activities you are aware of", these students' responses differed from that of the general sample. Students that changed their answer to recognize a benefit from water conservation more often answered they were not performing all of these actions (42.4% answered 'yes', 48.5% answered 'no') when compared to the general sample (49.4% answered 'yes', 38% answered 'no'). Further examining the sub-codes identified in these responses shows that the students who changed their answer to recognize a benefit more often did not give a reason (43.8% to 20.9% of the general sample) and more often identified they were not performing them because they had just learned about them (18.8% compared to 9%).

5.3.2: Do you benefit from conserving electricity?

Code	Pre	Post
Yes	128	152
No	14	10
I don't know	9	5
Did not answer	25	9

Table 5.8: Frequencies of main codes for question 5

Most students already recognized a benefit from conserving energy, and the responses that did change came primarily from students who did not answer originally. Only four less students answered that they do not benefit from electricity conservation and given the generally small increase in yes responses it can be determined that this trait is not strongly influenced by the program but most students already show strong support of it. Since the majority of students already recognized a benefit, it may be that there are better ways to determine the influence of the program on this specific variable.

Table 5.9: Frequencies of sub-codes for 'yes' responses to question 5

Sub-Codes – 'Yes' Responses	Pre (n=128)	Post (n=152)	Changed to 'Yes' (n=36)
Conserving Water	0 (0%)	42 (27.6%)	16 (44.4%)
Economic	66 (52.6%)	76 (50%)	11 (30.6%)
Ecosystem	14 (10.9%)	13 (8.55%)	0 (0%)
Future Use	35 (27.3%)	28 (18.4%)	5 (13.9%)
Health	10 (7.81%)	3 (1.97%)	1 (2.78%)
No Reason Given	11 (8.59%)	22 (14.5%)	9 (25%)

The sub-codes for this response do corroborate the finding that students have an increased awareness of the connection between water and electricity, with *conserving water* being identified as an additional sub-code post-participation. This code was identified in over 25% of the overall responses and was the most common benefit identified by students that changed their response to recognize a benefit from pre to post-participation. An economic benefit was recognized most frequently overall, similar to the

benefits of water conservation. The difference between the two questions is the frequency of the economic benefit code varied only slightly for electricity conservation but doubled (31 students compared to 63 students) for water conservation.

Two students that did not answer this question pre-participation changed their answer to *no* post-participation, two remained the same, and 21 changed to *yes*. Looking at the specific code segments for the students who identified no benefit, one answered, "no, because I am still using energy," and the other simply answered, "nope," with no reason stated.

Similarly, one student who responded *I don't know* changed their response to *no* post-participation, three gave the same response, and five changed their answer to recognize a benefit. The student who changed their response to *no* stated, "no, because nobody does." Of the students who recognized a benefit post-participation, three identified no specific benefit, one responded, "yes, we will save more water," identifying the benefit of *water conservation*, and the other responded, "yes, because it will save water and we won't have to spend as much money," identifying both a water conservation and economic benefit.

Five students who originally identified a benefit from conserving electricity identified no benefit on the post-participation survey, five students did not answer, and two changed to *I don't know*. Three students who no longer recognized a benefit did not give a reason why, one responded, "there is alot (sic) already," and one responded, "you cannot conserve electricity, you will still be using it." The students who identified the code of *I don't know* both just responded with "idk".

One student who perceived a benefit from conserving electricity did not believe there was any personal benefit to conserving water. This student identified an economic benefit of electricity conservation stating 'my parents would pay a lower bill', whereas their response for not benefiting from conserving water was 'I never really thought about it.'

Students who changed their answer to recognize a benefit from electricity conservation between pre to post-participation more frequently listed *conserve electricity* (19.4% to 13.1%) and *turn off faucet* (75% to 54%) as water conservation skills when compared to the general sample. This carried over into the intention to perform water conservation actions where more students who changed their answer to recognize a benefit from electricity conservation intended to not leave the faucet running (55.6% to 44.9%). These students also more often listed the most important thing they learned at the WET Center as being the connection between water and energy (22.2% compared to 12.5% of the general sample). Response frequencies between students who recognized a benefit post-participation and not pre remained consistent with the general sample for all other questions.

5.4: Knowledge of Skills

The following questions were designed to measure students' knowledge of skills they can perform to conserve water and electricity.

5.4.1: Are there actions you can personally take to conserve water?

Actions to Conserve Water	Pre	Post
Completely Fill Dishwasher/Washing Machine	13	25
Conserve Electricity	0	23
Conservative Use	29	23
Don't Leave Faucet On	74	95
Food Choices	0	8
No	10	3
Shorter Showers	113	134
Other	20	5
Did Not Answer	15	6

Table 5.10: Frequency of codes for water conservation actions

There was not a large difference observed from pre to post-participation in the number of students who listed actions they are aware of and can take. Nor was there a shift in the actions most commonly given in the responses of students, with *shorter showers* and *turn off faucet* being the most common on both. This could be a result of a lack of emphasis during the field trip on identifying a wider variety of actions that can be taken. In the classroom portion, students are asked to talk with their neighbors regarding actions they can take and are given a chance to share them with the class. There were not any actions introduced specifically by the teachers during the observed presentations, so students were able to learn more actions from their neighbors, but were not taught a wider variety by faculty during the field trip. There is one station in the scavenger hunt that relates specifically to actions that can conserve water in the home, but the journal only asks that students view the bathroom section of this station, which relates to the two actions students were already most frequently listing as being aware of.

There was a drop in the amount of actions listed that were grouped into the *other* coding between pre and post-participation. Since a student could list more than one action that could potentially be coded as *other*, these rates are identified as an overall percentage of total actions listed by students rather than the percentage of respondents that listed an action identifying the specific code. Pre-participation *other* responses accounted for 8% of the total actions listed. Post-participation these responses accounted for 1.6% of the total actions listed.

There was an increase in the number of actions listed per student from pre to post-participation. When comparing the number of actions listed per-student, a significant increase in actions listed was found to exist on the post-participation surveys ($t_{(175)}$, $p<0.0001$) with a mean increase of 0.36571 actions listed per student.

5.4.2: Are there actions you can personally take to conserve electricity?

Table 5.11: Frequency of codes for electricity conservation actions

Actions to Conserve Electricity	Pre	Post
Conserve Water	0	24
I Don't Know	8	2
No	6	7
Turn Off Electronics When Not In Use	33	20
Turn Off Lights	91	103
Unplug Electronics	25	63
Use Electronics Less	23	21
Use Natural Light	14	14
Watch Less TV	17	12
Other	12	10
Did Not Answer	21	7

Looking at the knowledge of skills that can be taken to conserve electricity reveals similar results. Most students listed actions on the pre-participation survey, and there was only a small increase in the overall number of students who listed at least one

action from pre to post-participation. The biggest change was the decrease of *I don't know* responses and there was even one more student that answered they were not aware of any electricity saving activities. Since most students were already aware of actions, examining the specific actions listed will help draw conclusions as to the effectiveness of influencing this variable.

The increase of knowledge in electricity conservation skills suffers from the same limitations that the knowledge of water conservation does, varieties of skills are not specifically discussed with students in depth. In the case of electricity conservation, specific actions are only discussed in the classroom presentation and not presented in the scavenger hunt. The building tour does reveal some ways to conserve electricity but they are presented in terms of building materials and energy efficient technologies that are incorporated into the built environment, which are not indicative of everyday conservation behaviors that students can perform themselves.

There were less actions listed per student pre-participation when compared to post-participation. A significant increase was found to exist in the number of actions listed per student ($t_{(175)}$, $p=0.0003$), with a mean increase of 0.29143 actions listed.

5.5: Behavioral Intention

The following questions asked students to list behaviors they intended to engage in on a regular basis.

5.5.1: List any water conservation actions you plan to perform regularly

Table 5.12: Frequency of codes for intention to perform water conservation skills

Intention to Perform Water Conservation Skills	Pre	Post
Completely Fill Dishwasher/Washing Machine	8	21
Conserve Electricity	0	23
Conservative Use	20	13
Don't Leave Faucet On	47	79
Food Choices	0	7
No Intention	21	13
Shorter Showers	86	117
Other	18	3
Did Not Answer	26	5

The results of the intention to perform water conservation actions question were extremely similar to the results on the question regarding knowledge of action skills. This question asked students to reveal which actions they are aware of that they intend to perform regularly, and the two most frequently observed responses to both were *shorter showers* and *don't leave faucet on*. These results were not surprising as it was expected that the most frequently recognized actions would also be those that students intended to perform.

The various skills that students intended to perform unsurprisingly mirrored those listed on the question regarding knowledge of conservation skills. The two actions that were revealed post-participation and not pre were again *conserve electricity* and *food choices*. Indicating that there was some, even if very little, influence of the program on the kinds of behaviors students intend to perform as a result of the connections they make

between water and it's use in various indirect aspects of daily life. There was an increase to the appearance of every code from pre to post-participation except for *conservative use* and *other*, again showing that students developed a more refined sense of what kinds of actions can be most effective to perform and therefore changed the kinds of actions they intended to perform.

Only one student who expressed intention to perform an action pre-participation did not answer post-participation, their answer pre-participation identified the *conservative use* code. Two students who did not answer originally expressed no intention and the remaining two did not answer on either survey. Five students who expressed no intention post-participation originally expressed intention to perform at least one action. The specific coded segments for each similarly read, “I can’t think of any”, or “I don’t plan to”.

There was a significant increase in the number of responses listed per student from pre to post-participation ($t_{(175)}$, $p<0.0001$) with a mean increase of 0.46857 actions listed per student.

5.5.2: List any electricity conservation actions you plan to perform regularly

5.13: Frequency of codes for intention to perform electricity conservation skills

Intention to Perform Electricity Conservation Skills	Pre	Post
Conserve Water	0	18
No Intention	19	13
Turn Off Electronics When Not In Use	30	21
Turn Off Lights	64	90
Unplug Electronics	18	49
Use Electronics Less	19	14
Use Natural Light	11	15
Watch Less TV	13	10
Other	2	6
Did Not Answer	40	16

The results of the intention to perform electricity conservation actions question were also very similar to the results regarding the knowledge of skills. The most frequent action was *turn off lights* on both pre and post-participation surveys, with the number of students listing this action increasing by 14.8%. The largest shift was students more frequently listing actions coded as *unplug electronics* rather than *turn off electronics,* which was expected given a similar shift in the question regarding the knowledge of actions. This points to students developing a recognition of what they understand to be either a more effective action to conserve electricity, or one that they are not currently performing.

Seven students who expressed intention to perform at least one action pre-participation did not answer the question post-participation, two originally expressed no intention, and three did not answer on either. Six students who originally expressed intention to perform at least one behavior expressed no intention post-participation. Three of the specific coded segments were simply “no”, or “none”, two of them were “I

don't know" despite both having listed action in the question regarding knowledge of electricity conservation skills, and one responded "I perform daily actions" but did not list any actions in the knowledge of electricity conservation skills.

There was, again, a significant increase from pre to post-participation in the number of actions listed per student ($t_{(175)}$, $p<0.0001$) with a mean increase of 0.37714 actions listed.

5.6: Locus of Control

The following questions were designed to gauge the locus of control identified in students regarding water and electricity conservation behaviors and actions.

5.6.1: Are you performing all the water and electricity conservation activities you are aware of?

Code	Pre	Post
Yes	70	87
No	66	67
I don't know	9	6
Did not answer	31	16

Table 5.14: Frequencies of main codes for question 10

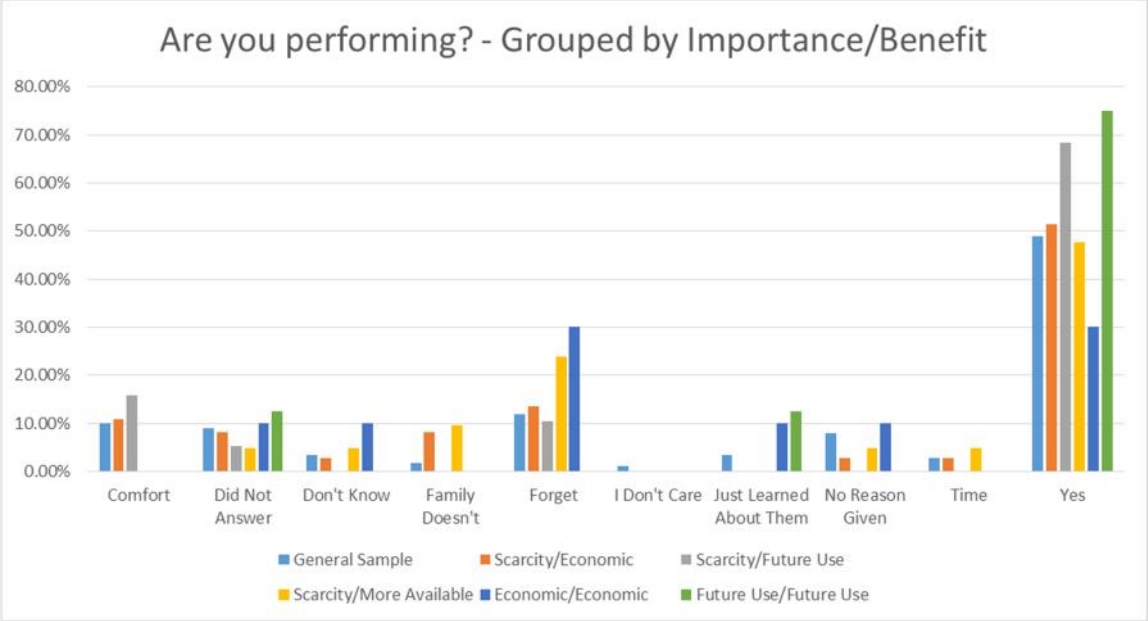
15 students who originally did not answer the question changed to a *yes* response post-participation, five who answered *I don't know* changed to *yes*, and 19 *no* responses changed to *yes*. One student who originally answered *yes* changed to *I don't know*, five did not answer on the post-participation survey, and 16 changed their answer from *yes* to *no* from pre to post-participation.

This question displayed the highest number of students that changed from a positive endorsement of conservation behavior to a negative one. Examining the coded segments of the students who changed their answer to *no* from something different, it was most common for them to not reflect a specific reason behind not performing all the actions they were aware of, *no reason given* was coded for 29.4% (5 students) of responses. The next most common codes identified in the reasoning were *forget* and *comfort*, each appearing on 23.5% (4 students) of responses. Two students, or 11.8%, gave a reason coded as *just learned of them*, *time* and 'family doesn't' were identified in 5.9% (one student) each.

Table 5.15: Frequencies of sub-codes for 'no' responses to question 10

Sub-Codes – 'No' Responses	Pre (n=66)	Post (n=67)
Comfort	20 (30.3%)	18 (26.9%)
Family Doesn't	3 (4.54%)	3 (4.48%)
Forget	30 (45.5%)	21 (31.3%)
I Don't Care	2 (3.03%)	2 (2.99%)
Just Learned About Them	0 (0%)	6 (9.09%)
Time	6 (9.10%)	6 (7.46%)
Too Young	1 (1.52%)	0 (0.0%)
No Reason Given	7 (10.6%)	14 (20.9%)

The most surprising result of this question is the number of students who originally answered they were performing these actions, but answered they were not performing them post-participation. Most of these students did not give a specific reason for why they were not performing these actions so it is difficult to pinpoint the reason their responses may have changed. The most obvious reason would be that the program exposed them to a variety of conservation actions they had not considered before, and were therefore not performing them. It is possible that follow up questioning with these specific students might reveal the reasons underlying this change.



Graph 5.2: Responses for question 10 using select Importance/Benefit combinations

The earlier heat map demonstrating the distribution of the importance of conservation by the benefits perceived was used to examine how the most frequently occurring combinations of responses related to self-reported behavior. The results show that students who recognize the importance of conservation being *scarcity* or *future use* and the benefit of *future use* responded that they are performing all the conservation actions they are aware of more often than the general sample and students who displayed other combinations of responses. Even though *future use* was identified to be temporally distinct from *scarcity*, students could be more likely to perform conservation behaviors based on a future direct personal benefit as opposed to a more altruistic benefit perceived in the present. This could also be true of the lower occurrence of behavior found in students who answered with the combination of *economic/economic*. If students are not directly responsible for the economic cost associated with water use, they only indirectly benefit by helping their family save money. The frequency of the *forget* code identified for why students who answered with a combination of *scarcity/more available* and

economic/economic are not performing these behaviors points to students being less likely to habituate these behaviors into their everyday lives if the benefit perceived is indirect, or altruistic in nature.

Locus of Control	Pre	Post
Internal	99	105
External	43	54
Group	3	1
Did Not Answer	31	16

Table 5.16: Locus of control for question 10

The locus of control identified had the opposite of the desired effect for this question; the increase in external locus of control was greater than the increase in internal. External locus of control means that students feel their ability to perform these actions, or the impact they have, is beyond their control. The increase in the number of students that reflect external LOC leads to the conclusion that students need to be reinforced with the idea that these behaviors are actions they can perform regardless of outside influence.

When comparing the responses from students who changed their response to *yes* from something else with the responses from the general sample on the other questions, there were some notable discrepancies. When comparing responses to the question 'Do you benefit from conserving water?' students who changed their answer to *yes* more frequently identified the code of *future use* when compared to the general sample (34.2% to 22.4%). These students also identified an internal locus of control for the following question regarding the impact of their actions when compared to the general sample

(81.6% to 68.2%). Comparing these students' responses with the general sample regarding intention to perform water conservation actions, the action of *unplug electronics* appeared more frequently (39.5% to 26.1%). Students that changed their answer to *yes* from another response for this question also more frequently listed their favorite part of the WET Center as the water use calculator than the general sample (42.1% to 27.3%).

5.6.2: Will your actions to conserve water and electricity have an impact?

Code	Pre	Post
Yes	113	147
No	17	14
I don't know	13	7
Did not answer	33	8

Table 5.17: Freauencies of main codes for auestion 11

28 students who did not answer the question pre-participation answered *yes* post. All of these students identified an internal locus of control (LOC) except four students that identified a group LOC. The coded segments for these four students read, “if everyone does it it will”, “only a small impact unless everyone else does it”, or a similarly worded response. Nine students who originally answered *I don't know* changed their answer to *yes*, and all but one identified an internal LOC, that student identified a group LOC stating, “if my mom and sister do as well.” Seven students changed their *no* response pre-participation to a *yes* response post with all students identifying an internal LOC except for one that identified *group*. That one student’s response was, “not a big one unless everyone starts”. Pre-participation these students most often answered their actions would not have an impact because they were not performing them due to laziness

or forgetfulness. Post-participation, when they changed their answer to *yes*, the coded segments of their responses gave reasons such as, "even if I am one person, I can still have an impact", and, "yes, I am using less water and electricity so bills will go down."

Table 5.18: Frequencies of sub-codes for 'yes' responses to question 11

Sub-Codes – 'Yes' Responses	Pre (n=113)	Post (n=147)
Economic Impact	21 (18.6%)	26 (17.7%)
Ecosystem Impact	14 (12.4%)	18 (12.2%)
Influence Others to Conserve	3 (2.65%)	16 (10.9%)
More Available for Use	41 (36.3%)	47 (32.0%)
Survival	1 (0.88%)	0 (0.0%)
No Impact Stated	39 (34.5%)	51 (34.7%)

There were nine students who originally answered *yes* on the pre-participation survey that changed their answer to a different response post-participation. Three of these students changed their answer to *no* and none gave any specific reason their actions would not have an impact. Of these three, one originally stated they would waste less water and two did not give any specific impact, though one stated, "a very tiny impact, but still an impact". One student who changed identified a *group* LOC on both surveys stating, "yes, if everyone else does", pre and, "no because there are 7 billion people on the earth", post-participation. Five students did not answer and one did not know.

44 students changed their answer to *yes* from pre to post-participation, with the specific impacts stated appearing at the same frequency as the general sample of 'yes' responses. 38 of these students identified internal, and six identified a group LOC. Examining how these students responded to other questions revealed that the students who changed their answer to *yes* more often gave *future use* as a benefit of water conservation than the general sample of *yes* responses for question two (31.8% against

22.4%) and less likely to list an economic benefit (22.7% against 40.4%), the other frequencies remained constant. For the question, 'Do you benefit from conserving electricity?', these students less often identified an *economic* benefit when compared to the general sample (27.7% to 50%), and more often did not list any specific benefit (22.2% to 4.5%).

Table 5.19: Locus of control for question 11

Locus of Control	Pre	Post
Internal	77	120
External	24	17
Group	42	31
Did Not Answer	33	8

Most students that identified an internal LOC post-participation and not pre had originally answered *I don't know*, or did not answer at all. 23 students who originally identified a *group* LOC identified internal, 14 students who identified an *external* LOC changed to identify *internal*, students did not necessarily change their yes/no response, but the coded segment read as such to recognize that their LOC had changed. Ten students who initially identified an *internal* LOC identified a *group* LOC post-participation, four changed to identify external, and four did not answer.

5.7 Multivariate Regression

Effect Likelihood Ratio Tests

Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
Importance=Benefit	1	1	0.23539507	0.6276
Importance=Impact	1	1	1.87046874	0.1714
Benefit=Impact	1	1	0.50234367	0.4785
Human Exemptionalism	1	1	0.90404902	0.3417
Eco-Crisis	1	1	3.59464068	0.0580
Right Of Nature	1	1	0.16321343	0.6862
Komachin	1	1	0.05621833	0.8126
Chinook	1	1	0.01834608	0.8923

Table 5.20: Results of multivariate regression

The results of the multivariate regression showed the whole model was not a good predictor of self-reported behavior (n=176, R^2= 0.0256). It also demonstrated that none of the combinations of variables, increases in environmental attitude, or the school the students attend had any kind of significant effect on self-reported behavior. This may be an indication that the Drops and Watts program is not effective at encouraging actual behavioral change and/or the combinations of variables used are not actually good predictors of environmentally friendly behavior in general.

Chapter 6 Chapter 6: Discussion

This chapter discusses the results of the research and how they relate to the WET Center program. Results of the surveys are compared to identify which variables showed the largest differences after participation in the Drops and Watts program, and connections are drawn between these changes and the specific parts of the program that likely influenced them. The changes in sub-codes are examined and an attempt is made to identify the underlying reasons for these changes to understand the most effective ways the program may have influenced the variables in question. Results are also compared to the existing body of literature regarding the variables influential to environmentally friendly behavior (EFB) and how they are influenced by environmental education (EE), though studies that focus on the same age group, specific behavior, and similar educational program are not widely available. The chapter is divided into sections of the variables that were studied.

6.1: Environmental Attitude

As measured by the New Ecological Paradigm (NEP) adapted for use with children of a similar age group (Manoli, Johnson, & Dunlap, 2007), environmental attitude was raised by 2.39 standard deviations from pre to post-participation. The increase in the overall score of the test was only 0.882 of a possible 70 points and the p-value of 0.0178 was very close to the alpha of 0.05 so the test was broken down into the three areas it is designed to measure.

The most interesting result from the three individual factors is that only one showed an increase greater than that of the composite, that being eco-crisis with an increase equal to 3.62 standard deviations. There are four statements on the NEP associated with this factor:

- There are too many (or almost too many) people on earth
- When people mess with nature, it has bad results
- People are treating nature badly
- If things don't change, we will have a big disaster in the environment soon

The increase of this factor relative to the increase in the other two, suggests that the program is not necessarily effective at influencing overall environmental attitude but it is effective at increasing students' recognition of the seriousness and urgency posed by current environmental issues. In the case of the Drops and Watts program, this recognition likely comes from the portions that educate the students as to how much water is currently demanded by human activities compared to the relative availability of water as a resource. There is also an emphasis in the classroom presentation on accessibility to potable water and the demands of a growing population on water resources, both of which relate to this factor of the NEP. This connection between curriculum and the shift in environmental attitude is further corroborated by the results of the knowledge of issues and locus of control questions that reveal 'scarcity' and 'future use' as the codes most often identified in the responses of the students who changed their answers between pre and post-participation. Despite the fact that the results of the regression demonstrated this increase does not have a significant effect on self-reported

behavior, it is still a positive outcome of the Drops and Watts program. The most important thing the regression demonstrated was this increase was not sufficient to influence self-reported behavior, further study is needed to observe if behavior is more effectively influenced by increases in other areas of the NEP, rather than just the *eco-crisis* portion.

Examining the results of the other two factors was interesting, though they both showed a smaller increase than was observed in the composite score. The factor of human exemptionalism actually showed a decrease in the mean scores from pre to post-participation. The statements related to this factor on the NEP are:

- People are clever enough to keep from ruining the earth
- Nature is strong enough to handle the bad effects of our modern lifestyle
- People will someday know enough about how nature works to be able to control it

There is an emphasis in the Drops and Watts program on offering a positive, solutions based outlook to current environmental issues, as well as an attempt to empower students with the belief that they can make a difference (A. Smith, personal communication, February 13, 2015). These elements of the program likely influenced the students to believe that humans can overcome the challenges presented by environmental issues. This is supported by the results of questions relating to locus of control, where the number of students who recognized an impact of their actions increased by 19.3%.

Instead of pointing to the decrease in this factor as a less favorable attitude toward the environment, it could be seen as an endorsement of the value of human ingenuity in the face of potentially disastrous problems. If this decrease was influenced by a recognition of individual and/or human capability, it could mean that this factor of the NEP is not an accurate indicator of environmental attitude with relation to conservation behavior. The questions do not specify reasons for confidence in human exemptionalism and it could be argued that a belief in human ability to deal with current environmental issues can be seen as endorsing a pro-environmental attitude. The reasoning behind this being these students are the next generation of problem solvers and will need to be coming up with new, innovative solutions in order to mitigate past and continued effects of human activity on the environment so a belief in their ability to do so will be a necessity. This has been shown to be an important factor of successful environmental education because it avoids promoting a 'psychology of despair' (Zufiaurre, Albertin, & Belletich, 2014) The factor is meant to measure if humans feel they are exempt or superior to the rest of nature in some way (Dunlap, Van Liere, Mertig, & Jones, 2000) but the wording of specific questions could also be measuring how capable students feel when dealing with environmental issues.

6.2: Knowledge of Issues

Though responses from students who developed a recognition of the importance of water conservation yielded other codes at a higher frequency compared to students who already demonstrated this recognition, the code identified most often in their responses was still *scarcity*. This code was included as at least one reason for the importance of conservation on almost half (48.8%) of the student responses and from

34.8% of students who showed an increase in this knowledge. This lends credibility to the earlier assertion that students become more sensitized to environmental problems as demonstrated by a large increase in support of the eco-crisis factor of the NEP. When examined in light of results on other questions, this increased knowledge will only result in actual behavioral change if other pre-requisites are met. If the students view the issues on a more global scale, or fail to draw the connection between the importance of conservation and their own perceived benefits and impacts, it is likely that this increase in knowledge will not result any kind of behavioral change (Fernandez-Juricic, 2000). Even if the students do recognize a benefit from their actions the benefits need to be related directly to the individual, rather than altruistic in nature.

Regarding the relationship between water and electricity use, one possible reason for the unexpected result regarding the frequency of the *cleaning and treatment of water* sub-code is the wording of the question. Structuring the question as, 'Does your electricity use affect water consumption?', rather than something that does not emphasize the use of one resource over another such as, 'Do your water and electricity use affect one another?' may have led to misunderstanding. The students may still have an increased awareness of how increased water use would increase electricity consumption related to the cleaning and treatment of water, but it is not revealed due to the wording of the question. This may also explain one student whose response was originally *I don't know* and changed to *no*. The coded segment read, “electricity use does not affect water use, but using water will make the electricity bill go up”, suggesting that if the question was worded differently, the response may have been different.

The students who developed a recognition of this connection did reveal a relationship to other questions, one was regarding their actions having an impact. Students who developed knowledge of the electricity/water connection recognized their actions would have an impact at a higher rate relative to the general sample. Developing this connection in knowledge allows them to recognize a greater impact to their conservation actions (Athman & Monroe, 2001). Not only were students more likely to recognize an impact of their actions, but the recognition of this connection also led to a number of sub-codes being identified post-participation that were not present pre-participation. Codes on questions relating to the importance of conservation, the benefits perceived, the skills that can be performed, and the impacts of actions all revealed a sub-code associated with the water/energy connection. In the case of the benefits perceived from conserving electricity, *conserving water* was the benefit most often identified in responses of students whose answers changed to recognize a benefit post-participation. This follows the Value-Belief-Norm theory that knowledge leads individuals recognize the impacts of their actions and form perceptions as to how they can reduce any negative impacts (Stern, 2000). It also demonstrates that an increase in knowledge can inform a variety of the other observed variables, though it was not demonstrated by the present research that these effects had any influence over actually performing behavior.

6.3: Personal Investment

Looking at how students viewed water conservation did not show a large increase in the number of students who felt they would benefit by conserving water. Most students (73.9%) already recognized a benefit before participating in the field trip. This

result is comparable to question two regarding the importance of conservation when comparing the differences in responses from pre to post-participation.

There were changes in the sub-codes most often identified in responses, pointing to an influence in the kinds of benefits perceived. The drop in frequency of *future use* appearing in answers may point to students developing a more immediate benefit from conservation. A direct connection to the learner's everyday life has been shown to be an effective way to influence behavior (Athman & Monroe, 2001), however, the combination of *scarcity* and *future use* did more often result in students reporting they were performing conservation actions. It could be that an immediate benefit is not necessary as long as the students recognize they will directly benefit from their actions at some point in time. When looked at in the context of graph 5.2, the drop in future use could be seen as a negative effect if the newly perceived benefit is more altruistic in nature rather than offering a direct personal benefit.

The increase in an economic benefit perceived should be more influential in motivating the students to perform conservation behaviors according to previous research identifying economic motivations as a primary influence on conservation behaviors (McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995). This, however, would need to be preceded by students recognizing that water conservation in general is an economic issue and recognizing that their actions will have an economic impact (Stern, 2000). The results of this study indicate they primarily view the importance of water conservation as relating to scarcity rather than economics. The results of graph 5.2 refute prior research that economics serve as a primary motivator for conservation behaviors as it relates to this particular age group. This could be due to the lack of a direct personal benefit,

similar to the results found in the students who answered *scarcity/more available.* The assumption was made that these students are not primarily responsible for the economic burden associated with water use, so the benefit they perceive is realized more by their parents than themselves. When the benefit perceived is altruistic, or serves to primarily benefit someone else, students appear less likely to habituate and perform that behavior, even if they recognize this as a benefit.

Comparable results were found regarding the benefits perceived from conserving electricity. The most telling result was found in the frequencies of the sub-codes, specifically, the appearance and prominence of the *conserving water* code, further reinforcing that students are able to draw connections between water and electricity use. This is supported by the fact that students who changed their response to recognize a benefit identified the most important thing they learned at the WET Center as being the connection between water and electricity. Despite the prominence of this code, an economic benefit was still the most commonly perceived among students overall. Previous research has shown the importance of economic motivators to resource conservation (McKenzie-Mohr et al., 1995), so the high frequency of economic benefits recognized, and the strong connections made between water and electricity use, could lead to an increased awareness of behaviors that can be performed to conserve resources and save money. The appearance of new skills on subsequent questions from pre to post-participation supports that this connection does increase the kinds of skills students are aware of. The results of the current study indicate that, while this recognition may lead to an increased awareness of actions, those actions will not be habituated by students based on an economic motivator.

The small change in frequency of an economic benefit perceived from electricity conservation compared to the large change in frequency for this same benefit with regard to water conservation is also interesting. Students are more likely to recognize they save money on both water and electricity when they conserve water but it would not appear that this connection carries over to conserving electricity. There is a strong emphasis in the program regarding how much electricity is used in connection to water use, but the amount of water used when generating electricity is presented as more of a cycle. Water is heated into steam and then cooled back into water and used again. In the classroom presentation power plants are shown to be located near large bodies of water and the ways water is recycled after being used in the plant are demonstrated. This is one possible explanation for why students perceive water use as having a higher economic benefit than electricity use, since they have an understanding that it is actually using both resources, whereas the water used in electricity production gets recycled. Regardless of why this discrepancy occurred, it would be in the interest of the WET Center to try and encourage students to recognize an alternate benefit from conservation that is more closely aligned with a direct benefit and the overall perceived importance of conservation in general.

6.4: Knowledge of Skills

Responses on the post-participation survey less frequently identified *conservative use* and *other* codes with regard to the actions they can take. Since these codes are more general in nature and do not often result in a large reduction in use, this points to a more concentrated and effective knowledge of skills being developed after participating in the Drops and Watts program. Most students already are aware of some kind of water saving

actions, but these small shifts in emphasis reveal a more refined set of skills being developed. This is also supported by the decrease in the number of students who did not answer or who did not identify any strategies they are aware of. These results are similar to other research that EE can help to refine the kinds of actions students are aware of, even if it does not increase the overall frequency of awareness (Zint, Kraemer, Northway, & Lim, 2002).

Also supporting the notion that students' knowledge of skills became more effective is the emergence of additional codes in the post-participation survey. The two additional codes of *conserve electricity* and *food choices* were not often revealed in answers, but their emergence does show students are making more connections regarding how water relates to other aspects of life. Since the *food choices* code was not often displayed, it does not seem that students are developing a sufficient knowledge of this skill to effectively carry it out, which is corroborated by the low frequency of this action revealed in the behavioral intention question. This is supported by the coded segments for *food choices* being general rather than specific for most responses such as, "don't eat food that takes more water", or "don't waste food", and not often giving specific foods or kinds of food. Students seem to really relate to the portion of the classroom presentation that tells how much water is used for a double cheeseburger (observation February 13, 26-27, 2015 March 12-13, 2015), but not many other foods are identified as being water intensive. Local and organic options are mentioned but not emphasized as ways to be more conscious regarding the water footprint of food but specific foods are not identified except in a chart next to one of the exhibits that lists some common foods and their water footprint. The segments related to *conserve electricity* reveal a more detailed knowledge

of actions as they list specific actions to conserve electricity with only five segments being a general response. This, coupled with the increase in the knowledge of the connection between water and electricity, may explain why more students included this as at least one action they could take.

It was also observed that students more often listed multiple actions they were aware of post-participation when compared to their responses pre-participation. The significant result of the matched pairs test shows that students are becoming aware of more actions they can personally perform, even if there is not a wider variety demonstrated in the general sample. It could be that this recognition is temporary and a result of recent exposure to the material. The lack of a successful retention test prohibits this comparison from being made. The increase in number of actions was also very small showing a mean increase of only 0.366 more actions being listed per student. While statistically significant, this may not point to the program being extremely effective at influencing this variable. Comparison with other evaluations using this same measure was not able to be performed due to the specificity of the actions and program being studied.

Regarding electricity conservation skills, one code, *turn off lights* was listed as at least one of the actions on the majority of student responses both pre and post-participation, with very little change in frequency between the two. There was change observed in the next most frequently revealed code with students more frequently listing actions coded as *unplug electronics* rather than *turn off electronics when not in use*. This could possibly be explained by various different factors. The first being most obviously that less students were aware that items still use electricity when plugged in. This is

something that was brought up by a student in every classroom presentation observed, and always received some further explanation by the teacher, referring to these items as 'energy vampires' and explaining that they still draw power even if not in use (observation February 13, 26-27, 2015 March 12-13, 2015). It is also possible that more often, students are already turning off electronics while they are not using them, so while it may be a way to conserve electricity, it was not very applicable to most students' everyday lives. Further questioning could reveal if this is indeed the case.

The code of *conserving water* did emerge on the post-participation surveys and did not appear pre-participation. This is expected, especially in light of the results of the knowledge of water conservation skills. Students are aware of this connection and recognized specific water saving actions they could perform that would also have an effect on electricity consumption. This seems to be a reoccurring theme, that the connection between water and electricity use forms the basis for the observed increases in the other variables and confirms the results from other studies that knowledge is a necessary precursor to the recognition of effective action (Cary, 2008; Hungerford & Volk, 1990; Stern, 2000).

There was, again, a significant increase in the number of actions listed per student between pre and post-participation surveys. The increase was similar to that observed in the knowledge of water conservation skills, an average of 0.291 more actions listed per student. The small increase gives pause as to how to interpret this effect. It could point to an overall increase in the knowledge of the variety of skills that can be performed but could also be a short term artifact of the information being fresh in the minds of students. Long term study would reveal if this increase remains permanent or not.

6.5: Behavioral Intention

Perhaps the most telling result from this question is the discrepancy between students that are aware of actions and those that intend to perform them. For almost every action listed on the knowledge of water conservation skills question, fewer students showed intention to perform than were aware of the action. There were only three students who did not claim to be aware of any skills they could perform to conserve water, however, 13 students answered they had no intention to perform any actions. The segments for the students with no intention mostly just read 'none', or 'I don't plan to', and did not reveal and specific reasoning for not performing the actions. Reasoning for this lack of intention is explored further in the question measuring locus of control and what is preventing students from performing all the actions they are aware of. Since these students do not intend to perform any actions, it can be assumed that they are not simply forgetting to do so, as was the most commonly revealed code for why students are not performing water conservation actions they are aware of. The next most commonly identified code was *comfort*, most often indicating that the students enjoyed taking long showers and did not want to give this up. If this is the case it would mean the overall benefits perceived by students are not enough to get them to sacrifice their own comfort in order to gain these benefits.

There was, again, a statistically significant increase in the number of actions listed per student from pre to post-participation, indicating students intended to perform more actions, and a wider variety of them, after participation in the program. This increase in number of actions per student was higher when compared to the increase in number of actions per student on the knowledge of water conservation skills question. The

significance, as well as the comparatively larger increase in actions listed per student between the knowledge and intention questions, would indicate that there is a genuine increase in the number of conservation actions students intend to perform, but only in those who previously demonstrated intention. Retention or follow up tests would be able to confirm this result.

There was a similar discrepancy observed in the number of students who are aware of actions and the number who actually intend to perform them. For every action listed except *turn off electronics* there were less students who intended to perform the behavior than were aware of it. For the *turn off electronics* code, there were 21 students who intended to perform that behavior, yet only 20 indicated they were aware of it. This discrepancy supports the claim that this action may be something they are already performing or have internalized as habit. Students will list the actions they have just become aware of through the program on the question regarding knowledge of skills, but when it comes to intention, they list the behavior they are already performing out of habit. The difference in awareness and intention means a more focused approach to influence students to perform these actions, or incorporate them into their daily routines, may be the most effective way to increase behavioral intention. As it stands, it does not appear that the program has a large influence on this variable in students who did not previously show intention, which could be a further indication of the disconnect between the perceived importance of conservation and the direct personal benefits students feel they gain from their behaviors.

As was the case with the previous questions, there was a statistically significant difference in the number of actions listed per student from pre to post-participation.

Despite the statistical significance, the mean increase in number of actions was only 0.377 more actions listed per students. This cannot be seen as a definitive endorsement that the program is influencing behavioral intention without a sufficient retention test to verify that the increase is not a temporary effect of just having participated in the program.

6.6: Locus of Control (LOC)

There was not a large shift in the locus of control identified for why students are not performing the water and energy saving actions they are aware of. There are a few possible reasons for the lack of change in this response. The first being the surveys are administered too closely to one another to accurately reflect how students may change the actions they are performing between pre and post-participation. Since the survey is administered only one day past participation in the program, students may not have had ample opportunity to incorporate new behaviors into their daily routine. This is supported by the primary reason behind students not performing these actions being that they forget to do so. If students do indeed begin to incorporate some of these actions into their daily routines, it is possible that this would be identified more accurately in a retention survey rather than the post-participation survey.

Since the majority of the responses coded as external also revealed the code of *forget* regarding the reason they are not able to perform the actions, it can be determined that these students lack a way of habituating these actions into their daily routine. Previous research indicates that forgetfulness regarding behavior often results from individuals not being able to form a strong enough connection between the action they

are performing, the benefit it offers them, and the way that benefit is connected to the larger issue (Ajzen, 1991; Stern, 2000). This is reinforced through the result that students perceive the most important reason to conserve water as being the issue of scarcity, but perceive their own benefit from conservation as being economic. If the direct connection between why conservation is important and the individual benefit gained by conservation is not made, students are less likely to habituate conservation action and will forget to perform them, even if they feel it is the 'right' thing to do (Athman & Monroe, 2001). The same applies to the more altruistic benefits perceived by students. Graph 5.2 indicates altruistic benefits are not only less often performed, but they are not performed based on the students forgetting to do so. Despite the fact that the responses would seemingly directly connect the benefit perceived to the overall importance, the nature of the benefit as an altruistic one appears to be responsible for the lack of habituation of these behaviors. Whereas when a student perceives a personal benefit that occurs at a later point in time and can connect it to the immediate importance of conservation, they are less likely to forget to perform the behavior.

The minor changes in overall response rate also reinforce the theory presented by Hungerford and Volk that education does not have a direct impact on LOC, but rather encourages students to perform certain actions and their success in performing these actions will reinforce an internal LOC (Hungerford & Volk, 1990). This is supported by the relationship observed between the students who changed their answer to *yes* on this question and how they responded to the following question relating to the impact of their actions. These students more often identified an internal locus of control for the following question than the general sample, which could mean they became aware of the

impact their actions would have and were therefore more likely to answer that they were performing them. It could also mean they began to perform conservation actions and were therefore more likely to recognize the impact these actions have. Regardless of which way this relationship works, it lends support to the assertion that only through actually performing the actions in question can an internal locus of control be reinforced.

The results of the next question regarding the impact of students' actions were determined to be inconclusive regarding the changes observed from pre to post-participation. There was a large increase in the number of students who felt their actions would have an impact, but these responses primarily came from students who did not answer the question on the pre-participation survey. While this may indicate that participating in the program does have an effect on perceiving impacts as a result of actions, the lack of pre-participation answers prevented making conclusions as to how or why these changes occurred. Part of the reason for the large lack of responses to this question initially may be that students did not understand what the question was asking.

The one change observed is the shift from *group* to *internal* locus of control. While the students may not have answered differently as to whether or not their actions will have an impact, there was a change in the kind of locus of control identified in their responses. This shift indicates students are more likely to realize the individual impacts conservation actions can have rather than believing these impacts are dependent on others doing the same. The coded segments lend credibility to this indication. The specific codes for students that shifted from *group* to *internal* originally read similar to, 'only if other people do as well' but changed to read similar to, 'yes, even the smallest impact makes a difference'. This points to students recognizing the impacts of their own

individual actions. Even if the program does not change the minds of students who feel their actions will not have any impact at all, it does have the potential to emphasize individual rather than group actions. Previous research identifies an individual locus of control as being more likely to lead to changes in behavior when compared to group LOC (Smith-Sebasto, 1995), so while this change may have been minimal, it is a desirable outcome of the program.

One interesting result was the comparison of how students who changed their answer to recognize an impact from their actions perceived the benefits they derive from water and electricity conservation. These students were less likely to recognize an economic benefit from conserving water and electricity and, in the case of water conservation, more likely to recognize *future use* as a benefit. If students who do not make the direct connection between the importance of conservation and their perceived direct benefits are less likely to habituate conservation behaviors, this result could mean students whose responses on this question were influenced by the program will be more likely to habituate these behaviors into their everyday lives. The part of the program that would have the most influence on students recognizing this impact would be the individual water use areas, such as the water calculator. The exhibit gives students an interactive and visual representation of water usage that in turn, allows them to conceptualize the amount of water they can save through their own actions. Retention tests and observation of actual behavior would lend credibility to this assertion.

6.7: Multivariate Regression

The return rate on the in home water audit was extremely low so it was determined that meaningful conclusions could not be drawn regarding what specific variables are most influential for actual behavior from such a small sample of returned audits. This lack of return rate could point to a variety of different conclusions. It is possible that the lack of return is a result of the program being ineffective at influencing students to actually engage in any kind of meaningful conservation behavior. It could also mean that students did not connect the water audit to a meaningful conservation behavior as it is more of a record of use rather than a specific behavior identified as having an impact by the students themselves. Based on feedback from teachers, it is also possible the attention span of an elementary school student had expired with regard to the subject of water conservation. While this may point to a lack of desire to engage in conservation, it does not necessarily mean that students are not performing the conservation actions they are aware of.

The results from the multivariate regression using self-reported behavior were not statistically significant, and demonstrate that none of the combinations of variables used are influential in determining self-reported behavior. The increases in environmental attitude and school the student attends did not show influence either. There are several way to interpret this result. The first would be the Drops and Watts program did not make sufficient connections between the variables in order to influence student behavior. Making direct connections between the variables observed was not enough to influence the self-reported behavior of students, so there must be some other factor that is preventing them from doing so. This result could lend credibility to the earlier assertion that the variables must not only be directly connected to one another, but must also be

directly linked to the individual, rather than a larger issue that may or may not have a direct connection to their everyday lives.

It could also be that the measure of self-reported behavior is not a strong enough indicator of actual behavior. There is always response bias present when you rely on subjects to answer truthfully and an observed behavior would be the most accurate indicator but was unfortunately unavailable. In light of the results of the regression analysis, the low response rate from the in home water audit may confirm that the program is not having a substantial influence on actual behavior.

Chapter 7 Chapter 7: Conclusion

7.1: Summary

Exposure to the Drops and Watts program increased student knowledge regarding the connection between water and electricity use which led to an increase in the conservation actions students were aware of. This influenced the kinds of benefits students recognized as a result of their behavior. Students gained a better understanding of the variety of effective behaviors they could perform and were also able to better recognize their individual ability to have an impact. The intention to perform specific behaviors did not increase among students who, before participating in the program, did not already intend to perform conservation actions, nor were students more likely to report they were performing all the actions they are aware of. In fact, the opposite was true, that students were more likely to report they were not performing these actions after participation.

Students appeared to become more sensitized to global resource availability issues and recognized these larger issues to be the most important with regard to conservation. The disconnect observed between the more localized impacts of their conservation actions and what they perceive to be the most important reasons to conserve creates a barrier to them performing and habituating these conservation actions in their everyday lives (Athman & Monroe, 2001; Fernandez-Juricic, 2000). Students recognized an economic benefit of their actions, which is a common motivator for performing conservation behavior (McKenzie-Mohr, Nemiroff, Beers, & Desmarais, 1995), but in this case, economic motivation was insufficient since it provides only an indirect benefit

to the students. Since there is not recognition of an immediate economic concern with regard to the overall issue of conservation and the students are not directly economically responsible for their resource consumption, this perceived benefit is not substantial enough to overcome barriers to conservation behavior, such as personal comfort.

Due to the lack of a retention test, the results observed in the post-participation survey are subject to change in the students; their answers may change over a period of months when the material is not as recent or emphasized in their lives. The results may not give a good indication of how frequently students should be exposed to the material for it to be retained effectively, but prior research has shown that repeated exposure over a long term period will be the most effective way of encouraging changes in conservation behavior (Marcus, 2012). Despite the limitations of the research, it does provide valuable information for both the specific program studied, and general educational programs with the goal of influencing behavior.

The results of this research do indicate that the program does have some level of influence over a number of variables that are thought to be influential to behavior. What they also demonstrate is the effect of the Drops and Watts program is not sufficient on its own to show a substantial change in actually performing behavior. While this result does not mean that these variables are not influential to behavior, it does indicate there are further barriers to influencing behavior in the observed population than just improving environmental attitude and making direct connections between the variables observed. Further testing would be able to shed some light on what barriers still exist, or how the WET Center might be able to improve the influence it has over these traits.

7.2: Conclusions for the Drops and Watts Program

One barrier to conservation behavior, as determined by this research, was the lack of connection between the overall importance of conservation and the direct benefits perceived by students preventing the habituation of behavior. The results demonstrate it is not enough for the benefits to be connected to the overall issue, but they must provide a direct benefit to the individual, rather than an altruistic benefit, if the behavior is to be successfully habituated. Using this as a starting point, the WET Center could modify the emphasis of the Drops and Watts program. Student perception of water scarcity as a global issue was reinforced through the program, though the direct benefit the students perceived to themselves was only realized at a later point in time. It was this benefit that appeared the most influential to the students' self-reported behavior. An attempt could be made to connect the issue of water scarcity with the everyday lives of the students by emphasizing how our water sources get replenished and the kinds of dangers facing this natural cycle, rather than emphasizing the lack of access to water in foreign countries or the overall percentage of potable water on the planet. This could shift the most commonly perceived benefits in the direction of *future use*. If there is not an immediate threat to the region as a result of water scarcity, presenting the overall importance of conservation could be modified to reflect more of an economic risk to the students themselves. The program mentions how demand will increase with population but supplies are dwindling due to climate change, which will create a larger economic burden in the future. If the program places an emphasis on the personal economic responsibility students will face in the future, this might be an effective way to encourage habituation of behavior, similar to the *future use* benefit.

With regard to the conservation actions students are aware of, the WET Center could make a targeted effort to identify the most effective and desirable actions and place primary emphasis on those. Also, since students become aware of a variety of actions that can indirectly affect consumption, such as food choices, an effort should be made to define the most effective actions within those broad categories. Students could be made aware of specific foods that are more water intense than others, how packaging of food affects the amount of water used to make it, and any other specifics regarding food choices that might be effective. Emphasizing that local and organic foods contain a smaller water footprint might be effective, but these types of foods are also restricted by other barriers that might prevent purchasing. In terms of embodied water costs associated with other manufactured goods, such as clothes, an emphasis on cradle to cradle use and reuse may help to identify other actions students can take that will lead to indirect conservation of resources, and could also reveal an economic benefit of their own.

The green building portion of the tour, while not directly emphasizing conservation actions, does plant the seeds for future action by students. Students did gain an understanding and interest in green building and recycled products that can serve to influence their behaviors later in life when they are making decisions regarding what kind of built environment they want to live and work in. Identifying students that have developed an interest in green building and recycled materials as a result of participation and offering them volunteer positions could prove useful. These students could share their experiences with future participants and hopefully cultivate what could be a long term interest in conservation strategies and pro-environmental behavior.

The potential to use the data gathered in this study to provide a template for future evaluations also exists. While the time and money required to continually administer and evaluate open ended surveys may not exist for the WET Center, the results could be used to create a general template for a more closed response survey that would specifically benefit the Drops and Watts program. Using the kinds of benefits, behaviors, and impacts identified by students to create a short form survey using multiple choice, Likert type, or other responses could prove useful in studying how any modifications made to the program affect its influence on these variables. These kinds of evaluations could be an ongoing part of the WET Center's efforts and the potential exists for a long-term study to be conducted to better evaluate the continued effects of participation.

7.3: Generalized Conclusions

The results of this study indicate an expanded knowledge of the issues surrounding conservation appears to be a precursor for the formation and reinforcement of the benefits, skills, and impacts perceived by individuals. Attitude change is related to the level of knowledge possessed about an issue and the expectation of success must also be connected to this knowledge for effective behaviors to be carried out.

In-depth knowledge also allows students to recognize more benefits as a result of their actions and leads to an increased recognition of the impacts their actions can have. Increasing knowledge also allows students to recognize a wider variety of actions that are more efficient at accomplishing the desired conservation objectives. These results indicate that knowledge will not lead to behavior change on its own, but can positively influence other variables that do lead directly to behavior. These other variables should

be related back to the individual's knowledge to allow them to habituate the desired behavior (Athman & Monroe, 2001; Fernandez-Juricic, 2000).

Simply recognizing a benefit from actions is not sufficient to successfully encourage behavior, the benefit must also be directly attributed to the individual. An altruistic benefit appears to be enough for the students to want to perform actions, or recognize they should be, but it is not enough for students to remember to consistently perform them. Since habituation of these actions is imperative in the case of everyday conservation behaviors EFB (Marcus, 2012; Zint, Kraemer, Northway, & Lim, 2002), any program attempting to encourage similar behaviors should strive to make the connections which encourage habituation.

7.4: Future Research

To determine the effectiveness of conservation based EE programs at promoting water conservation in middle school students, long term studies are needed. The data provided by this study and past research can help to inform future evaluations as to what kinds of behaviors and benefits should be targeted by these programs. The data can also help to pinpoint where connections between benefits perceived, overall importance of issues, and impacts of actions are lacking in order to help fully understand how to strengthen these connections.

Future research should focus on long term effects of exposure to programs, as well as track how repeated exposure might influence the variables influential to EFB. It will also be important to incorporate opportunities to observe actual conservation behavior in students to make direct connections as to how these variables act in relation

to one another and which are the most influential for specified behaviors. Since the present results indicate that the level of influence observed, and the connections made were not influential to performing actual behavior, it would be worthwhile to see if repeated exposure to conservation education programs is able to reinforce these variables. It might be that exposure to the material is not sufficient in the short term but a continued reinforcement may be able to encourage behavior more successfully.

Comparative studies should be undertaken to determine how generalizable the conclusions of this research are. Do middle school students in different parts of the United States reflect similar recognition of environmental issues, the benefits perceived, and the impacts of their actions? It would stand to reason that the results of the same survey, given to middle school students in a drought stricken region, might have completely different results. It can be theorized that those students would be far less likely to view economics as the primary benefit gained from conservation, and more likely to view future use as the main benefit. A program such as Drops and Watts may be much more effective at influencing behavior in that situation as there may not be a disconnect between the large, global issue, and the direct benefit perceived by students. This highlights the importance of studies that are specific to the program and region in which they take place. By conducting further evaluations of more diverse areas and populations, a common theme might be revealed that could apply to conservation behavior on a larger scale. Comparative studies would also be useful in determining if the level of influence the WET Center has over the observed variables is more or less than the influence of other programs. Since it was determined that exposure to the Drops and Watts program was alone not enough to encourage behavioral change, comparing it

to more or less successful programs would be useful in determining if these variables should even be the focus of education, or if there are more effective ways education can attempt to influence behavior.

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Appendix I – Survey

Pre-Participation Survey

1 / 3 33%

1. Name/Teacher

Name

Teacher

2. Rate your agreement with the following statements.

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Plants and animals have as much right to live as people							
There are too many, or almost too many, people on earth							
People are clever enough to keep from ruining the earth							
Humans must live within nature's limits							
When people mess with nature, it has bad results							
Nature is strong enough to handle the bad effects of our modern lifestyle							
People are supposed to rule over the rest of nature							
People are treating the earth badly							
People will someday know enough about nature to control it							
If things don't change, we have a big disaster in the environment soon							

Next

2 / 3 67%

3. Is conserving water important? Why or why not?

4. Does your electricity use affect water use? Why or Why Not?

5. Do you benefit from conserving water? Why or why not?

6. Do you benefit from conserving electricity? Why or why not?

7. Are there actions you can personally take to use less water? List any you can think of.

8. From question 7 above, list any actions you plan to perform regulary.

Prev Next

3 / 3 100%

9. Are there actions you can personally take to conserve electricity? List any you can think of.

10. From question 9 above, list any actions you plan to regularly perform

11. Are you performing all the water and electricity saving activities you are aware of? If not, what is preventing you from doing so?

12. Will your actions to conserve water and electricity have an impact? Why or why not?

Prev Done

Post-Participation Survey

1. Name/Teacher

Name

Teacher

2. Rate your agreement with the following statements.

	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Plants and animals have as much right to live as people							
There are too many, or almost too many, people on earth							
People are clever enough to keep from ruining the earth							
Humans must live within nature's limits							
When people mess with nature, it has bad results							
Nature is strong enough to handle the bad effects of our modern lifestyle							
People are supposed to rule over the rest of nature							
People are treating the earth badly							
People will someday know enough about nature to control it							
If things don't change, we have a big disaster in the environment soon							

Next

2 / 4 50%

3. Is conserving water important? Why or why not?

4. Does your electricity use affect water use? Why or Why Not?

5. Do you benefit from conserving water? Why or why not?

6. Do you benefit from conserving electricity? Why or why not?

7. Are there actions you can personally take to use less water? List any you can think of.

8. From Question 7 above, list any actions you plan to perform regulary.

Prev Next

9. Are there actions you can personally take to conserve electricity? List any you can think of.

10. From question 9 above, list any actions you plan to regularly perform

11. Are you performing all the water and electricity saving activities you are aware of? If not, what is preventing you from doing so?

12. Will your actions to conserve water and electricity have an impact? Why or why not?

Prev Next

4 / 4 100%

13. What is the most important thing you learned at the WET Science Center?

14. What was the best part of your visit to the WET Science Center?

15. What was the best exhibit at the WET Center?

16. What do you wish you learned more about at the WET Center?

17. Now that you have been on a trip to the WET Science Center, what do you want to know more about or get involved with?

Prev Done

Appendix II – Code Tables

Table 1: Codes for question: Is conserving water important?

Yes	No	I don't know	Did not answer
Survival	Gets Recycled*		
Scarcity	Plenty Available		
Less need for treatment**	Technology*		
Future Use			
Ecosystem Impacts			
Economic Benefit			
Conserving Energy			

Table 2: Codes for question: Does your electricity use affect water use?

Yes	No	I don't know	Did not answer
Cleaning and Treatment of water	No connection		
Generation			
Transportation of Water			
Water Heating			

* - Indicates code only appeared on pre-participation survey
** - Indicates code only appeared on post-participation survey

Table 3: Codes for question: Do you benefit from conserving water?

Yes	**No**	**I don't know**	**Did not answer**
Conserving Energy	Future Generations*		
Economic	Plenty Available*		
Ecosystem	Makes No Difference**		
Future use			
Health Benefits			
More Available to Others			

Table 4: Codes for question: Do you benefit from conserving electricity?

Yes	**No**	**I don't know**	**Did not answer**
Conserving Water**	Nobody Else Is**		
Economic	Still Using Electricity**		
Ecosystem	Unlimited Supply		
Future Use			
Health Benefits			

* - Indicates code only appeared on pre-participation survey
** - Indicates code only appeared on post-participation survey

Table 5: Codes for question: Are you performing all the water and electricity saving actions you are aware of?

Yes	**No**	**I don't know**	**Did not answer**
	Too Young*		
	Time		
	Just Learned About Them**		
	I Don't Care		
	Forget		
	Family Doesn't		
	Comfort		

Table 6: Codes for question: Will your actions to conserve water and electricity have an impact?

Yes	**No**	**I don't know**	**Did not answer**
Survival*			
More Available			
Influence Others			
Ecosystem			
Economic			

* - Indicates code only appeared on pre-participation survey
** - Indicates code only appeared on post-participation survey