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Exploring The Effects of a STEM Integrated Program Experience on Girl Scouts' Pro-environmental Intentions

Miranda E. Furrer
Purdue University

EXPLORING THE EFFECTS OF A STEM INTEGRATED PROGRAM EXPERIENCE ON GIRL SCOUTS' PRO-ENVIRONMENTAL INTENTIONS

by

Miranda E. Furrer

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THE PURDUE UNIVERSITY GRADUATE SCHOOL
STATEMENT OF COMMITTEE APPROVAL

Dr. Hui-Hui Wang, Co-Chair

Department of Agricultural Sciences Education and Communication

Dr. Neil Knobloch, Co-Chair

Department of Agricultural Sciences Education and Communication

Dr. Bryan Pijanowski

Department of Forestry and Natural Resources

Approved by:

Dr. Mark Russell

Head of the Graduate Program

Dad- this is for you. Thank you for sharing your love of nature with me. None of this would have been possible without you.

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ABSTRACT

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Youth have a natural curiosity about the world around them. However, even with this curiosity and the known benefits to spending time outdoors, many youth do not spend much time outdoors; they spend a majority of their time indoors. Through programming relating to a real-world problem, such as science, technology, engineering, and mathematics (STEM) integrated programming, youth can begin develop an appreciation for the world around them by learning and by having an interest in spending more time outdoors. By spending more time in the outdoors, youth may develop a stronger connection to their environment, which is important in this time of increasing global challenges and a disconnect with the natural environment.

The purpose of this study was to explore and describe the effects of a STEM integrated non-formal program, with an outdoor experience, on Girl Scouts' pro-environmental intentions. This study took place over six weeks in the fall of 2017 with two groups, control and treatment, with 25 total participants (14 control, 11 treatment). The control group completed their program entirely indoors, while the treatment group had a portion of outdoor exploration time each week along with their indoor lesson. The researcher looked to compare differences in interest, engagement (affective, behavioral, and cognitive), and intentions to participate in pro-environmental behaviors between the control and treatment group. Girl Scout participants completed a three point Likert scale pre- and post- program questionnaire, which was developed through examination of literature relating to environmental education, engagement, and interest.

Girls from both groups were interviewed following completion of the program to learn more about their experiences with the program and what motivated them to have intentions to participate in pro-environmental behaviors.

There were four conclusions to this study. First, Girl Scout participants, both control and treatment groups, described being more interested in nature and the outdoors after participating in this STEM integrated program. Second, Girl Scout participants in both the control and treatment group for the STEM integrated program were cognitively engaged and the girls in the treatment group with the outdoor experience were behaviorally engaged when compared to their peers that had their program entirely indoors. Third, Girl Scout participants in both the control and treatment groups described similarly positive views toward their intentions to participate in pro-environmental behaviors. Lastly, Girl Scout participants in both groups shared positive experiences during the STEM integrated program, and described the parts of the program that motivated them to participate in outdoor activities and pro-environmental behaviors.

The results of this study indicate that STEM integrated programming may be a link between youth and interest in the outdoors. Regardless of whether Girl Scout participants spent time outdoors during their program, all participants were interested in the outdoors and had intentions to participate in pro-environmental behaviors. Future research might focus on providing a more in-depth program experience, specifically regarding the length of the program and the amount of time youth were outdoors. Continuing to examine the interactions between STEM and environmental education would be an area of investigation following this exploratory study.

CHAPTER 1 INTRODUCTION

1.1 Introduction

Youth have a natural curiosity about the world around them (Parsons, 2011). There is a large amount of information about the benefits of spending time outdoors, both physically and mentally. Research has shown that being out in nature can lead to an increase in well-being, physical health, and relaxation (Weinstein, Przybylski, & Ryan, 2009). It can also lead to a decrease in stress (Weinstein et al., 2009). However, even with these benefits, many youth do not spend much time outdoors; they spend a majority of their time indoors, on the internet, playing video games, or watching TV (Wells & Lekies, 2006; The Nature Conservancy, 2011). Through programming, such as science, technology, engineering, and mathematics (STEM) related programming, youth can begin develop an appreciation for the world around them by learning and by spending more time outdoors. By spending more time in the outdoors, youth can develop a stronger connection to their environment (Weinstein et al., 2009).

There is a need for more STEM education (Fraser, Gupta, Flinner, Rank, & Ardalan, 2013). Large companies have a concern about the growing shortage of qualified STEM workers nationwide (Fraser et al., 2013). STEM jobs are often largely integrated with one another, meaning that multiple disciplines are utilized in each position. However, the mainstream school system tends to keep the areas of the STEM disciplines separate (Glancy & Moore, 2013). There has been a shift to begin looking at problems in a holistic way, through integration of the STEM disciplines (Glancy & Moore, 2013). STEM integration, learning that incorporates all areas of STEM, presents an exciting way for youth to get involved with the world around them.

There are many benefits to teaching in an integrated way. Some of these benefits include learner-centered teaching methods, increase in higher-level thinking skills, increase in problem solving skills, and a greater retention of knowledge (Stohlmann, Moore, & Roehrig, 2012). Through integration, students can become engaged in real-world problems that relate to their lives, strengthening the impact of programming (Sanford, 2012). Integrated teaching is not just for the formal classroom. It can be utilized in a non-formal or informal setting as well, such as with the Girl Scouts. Non-formal learning can be defined as education that is not formal, but does have organization of some type (Smith, 1974). Informal learning takes place in an unstructured setting and can be taught by anyone with more experience than the learner, such as parent or babysitter (Smith, 1974). Through a STEM integrated program that incorporates hands-on activities, youth can learn about STEM and the ways that STEM and environmental education are connected to real-world problems around them, such as the recent decline in pollinators (Clark & Ernst, 2007; Gallai, Salles, Settele, & Vaissiere, 2009).

Girl Scouts of the USA is an international youth program that focuses on developing courageous, confident girls who can make the world a better place (Girl Scouts, 2016). Through their 105-year history, the Girl Scouts aim to help girls develop into leaders through enriching experiences such as community service projects, field trips, and environmental stewardship experiences. Girls learn to work with their troops and establish friendships, have fun, and be good stewards of their community. The Girl Scouts have recognized the importance of getting youth outdoors and in 2015, partnered with the National Park Service to launch the “Girl Scouts Ranger Program” (Girl Scouts, 2016). Through this partnership, girls have the opportunity to have their own unique experiences in nature while exploring and earning badges and patches along the way. By valuing experiences taking place in nature, the Girl Scouts have made it a priority for their members to get outdoors while learning about the world around them. Troop leaders look for new experiences for their girls, and in 2012, the Girl Scouts added STEM resources to their line-up (Elkin, 2012). Pairing STEM activities with the interest of girls in nature and the outdoors is an ideal way to enhance the Girl Scout troop experience. It was posited that Girl Scouts that attend an afterschool program integrating STEM concepts and an outdoor experience will have an increased interest in nature and intentions to participate in pro-environmental behaviors.

1.2 Statement of the Problem

The goal of environmental education, per a 1977 Intergovernmental Conference on Environmental Education, is to ‘aid citizens in becoming environmentally knowledgeable, and, above all, skilled and dedicated citizens who are willing to work, individually and collectively, toward maintaining a dynamic equilibrium between quality of life and quality of the environment’ (Hungerford, Peyton, & Wilke, 1980, p. 44). In order to work towards this goal, people must develop a connection to their environment. Youth can gain an attachment and meaning of places they visit often through exploration of their environment (Kriesberg, 1999). There are many ways to teach environmental education, but one way to make connections clearer between real-world problems and youth may be through the introduction of STEM integration along with exploration of their environment. Utilizing STEM integrated activities to foster a connection between students and their environment may be a way to increase their intentions to participate in pro-environmental behaviors that include planting a pollinator garden or building a bee nest, which is ultimately the goal of environmental education (Walker & Chapman, 2003).

By utilizing a program design where youth spend time, both indoors and outdoors, may help them to see the connections between the design-based STEM activities and the real-world. Making connections to their environment is a way to encourage them to protect it, and a way for youth to make connections is to have experiences that relate to a real-world problem (Wells & Lekies, 2006). However, there is limited research on the connections between STEM and environmental education, and there is even more limited research on utilizing STEM integration as a method for increasing students' intentions to participate in pro-environmental behaviors that contribute to environmental conservation (Kurisu, 2015). Students who participate in a non-formal STEM program that focuses on design challenges relating to the real-world problem of pollinator decline could be motivated to exhibit pro-environmental behaviors. The addition of an outdoor experience with the program could increase the effect of the program on students, with there being supporting research for the positive effects of spending time outdoors on youth.

1.3 Significance of the Study

This study builds on the current environmental education and STEM education literature and is significant for the following five reasons.

This study attempts to: 1) enhance programming used in environmental education by incorporating STEM concepts, 2) help educators understand how to better prepare curriculum to encourage student learning of natural resource topics, 3) clearly show the connections between STEM education and environmental education by using a curriculum that is STEM integrated with focus on natural resource topics that relate to students' everyday lives, 4) this study may encourage girls to become more involved with STEM education, and 5) explore ways to educate youth about some of the issues facing a growing world.

First, this study can enhance programming currently used in environmental education. As with any method, it should be updated to fit the needs of the participants, in this case, elementary-aged Girl Scouts. The knowledge gained from this study through observations and discussion with youth could provide environmental educators with a better idea of how to strengthen current curriculum and create new programs. This study will implore educators, including the researcher, to reflect on practices and evaluate curriculum currently being used to determine its' effectiveness.

Second, observations made during this 6-week STEM integrated program may provide educators with new and improved methods for interactive, hands-on programming to encourage students to get enthused about natural resources and the environment. The lesson plans in this program all incorporate a design portion and encourage youth to work together to use the engineering design process, which involves asking a question, designing a solution, testing that solution, and redesigning the solution to improve it (Cunningham, 2009). Activities that include an engineering design challenge are hands-on in nature and require youth to work as a team to design something based on a given challenge, such as design a 'perfect flower' or pollinator garden with specific parameters. In a study conducted by Waliczek and Zajicek (1999), hands-on gardening was shown to increase students' pro-environmental attitudes. Environmental education learning is best done in the environment where students interact on a regular basis, such as in a local park, in the woods, or in their own backyards. For youth, the outdoors can serve as a familiar and comfortable location for activities to take place (Ewert, Place, & Sibthorp, 2005)

Third, this study may help to make the connections between STEM education and environmental education clearer. Many of the ideas and activities that are associated with environmental education have STEM components, but it may not be directly called STEM. For example, doing a pond study may require the use of a microscope for students to see organisms would be a STEM activity. The connections between STEM and environmental education would be easier to see and would become integrated by taking a lesson one step further and adding a mathematics problem like counting the number of organisms in a certain area and calculating the approximate number of organisms in the whole pond. The way in which educators teach can make the connections between the STEM and environmental education clearer (Tawfik, Trueman, & Lorz, 2014). By teaching students' relevant topics that relate to real-world problems, such as the importance of pollinators, they will be able to see how environmental and STEM education relate to one another.

Fourth, this study may help girls become involved in STEM education. Girls are underrepresented in STEM careers such as engineering and computer science, and there is a need to get more girls as well as a more diverse population, including minorities, involved in all STEM areas (Shapiro & Williams, 2012; National Science Board, 2016). Organizations such as The National Girls Collaborative Project, the American Association of University Women (AAUW), and Girl Scouts are all working to bring STEM opportunities to women and girls across the country (Masten, 2015). The Girl Scouts value STEM education and offer programs to support STEM education within troops (Elkin, 2012). A few of the new STEM challenges that have been offered through the Girl Scouts include: Engineering: Think Like an Engineer, Computer Science: Think Like a Programmer, and Outdoor STEM: Think Like a Citizen Scientist (Girl Scouts, 2016). With the focus already being on STEM-related activities, this program can be another way for troops to continue their STEM education relating to a real-world problem such as pollinator decline.

Lastly, this study may help youth become more engaged with pro-environmental intentions, through education. The global population is rising, and is expected to reach more than nine billion by 2050 (United Nations, 2015). This presents many challenges, especially when coupled with the effects of climate change. Some of these challenges include having enough food supply, clean water, energy supply, and pollinator decline (Global Challenges Foundation, 2017; Gallai et al., 2009). Pollinator decline, the focus of the STEM integrated curriculum in this study, is important because one out of every three bites of food taken is due to a pollinator such as bees (Pollinator Partnership, 2018b). Youth have the ability to make a difference in their community to help local pollinators by doing things such as plant gardens, installing pollinator nests, and simply leaving pollinators alone (Pollinator Partnership, 2018b). By engaging youth in discussions about the environment, they can have a better understanding of the challenges facing our world and could become inspired to participate in simple pro-environmental behaviors that could impact their future and the future of others.

1.4 Purpose of the Study

The purpose of this study was to explore and describe the effects of a STEM integrated non-formal program, with an outdoor experience, on Girl Scouts' pro-environmental intentions.

1.5 Research Questions

The following research questions, which were informed by the conceptual and theoretical frameworks, guided the study:

1. What were students':
    a. Prior experiences regarding nature and the outdoors?
    b. Interest level in youth activities prior to participating in the program?
    c. Interest level in outdoor activities prior to participating in the program?
2. To what extent did students in the control and treatment group:
    a. Engage affectively with their environment while participating in this 6-week STEM integrated pollinator program?
    b. Engage cognitively while participating in this 6-week STEM integrated program?
    c. Engage behaviorally in program activities while participating in this 6-week STEM integrated program?
    d. Indicate interest in participating in youth and outdoor activities following the program?
3. To what extent did students in the treatment group have intentions to participate in pro-environmental behaviors after attending this 6-week STEM integrated pollinator program with an outdoor experience, when compared to the control group without an outdoor experience?
4. What experiences in this 6-week STEM integrated pollinator program motivated students, in both the treatment and control groups, to have a greater interest in nature and the outdoors?

1.6 Limitations of the Study

The following are the limitations of this study:

1. This study did not include a random sample. It was a convenience sample. This can add to sampling bias (Shadish, Cook, & Campbell, 2002) and is not generalizable to all students in grades 4-6 due to the program taking place at only three Girl Scout troops in Lafayette, Indiana.
2. This study had a quasi-experimental design, with a limited number of participants (small sample size). There was limited statistical power, and there may not have been a normal distribution for key variables.
3. The researcher determined the order for interview questions and which participants were interviewed. This may lead to researcher bias (Mays & Pope, 1995).
4. Students in grades 4-6 have limited attention spans, which can limit their focus on tasks such as completion of a questionnaire or answering questions in an interview setting. If a questionnaire or interview takes too long, the students can lose focus and may get off-topic and could lose clarity on what the researcher is asking them to do. It is thought that elementary aged students have an attention span of approximately 10-15 minutes, but there has been limited research to back this claim (Wilson & Korn, 2007).
5. The primary researcher helped develop the lesson plans used in this study, and therefore may have influenced outcomes of the study (Shields, 2010).
6. Youth that were a part of the treatment group had a small exposure to the outdoors, which limits the ability to make clear connections between time spent outdoors and intentions to participate in pro-environmental behaviors.

1.7 Basic Assumptions

The following assumptions were determined by the researcher:

1. The researcher used a post-positivist paradigm. The researcher assumed that the absolute truth cannot be found and that evidence in research is imperfect (Creswell, 2003).
2. The researcher used a deductive approach to support the testing of a developed theory (Trochim, 2001).
3. Youth answered questionnaire and interview questions honestly.
4. Youth had an interest in nature and the outdoors.
5. Youth had a basic understanding of science (Shields, 2010).
6. Youth had a basic knowledge of the places around them (parks, schools, libraries, home).
7. Data were collected objectively so that researcher bias was minimized.
8. The educator implemented the lesson plans as planned.
9. The prepared lesson plans were grade-level appropriate.

1.8 Definition of Terms

Behavioral engagement: effort youth put forth to participate and persist with activities (Davis, Summers, & Miller, 2012)

Biophilia: the urge to affiliate with other forms of life (Louv, 2005)

Cognitive engagement: Completion of tasks and student monitoring of their own learning habits (Davis et al., 2012)

Critical thinking: learning and thought that goes beyond memorization of information and facts (Abbott, 2014)

Emotional (affective) engagement: student's positive emotions related to nature-based activities (Davis et al., 2012)

Engagement: the degree which students show attention, passion, curiosity, interest, and optimism when they are learning or being taught (Hidden curriculum, 2014)

Environmental education: Education that allows individuals to explore issues within the environment, participate in activities to solve problems, and act to make a difference with the environment (EPA.gov)

Free-choice learning: learning that occurs when individuals choose to seek out information, and control their learning experiences (Falk, 2005)

Informal education: learning acquired by interaction with the environment, in an unorganized fashion (Smith, 1974). An example could be an individual visiting a zoo and making observations of an animal/exhibit.

Interest: the psychological state of engagement or the predisposition to reengage with specific content (Hidi & Renninger, 2006)

Motivation: desire or want that energizes and directs goal-oriented behavior (Huitt, 2011)

*Non-formal education***:** education that is not formal but is organized with some purposes and a clientele in mind (Smith, 1974). An example of non-formal education would be an after-school program that has a semi-structured learning environment.

Outdoor experience: in this study, outdoor experience was defined as an experience had in the outdoors by participants that includes observations and an awareness of the surrounding environment

Pollinator: an animal that moves pollen from a male flower to a female flower, to assist in fertilization ovules in the flower (Pollinator Partnership, 2018a)

*Pro-environmental behavior***:** any type of behavior that aims to minimize any negative impact of an individual's actions on the natural and designed world (Jensen, 2002)

Sense of place: the meaning or attachment associated with a place by an individual or group (Jorgensen & Stedman, 2001)

STEM: science, technology, engineering, and mathematics.

STEM education: interdisciplinary approach to learning where rigorous academic concepts are coupled with real-world lessons as students apply science, technology, engineering, and mathematics in contexts that make connections between school, community, work, and the global enterprise enabling the development of STEM literacy and with it the ability to compete in the new economy (Gerlach, 2012)

STEM integration: a form of STEM education that helps students to see the interactions between the different disciplines and how they can be applied to meaningful, real-world problems (Vasquez, Sneider, & Comer, 2013)

CHAPTER 2 LITERATURE REVIEW

2.1 Purpose of Study

The purpose of this study was to explore and describe the effects of a STEM integrated non-formal program, with an outdoor experience, on Girl Scouts' pro-environmental intentions.

2.2 Research Questions for the Study

The following research questions, which were informed by the conceptual and theoretical frameworks, guided the study:

1. What were students':
    a. Prior experiences regarding nature and the outdoors?
    b. Interest level in youth activities prior to participating in the program?
    c. Interest level in outdoor activities prior to participating in the program?
2. To what extent did students in the control and treatment group:
    a. Engage affectively with their environment while participating in this 6-week STEM integrated pollinator program?
    b. Engage cognitively while participating in this 6-week STEM integrated program?
    c. Engage behaviorally in program activities while participating in this 6-week STEM integrated program?

d. Indicate interest in participating in youth and outdoor activities following the program?

3. To what extent did students in the treatment group have intentions to participate in pro-environmental behaviors after attending this 6-week STEM integrated pollinator program with an outdoor experience, when compared to the control group without an outdoor experience?
4. What experiences in this 6-week STEM integrated pollinator program motivated students, in both the treatment and control groups, to have a greater interest in nature and the outdoors?

2.3 Environmental Education Literature

There has been a large amount of research done in the realm of environmental education over the last 50 years on varying topics such as environmental behaviors, environmental literacy, and student beliefs about the environment. In 1969, William Stapp wrote what is regarded as a seminal article in the *Journal of Environmental Education* that discussed the concept of environmental education. Stapp posited that the direction of environmental education should aim to be inclusive to those living in urban areas as well as rural. In order to do this, he proposed a new definition of environmental education. "Environmental education is aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (Stapp, 1969, p. 31). Environmental education aims to change citizen behavior through environmental awareness, personal investment in the environment, and empowerment/intention to act (Hungerford & Volk, 1990). According to the North American Association for Environmental Education, the field of environmental education targets sustainability and showing how nature and people can co-exist (NAAEE, n.d). While much of the environmental education done today focuses on youth, environmental education does exist for learners of all ages (NAAEE, n.d.).

A study looking at if climate change can enhance biology lessons uses a similar research design to the current study (Monroe, Hall, & Li, 2016). The researchers in this study had two groups (secondary students aged 14-18). One served as the control group (lessons did not mention climate change) and the second group served as the treatment group (climate change was mentioned). The researchers utilized a mixed methods approach with a pre- and post- test and employed semi-structured interviews (Monroe et al., 2016). The study found that when climate change was mentioned in lessons, the students had a better understanding of the carbon cycle and carbon sequestration. This connection to a real-world problem made the lessons more relatable for the students and through the student interviews, making the connection between the carbon cycle and climate change throughout the lessons was of value (Monroe et al., 2016). This study shows the importance of students making a connection to the material being learned. Another study, conducted by Fröhlich, Sellmann, and Bogner (2013), examined the influence of situational emotions on students' pro-environmental intentions through an educational intervention. The participants in this study were fifth graders in Bavaria that participated in a 'From Farm to Fork' program with the inclusion of hands-on experiments to educate youth about sustainability. The study employed a quasi-experimental research design and utilized pre-test, post-test, and retention tests to measure consumerism, emotions, interest, well-being, boredom, and knowledge. The study found that the length of the program was likely too short to motivate students to turn their pro-environmental intentions into behaviors, but that interest was a very important factor for learning and motivation (Fröhlich et al., 2013). Around the age of 11 is when youth begin to understand their impact on the environment, making this age the ideal time to involve youth in programming relating to environmental sustainability. The researchers proposed that it is important to look at situational emotions, which can influence affective factors like attitudes and intentions, following an intervention such as the one in this program (Fröhlich et al., 2013). The researchers believe that a well-designed educational program can have an impact on youths' interest in participating in pro-environmental behaviors.

Along with having classroom experiences, youth must be exposed to the outdoors if they are to protect it. Several studies have shown that having nature experiences as a child can lead to participation in pro-environmental behaviors as an adult. One study in particular looked at the connections between involvement with the natural environment as a child and adult environmentalism (Wells & Lekies, 2006). This study used a phone survey method to collect data from adults living in large metropolitan areas. The independent variables included childhood participation with nature, participation in environmental education, and nature experiences with other people (Wells & Lekies, 2006). The two dependent variables were environmental attitudes and environmental behavior. The study showed that participating in activities relating to 'wild nature' during childhood such as hiking, camping, fishing or hunting, had a positive association with environmental attitudes and behaviors during adulthood (Wells & Lekies, 2006). Findings from this study indicate that when youth engage with the natural environment, it is likely to have a profound impact on their views and actions regarding the environment. Another study done by Dettmann-Easler and Pease (1999) to evaluate the effectiveness of environmental education programs in fostering positive attitudes toward wildlife indicate similar results, in that students experience higher positive attitudes when out in the environment as opposed to only learning in the classroom. The studies by Wells and Lekies (2006) and Dettmann-Easler and Pease (1999) support the need for outdoor education incorporated with programs, such as the STEM integrated program in the current study. Outdoor experiences are a vital part of getting youth engaged with the world around them. An experience in a complete 'natural' area outside of an urban setting is preferred, but not always possible. In this study, an outdoor experience is defined as a time of exploration for youth, in an urban setting. Outdoor experience and education focuses on the role of nature, adventure, risk, social and interpersonal relationships, and development of skills (Potter & Dyment, 2016). Along with the potential for enjoyment, there are many benefits to spending time outdoors, and one of these benefits includes developing a stronger connection to the environment (Weinstein et al., 2009). Spending time outdoors has also been linked to a decrease in stress levels, and increases in relaxation and well-being (Weinsten et al., 2009). With benefits of having outdoor experiences, the largest may be the development of a positive view towards the environment, leading to participation in pro-environmental behaviors (Hanna, 1995).

However, not all environmental education programs can incorporate an outdoor experience. This is where urban environmental education becomes critical. Urban environmental education is a growing area of interest in the field of environmental education. In 2010, the U.S. Census showed that 80.7% of the U.S. population live in an urban environment (U.S. Census Bureau, 2015). Urban environmental education can include three aspects, the 'natural' environment, the 'social/political' environment, and the 'built' environment which would be engineering (Howard, 1980). An urban environment includes all of these things, and youth should be exposed to the interactions between them to better understand them. Youth may not be aware of all the ways these environments interact, and it is up to the educator to help them understand that the environment encompasses more than just the natural world that is typically thought of when discussing environmental education topics. Urban environmental education often combines disciplines when taught. For example, community/youth garden programs taught students in Brooklyn about gardening and science while also helping youth work as a team and develop their public speaking skills (Kudryavtsev, 2013). These experiences in an urban setting can also have equally as large of an impact on youth participants (Wals, 1994). In a study conducted by Wals (1994), the researcher took the role of observer, interpreter, and participant in a phenomenological qualitative study that took place over three years in Detroit. Students participating in the study watched nature shows during class and took walks to a local park. The researcher observed students' reactions to a spider in the classroom, litter, and the nature show. The observations were recorded in a research journal, along with written reflections and ideas the students had. When students would walk, they would discuss their likes and dislikes about the community with their fellow peers, and decided on a project or issue they would investigate through the course of the study. Additional data were collected through in-depth interviews. The results from this study indicate that even students in an urban setting can develop a connection to nature. Students thought of nature as a place that could be used to have fun and is interesting. Wals (1994) discussed the importance of introducing experiences in nature for teaching students about environmental issues, and helping students to make connections between themselves and the real world.

Overall, there has been some research done in the area of environmental education relating to interaction between the outdoors and participating in pro-environmental behaviors. With the benefits associated with spending time outdoors, it may be the missing link to get more individuals, starting with youth, to participate more in pro-environmental behaviors. While it would be ideal to provide all youth with an immersive experience in nature, that is not possible due to transportation, timing, and monetary issues. However, even in an urban setting, youth may be able to develop a connection to their environment and want to participate in pro-environmental behaviors. Environmental education focuses on getting people involved and engaged with their environment so that they are empowered to make a change.

2.4 Theoretical Framework- Four-Phase Model of Interest Development

Hidi and Renninger's (2006) Four-Phase Model of Interest Development was used to frame the study. The model looks at four phases of interest development in learners which include triggered situational interest, maintained situational interest, emerging individual interest, and well-developed individual interest. Interest is defined here the psychological state of engagement or inclination to reengage with content which includes classes of objects, events, or ideas (Hidi & Renninger, 2006). Educators struggle to keep students interested in learning, but may not realize that they have the ability to influence development of interest. Each phase of the model has differing amounts of affect, knowledge, and value (Hidi & Renninger, 2006). The phases are thought to develop in the listed sequence, and can progress over time. Research on educational methods have traditionally focused on both situational and individual interest, both of which are always motivating for learners.

The four phases of interest development can be described as follows:

1. **Triggered situational interest** can be sparked by the environment or text that contains new or surprising information. Typically this type of interest is externally supported and learning environments that contain group work, puzzles, and other hands-on activities have been found to trigger situational interest in youth.
2. **Maintained situational interest** is held and sustained through tasks that have meaning and involvement on a personal level. This level of interest is also usually externally supported through project-based learning and group work.
3. **Emerging individual interest** is where an individual seeks reengagement with content over a period of time, and includes having positive feelings, stored knowledge, and stored value. Usually self-generated, this type of interest does need support from peers that can encourage each other when things become challenging. Emerging individual interest may or may not result in a well-developed individual interest.
4. **Well-developed individual interest** is when an individual looks to reengage with the content more often than other activities and has positive feelings about the experience. Typically self-generated, an individual can still benefit from peer support, which can contribute to knowledge learned.

In this study, the researchers aimed to reach level three in the four-phase model of interest development, emerging individual interest. There was limited time spent with youth participating in the STEM integrated program, which limited the ability to achieve and observe a well-developed individual interest level. With emerging individual interest, youth could be motivated to pursue an interest or activity on their own, which in this case is the intention to participate in pro-environmental behaviors. Along with the four-phase model of interest, the psychological needs associated with interest are an important factor when discussing motivation of youth. These needs, introduced by Deci and Ryan (2000), include competence, autonomy, and relatedness. It is thought that by having relatedness, competence, and autonomy, individuals will be motivated to have a higher level of engagement (Skinner, Chi, & The Learning-Gardens Educational Assessment Group, 2012). Autonomy refers to an individual's volition, their will to do something. Competence refers to feelings of being able to do something, while relatedness makes the need for interactions clear (Skinner et al., 2012).

The motivation that will be examined in this study will be broken down from the larger idea of engagement, through learning in a hands-on context. Skinner et al. (2012) looked at the self-determination theory and determined that engagement was an important addition to the original theory. Engagement through integrated, project-based, and hands-on learning, can be divided further into behavioral engagement, affective engagement, and cognitive engagement (Fredricks, Blumenfeld, & Paris, 2004). Behavioral engagement is defined as behaviors that the students participate in before, during, and after the program. This can include active participation in program activities and respect for nature and others. Affective, or emotional, engagement includes reactions such as excitement, boredom, and interest. Cognitive engagement is when the student is striving for more knowledge, and likes to face a challenge. The activities in the STEM curriculum presented in this program will build upon prior knowledge and will challenge students to interpret their experiences in a different way. The experiences that students have in this program will engage them in all three ways. All types of engagement, affective, cognitive, and behavioral, can be shaped through educator and peer interactions with the students participating in the program (Skinner et al., 2012). Because the program took place outside of school, there was no testing of the youth on content knowledge. However, youth will use the knowledge they learn and apply it to a design-based challenge. During the program, there were moments of reflection and introductions of new ideas and concepts. Times of outdoor exploration during a direct experience in nature are important for youth, as they may be more likely to feel engaged and empowered to do something about the environment (The Nature Conservancy, 2011). By looking at the interest levels and engagement of youth participating in the program, the researchers will be able to gain a better understanding of the ways to get youth to maintain and develop sustained interest in nature and the outdoors.

The four-phase model of interest development was chosen for this study due to the need to better understand interest in youth in regards to encouraging them to participate in pro-environmental behaviors. Individuals can be engaged three ways to motivate them about pro-environmental behaviors. Non-formal STEM education, like this pollinator program, can help students towards the pathway of making a connection with their local environment, whether that is at a park, in the woods, or in their backyards. It is important to understand the interest and motivations behind youth learning and participation so that educators can make adjustments in curriculum to have a larger impact on youths' intentions to participate in pro-environmental behaviors.

2.5 Conceptual Framework

The conceptual framework in this study was informed by the four-phase model of interest development, by Hidi and Renninger (2006).

The variables measured in this study are identified in Figure 2.1. The independent variables include prior experiences/interest (interest in youth activities, interest in the outdoors, and engagement) and triggered situational interest (STEM program experience). The dependent variables in this study include maintained situational interest (interest in youth activities, interest in the outdoors, and engagement) and emerging individual interest (intention to participate in pro-environmental behaviors and outdoor activities). Demographic information included age and home location (i.e., rural or urban), and was used to compare the treatment and control groups. Prior experiences included things that related to the outdoors or enjoying time in nature. It was important to understand what girls' prior experiences and interests were relating to the outdoors and other youth activities they enjoy before the program began in order to get a clearer picture of the effects of this program on them. STEM program experience included the pollinator content, design activity, and an outdoor experience (for the treatment group). The STEM program experience may influence affective, cognitive, and behavioral engagement as well as intentions to participate in outdoor experiences and pro-environmental behaviors. The four-phase model of interest development and Skinner's work focusing on intrinsic motivation and engagement with students as an 'active ingredient' in garden-based education informed these variables (Skinner et al., 2012). In the conceptual framework, boxes represent independent or fixed variables, and the circular shapes indicate dependent variables that were measured through quantitative and qualitative methods.

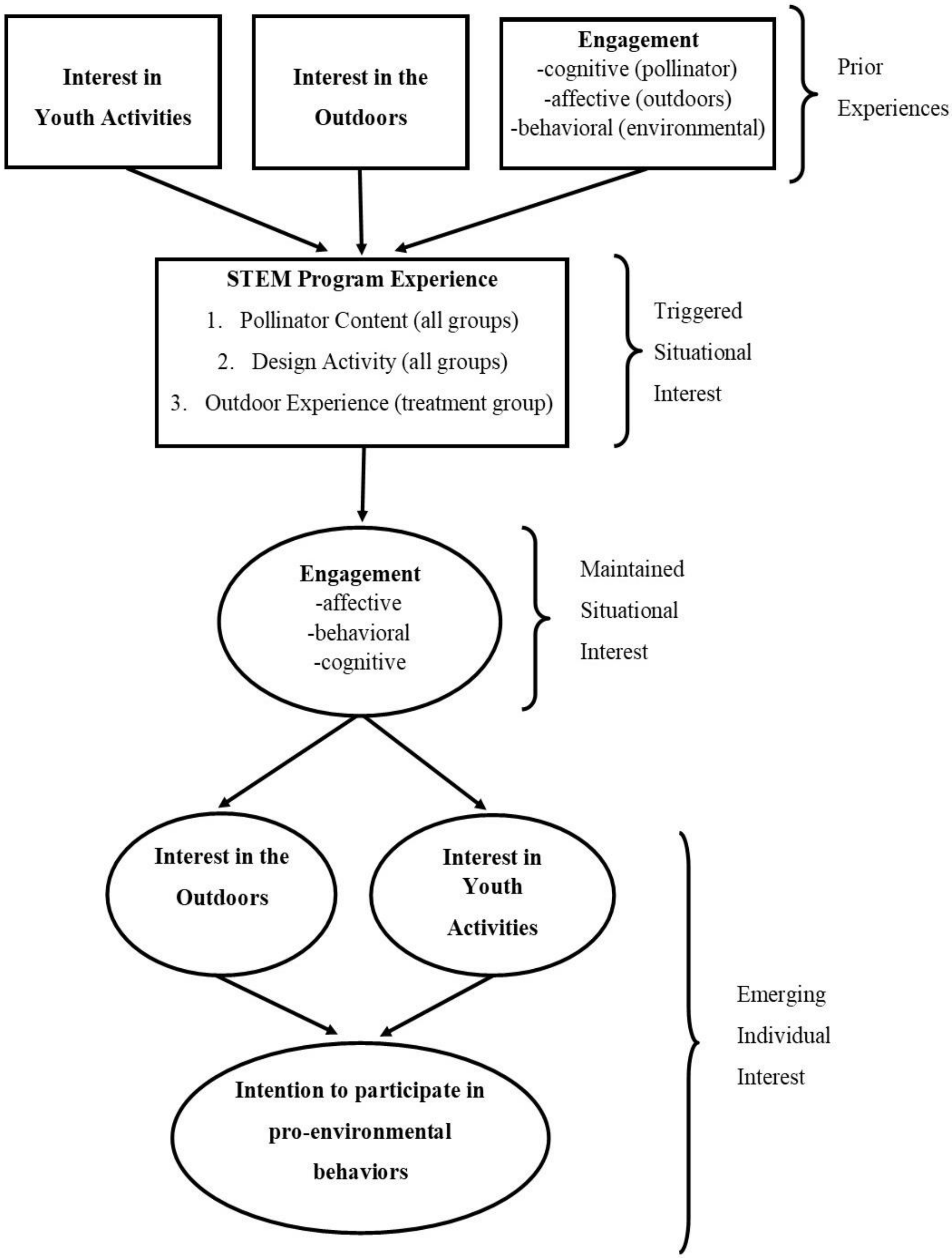

Figure 2.1. *Operational Framework*

2.5.1 Prior Experiences (Youth Interest)

Youth spend small amounts of time outdoors. In a survey of American youth conducted by the Nature Conservancy (2011), it was shown that fewer than two in five youth participate in activities such as hiking, fishing, or visiting a park on a weekly basis. However, youth that had had a personal experience in nature, were more appreciative of it, and were more interested in spending time outdoors and protecting the environment (The Nature Conservancy, 2011). Louv (2005) suggested in his book that youth are deprived of the benefits of nature, which can deprive them of the many benefits of nature exposure. A study conducted by Pergams and Zaradic (2008) indicated that less people were spending time outdoors, and were shifting to activities other than outdoor recreation. Youth do not often have the opportunity to choose where they spend time, and if their guardians are choosing to not expose them to nature, then they may not have an initial interest in outdoors and nature. By understanding where youth participating in the STEM integrated program begin, it will be easier to see if there are any changes in their interest levels following the program.

Youth may have had significant life experiences that have influenced their willingness or interest in participating in outdoor-related activities. These experiences can have a profound impact on individuals and their pro-environmental attitudes and behaviors (Arnold, Cohen, & Warner, 2009). A qualitative study looking at the significant life experiences influencing teenaged environmental leaders showed that there were two primary factors that influenced their development as leaders, influential people, and influential experiences (Arnold et al., 2009). Influential people included parents, friends, role models, and teachers. Influential experiences included time spent outdoors (mentioned in every interview), school, and youth groups. Youth that participated in the current study may not have yet met an influential person or had an influential experience, but could potentially experience that through the program. Understanding prior experiences of youth is a critical part of understanding the ways their interest levels can be piqued.

2.5.2 Triggered Situational Interest (STEM Program Experience)

This STEM program experience will trigger situational interest in youth that participate. Triggered situational interest is typically externally supported, which comes from the educator teaching the program (Hidi & Renninger, 2006). At the beginning of the program, it is essential to trigger interest in youth so that they may want to reengage with the content, and begin to move through the stages of the four-stage model of interest development.

There is a large demand and investment in programming related to the topics of science, technology, engineering, and mathematics, in both formal and non-formal settings (Federal STEM Education Strategic Plan, 2013). Non-formal programming presents a unique opportunity for student learning outside of the classroom setting. Non-formal education is much less rigid with regards to what must be taught and how it is taught (Eshach, 2007). Educators can choose topics they would like to teach students and ways to incorporate STEM concepts within those topics, however it is still structured learning.

There are many ways to integrate STEM programming (Vasquez et al., 2013). Vasquez et al. (2013) proposed three increasing levels of STEM integration. Multidisciplinary is the lowest level, and students learn skills and concepts in each discipline in relation to a central theme. The next level, interdisciplinary, helps students learn skills and deep knowledge because two or more disciplines are linked together. The highest level of integration, transdisciplinary, allows students to make real-world connections by applying what they have learned from two or more disciplines, shaping their learning. When students are given a real-world problem to tackle, they will become more engaged because they can see the potential effect of that problem on their own lives (Glancy & Moore, 2013). Not all STEM integrated programming is transdisciplinary, or needs to be, the level can vary from lesson to lesson. For the purpose of this study, the main focus of the integrated STEM curriculum was on science and engineering as it relates to the real-world problem of pollinator decline at an interdisciplinary level of integration. Through gaining knowledge about pollinators (i.e., biology, ecology, entomology), students used critical thinking skills along with design skills (i.e., engineering) to test and refine designs for pollinator flower choices, a successful pollinator garden, and create a conservation plan for pollinators.

Pollinator content in this study was developed as part of an AgSEED grant project at Purdue University (Furrer, Wang, Orick, & Mitchell, 2017). The project focused on using design challenges to help students in an after-school setting develop critical thinking skills. This STEM integrated curriculum was taught in an after-school setting for youth similar in age to those that participated in the Girl Scout program.

Design is an important part of the engineering process, including definition of the program, generating solutions, evaluation of those solutions, and determination of a possible solution (Householder, 2012). All lessons featured a design element that required teamwork and possibly modifying the solution to the given problem. Through design challenges, students can use their creativity to determine a solution to a problem (Hegedus, 2014). Typically, engineering design is thought of as design and creation of a prototype. In this study, it was more about the process the students go through to come up with a solution. Many students in upper elementary grades are beginning to be introduced to the engineering design process and have not had much experience using it (Hegedus, 2014). Through this program experience, youth will learn what the engineering design process is and how it can be used in STEM activities relating to pollinators.

This STEM program experience will trigger interest in youth that participate. Triggered situational interest is typically externally supported, which comes from the educator teaching the program (Hidi & Renninger, 2006). At the beginning of the program, it is essential to trigger interest in youth so that they may want to reengage with the content, and move through the stages of the four-stage model of interest development.

2.5.3 Maintained Situational Interest (affective, cognitive, and behavioral engagement)

Interest in this study is defined as the psychological state of engagement or inclination to reengage with content, which includes classes of objects, events, or ideas (Hidi & Renninger, 2006). Student engagement is an essential part in the active learning process (Shields, 2010). Active learning and engagement go hand in hand when looking to increase the motivation of youth. Engagement is a multidimensional construct that includes behavioral, cognitive, and affective engagement (Li & Lerner, 2013). Engagement is different from motivation in that engagement is the extent to which the student tries to learn a subject as opposed to passively taking in the information (Reeve, 2012). The major difference between motivation and engagement is that motivation is not observable. It is something that is internal within a person, and engagement is the outward, observable behavior (Reeve, 2012). They are linked with one another, but one can observe engagement and cannot observe motivation. By having engagement, youth would have maintained situational interest in the program content and activities. This maintained interest comes after triggering situational interest, and includes personal involvement of youth in the content. Figure 2.2 shows the relationships between interest, motivation, and engagement.

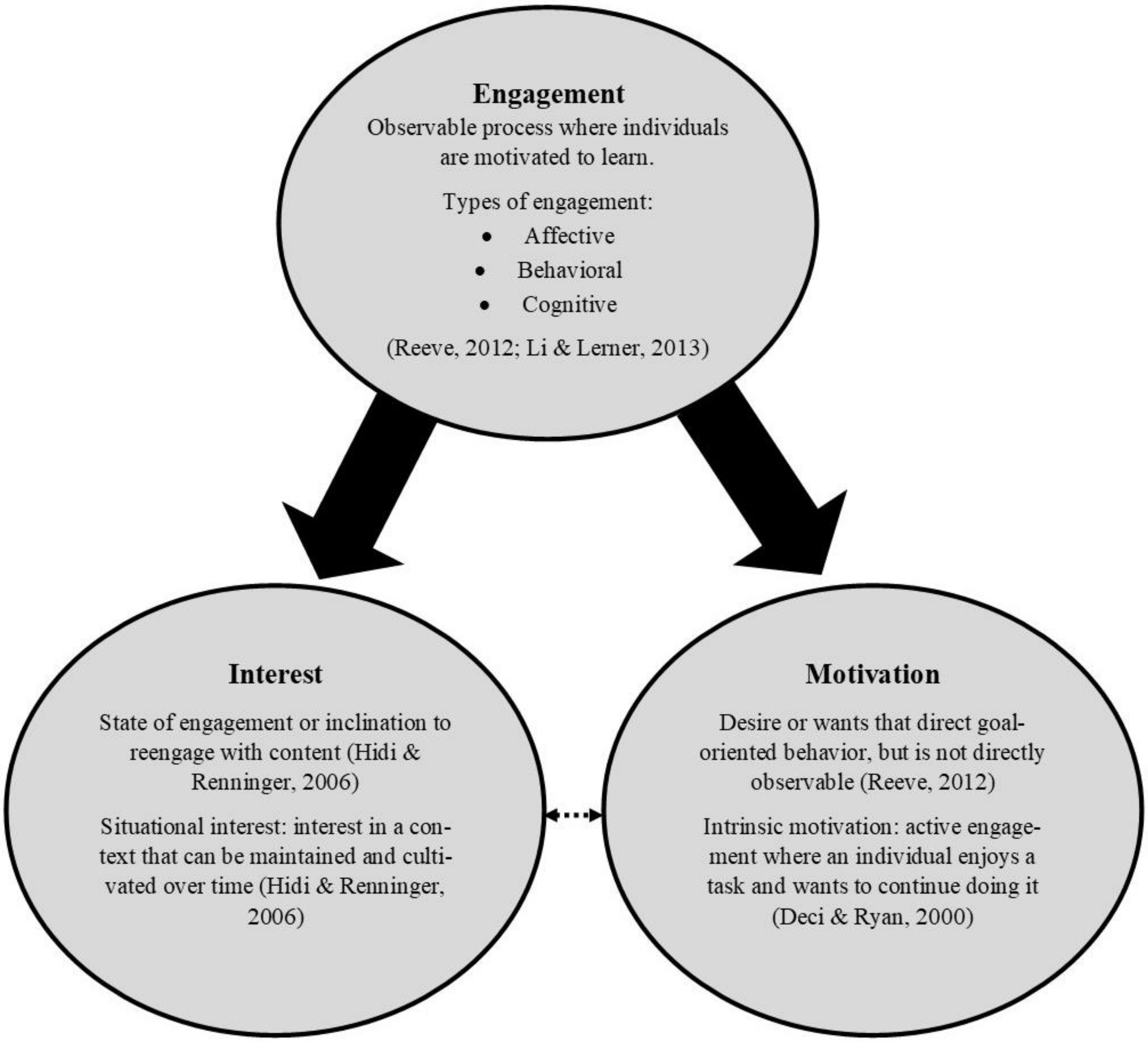

Figure 2.2. *Relationships between interest, motivation, and engagement*

A study done by Skinner et al., (2012) looked at engagement in garden-based education. The belief of the researchers was that if garden-based education can promote engagement in the gardens, then similar programs may be a way to increase engagement in the classroom and beyond, which could contribute to their success in academics (Skinner et al., 2012). Students self-reported their engagement with the garden at their school, and the researchers looked specifically at behavioral engagement, emotional engagement, behavioral disaffection, and emotional disaffection. The study found that youth engagement came from autonomy and intrinsic motivation. Intrinsic motivation can be defined as the active engagement of an individual where they find a task enjoyable and want to keep doing it because they are interested in it (Deci & Ryan, 2000). While this study had an interest in learning about how garden-based education can influence students' academic achievement, it also has implications for other programs in a non-formal setting relating to the outdoors. During the garden-based program, students experienced the outdoors, and were learning about how important things like recycling and composting are to them. This idea could be applied to a non-formal setting, such as the one in this study. If youth are interested, they strive to learn more, and with support from peers and educators, this interest can be maintained.

In a survey conducted by the Nature Conservancy (2011), it was found that youth who spent time outdoors reported they were significantly more likely to care about environmental issues and were twice as likely to enjoy spending time outdoors. This survey supports the need to get youth engaged with the outdoors so that they will be more likely to protect it. Through engaging programs that introduce youth to the outdoors, they may be more likely to have an interest in participating in pro-environmental behaviors.

2.5.4 Emerging Individual Interest (Intention to participate in pro-environmental behaviors and outdoor activities)

There are limited resources in the world that can be used by humans, such as water, food, and materials (Young, 1993). Stress on these limited resources will be an increasing challenge that people will face in the future. A way to combat these issues is through pro-environmental behaviors. Pro-environmental behaviors would be such things as recycling, providing habitat for wildlife, and conserving energy (Steg & Vlek, 2009). While the goal of environmental education programming may be to change behavior, this is a difficult thing to accomplish. For the purpose of this study, the goal is to simply encourage participation in pro-environmental behaviors. The youth would show this interest by indicating an intention to participate in pro-environmental behaviors. An intention to participate could be gained by youth from engagement with this STEM integrated program.

Past research regarding pro-environmental behaviors has taken a look at how educational programs influence specific attitudes like environmental concerns, which is often not strong enough to cause people to act in a different way than they were before (Pelletier, 2002). A key to promoting pro-environmental behaviors is to increase individuals' motivations to act in a positive way towards the environment. If individuals do not have the knowledge or interest about what their impacts toward the environment could be, they will not be motivated to make changes in their lifestyle (Kollmuss & Agyeman, 2002).

How an individual intends to act has an effect on their behavior (Darner, 2009). In environmental education that has an impact on an individual's intention to act, the learning is active and involved. With this active learning, educators and researchers know that there will be a larger impact on students if they have a direct experience in nature or if they can see an environmental problem firsthand (Darner, 2009). However, there has not been one way determined to best accomplish the goal of having intentions to participate in pro-environmental behaviors. While it is clear that a direct experience with the outdoors can have an impact on pro-environmental intentions, it is unclear exactly how youth learn and the ways in which they are motivated, when in a non-formal environmental education setting. Through developing an increasing interest level in youth participants during the STEM integrated program, an emerging individual interest may be shown. This emerging individual interest was the phase the researcher aimed to achieve in youth. When youth have an emerging individual interest, then they want to reengage with content on their own and often. Youth enjoy learning more about the content and begin to generate curiosity questions that can be supported externally by instructors or working with peers (Hidi & Renninger, 2006).

2.6 Need for Study

According to Kudryavtsev, Stedman, and Krasny (2012b), there is limited research regarding how environmental education can shape one’s intentions to participate in pro-environmental behaviors. A search of the literature showed that while many studies have been conducted, there has been no consensus on how environmental education can specifically influence intentions to participate in pro-environmental behaviors (Kollmuss & Agyeman, 2010). In a study done in the Czech Republic, middle school students attended an environmental education program with the goal of developing an attachment to their community and the surrounding natural area (Cincera, Johnson, & Kovacikova, 2015). The most important piece of establishing place attachment, according to Ham (2013), is the ability to communicate a theme to participants. In the study by Cincera et al. (2015), students experienced many new things, and responded in a positive manner to experiential activities. Overall, students did not appear to have an increase in their sense of place, their place meaning and attachment. In 2012a, Kudryavtsev et al. studied a group of high school students in an urban environment to determine if attending an environmental education camp could increase the sense of place in students. Students were given a questionnaire, both pre- and post-program. This questionnaire showed that students gained an increase in place meaning, but not place attachment (Kudryavtsev et al., 2012a), meaning that they ascribed a greater meaning to the place following the program, were no more attached to the place than when they began. Both of these studies incorporated an outdoor experience in their programs, but did not mention STEM.

STEM education and environmental education are aligned because of the concepts and content taught in lessons. Many of the things we have in the material/designed world have been inspired by nature, as seen through examples of biomimicry such as Velcro, bullet trains, and airplanes. There are numerous connections between STEM and the environment, and environmental educators are beginning to utilize STEM concepts in their curriculum (Gardner, 2012). Much of the research that has been done relating to STEM has been in a formal classroom, with little attention paid to non-formal or after school programs. However, there is an opportunity for formal and non-formal classrooms to collaborate to bring STEM education to more children (STEM Smart Brief, n.d.). There is a need to see if a STEM integrated program, coupled with an outdoor experience, could have an impact on youth interests and intentions to participate in pro-environmental behaviors.

2.7 Summary

In this chapter, the environmental education literature was examined, specifically looking at the impacts of urban environmental education and the importance of youth having an outdoor experience. The theoretical framework of Hidi and Renninger's (2006) four-phase model of interest development was introduced. The conceptual framework was described in detail with supporting literature for the variables examined in the study. The independent variables included prior experiences and triggered situational interest (STEM program experience). The dependent variables of interest in youth activities, interest in the outdoors, engagement, and intentions to participate in pro-environmental behaviors and outdoor activities were also discussed to provide clarity of what was being measured in this study.

CHAPTER 3 METHODS

3.1 Purpose of Study

The purpose of this study was to explore and describe the effects of a non-formal STEM integrated program, with an outdoor experience, on Girl Scouts' pro-environmental intentions.

3.2 Research Questions

The following research questions, which were informed by the conceptual and theoretical frameworks, guided the study:

1. What were students':
    a. Prior experiences regarding nature and the outdoors?
    b. Interest level in youth activities prior to participating in the program?
    c. Interest level in outdoor activities prior to participating in the program?
2. To what extent did students in the control and treatment group:
    a. Engage affectively with their environment while participating in this 6-week STEM integrated pollinator program?
    b. Engage cognitively while participating in this 6-week STEM integrated program?
    c. Engage behaviorally in program activities while participating in this 6-week STEM integrated program?
    d. Indicate interest in participating in youth and outdoor activities following the program?

3. To what extent did students in the treatment group have intentions to participate in pro-environmental behaviors after attending this 6-week STEM integrated pollinator program with an outdoor experience, when compared to the control group without an outdoor experience?
4. What experiences in this 6-week STEM integrated pollinator program motivated students, in both the treatment and control groups, to have a greater interest in nature and the outdoors?

3.3 Research Design

Through this study, the researcher aimed to explore the levels of affective (emotional) engagement, cognitive engagement, behavioral engagement, intentions to participate in outdoor activities, and intentions to act, and the differences between the control and treatment group. This study was a quasi-experimental design using a mixed methods approach. Mixed methods approach includes both quantitative and qualitative methods. The researcher analyzed both sets of data and integrated them to draw conclusions to better understand the research problem (Creswell, 2015). A mixed methods approach like this can be a great way to expand on quantitative data by qualitatively interviewing participants (Tashakkori & Teddlie, 2003). This mixed methods approach was chosen because it allowed for a more holistic understanding of the experience youth had during the program (Tashakkori & Teddlie, 2003). The researcher used a convergent design of the mixed methods approach. This design allowed the researcher to collect both quantitative and qualitative data simultaneously while in the field (Creswell, 2015). Through this design, data can be merged and arguments regarding results can be strengthened

(Creswell, 2015). Quantitative data was collected through a pre- and post- questionnaire given to youth that participated in the program. Qualitative data was collected through semi-structured interviews with nine youth following the program. The quasi-experimental design was possible due to working with equivalent Girl Scout troops with similar demographics, ages, and sizes of group. Having a short questionnaire for students to fill out at the beginning and the end of the program paired with semi-structured interviews is an effective way to gain an understanding of the experience youth had (Creswell, 2015).

The pre-program questionnaire was delivered to youth on the first program session (1.5 hour troop meeting) prior to the day's lesson. The intervention of the outdoor experience took place for a 20-minute portion of each program session for one Girl Scout troop (Troop 1).

The following is a visual representation of the non-equivalent control group research design:

S O X O (treatment group)

– – – – – – – – – –

S O O (control group)

O represents the pretest and posttest. The control group was the group that participated in the indoor portion of the program, and X represents the outdoor experience (treatment) during the program. The top line represents the treatment group, while the bottom line represents the control group. The S represents the selection variables, which included the meeting location. Troop 1 met at a location that was surrounded by woods, which provided a place for youth to have an outdoor experience. Troop 2 and 3 met in two local elementary schools.

The study was conducted in the Fall of 2017. The program lasted six weeks for approximately one hour each week, beginning in September, 2017. The control group had an indoor lesson that lasted 45 minutes, and the treatment group had an indoor portion for 25 minutes with a 20-minute outdoor experience each program session.

3.4 Participants/Context/Validity

The participants in this study were 2^{nd} to 7^{th} graders that were active members in three local Girl Scout troops in the Lafayette, Indiana area. The troops constituted two groups in the study, the control and treatment. Two troops made up the control group (Troops 2 & 3), and one troop (Troop 1) made up the treatment group. The existing and accessible troops served as a convenience sample for the researcher. Because this was a quasi-experimental design, comparing two groups of Girl Scouts was a way to utilize this research design. Results of this study can be transferable to other Girl Scout troops with similar demographics in the Lafayette, Indiana area, but cannot be generalized beyond the local area, due to possible differences in socio-economic status, interest level, and prior experiences. All participants were female, based on participation requirements by the Girl Scouts of America. The results from this convenience sample can help to strengthen the instrument to be utilized in future evaluations of similar STEM integrated programs.

The Institutional Review Board at Purdue University approved consent forms and assent forms for participants (Appendixes C and D). Consent and assent forms were provided at the Girl Scout meeting prior to the beginning of the program and were collected by troop leaders then given to the researcher to ensure confidentiality. All participants and parents were offered a copy of the consent/assent forms for their reference. All participants consented to participate in the research study.

This study took place at three Girl Scout troops, during a six-week time period.. The first troop met at a local church in Lafayette. This group served as the treatment group due to the availability of an outdoor space for students to utilize. There were 11 girls in the 4th to 7th age range that participated in the program in troop one. The second troop met at a local elementary school in Lafayette. This troop only met indoors and served as the control group. Five girls in the targeted age range participated in the program for troop two. Due to the small sample size from the control group, a third troop was added to serve as part of the control group. Troop three meet at a local elementary school in Lafayette and had nine participants.

Troop meetings were held in the evening during the week, on Wednesday (troops one and three) and Thursday (troop two) from 6:00 - 7:30 p.m. Each troop conducted a business meeting during the first part of the meeting, and the second portion was a planned educational activity, which was the STEM integrated program. Each troop ended the evening with a song, 'Make New Friends.' Troop one began the six-week program on September 20, 2017 and troop two began the six-week program on October 5, 2017. Troop three's program was three sessions instead of six, due to their meetings being biweekly, and began on November 1, 2017.

External validity was a limitation during this study. This sample group of Girl Scouts aged 7-13 are not representative of all youth of that age, or even of youth from the same community where the study was done. The researcher ran a Chi-Square test of independence to determine if there were any significant differences between the groups. The Chi-Square test had a Phi value of -0.03 and a significance of 0.14, meaning there was no significant difference between the control and treatment groups for demographics, home location (urban/suburban or rural/farm). Each troop does things differently, and involvement may vary from community to community and state to state. There was not an opportunity to have a random sample in this study, which would have been ideal (Fraenkel & Wallen, 2003). There are limited locations in town with similar after-school programs where the researcher could find two equivalent groups to compare. The Girl Scouts were the best option for this study because the researcher had conducted previous educational programs with this organization, resulting in an existing professional relationship. Troop leaders were eager to have the opportunity to participate in more activities with their troops, having previously done some STEM integrated programming through graduate-level class activities at Purdue University.

3.5 STEM Integrated Program & Participant Treatment

Both groups in this study participated in a STEM integrated program relating to pollinators, which lasted six weeks. The treatment in this study was the addition of an outdoor experience during the program. Troop one was the treatment group due to their meeting location having a usable outdoor space. Troops two and three were the control group, with their learning having taken place completely indoors. Table 3.1 summarizes the experiences youth participants had with the program.

Table 3.1. *Summary of Youth Program Experience*

	Number of Girls	**Outdoor Experience**	**Program Instruction Time**	**Data Collected**
Troop 1	11	Yes	25 minutes indoors 20 minutes outdoors	Quantitative Qualitative
Troop 2	5	No	45 minutes indoors	Quantitative Qualitative
Troop 3	9	No	90 minutes indoors (2 lessons per session)	Quantitative

Both groups, treatment and control, that participated in this study completed the same STEM integrated program, which were described in Table 3.2. This program integrated STEM concepts and applied them to the issue of pollinator decline. Both program sessions (treatment and control) included a design component in many of the lessons and incorporated hands-on activities, in which students participated. Lesson plans primarily focused on science concepts, and incorporated the other disciplines throughout. For example, the Planning a Pollinator Garden lesson utilized science (plant identification), technology (large drawing paper, markers, rulers), engineering (designing and redesigning a garden based on a scenario), and mathematics (determining area of a garden).

Table 3.2. *STEM Integrated Lesson Descriptions*

Lesson Title & Description:	
1.	**Material Impacts on Nature** This lesson provided an introduction to the STEM integrated program. Youth were able to describe the differences between the designed and natural world, analyzed the impact of agricultural practices on nature, and designed a meal that could exist without pollinators.
2.	**Bee, Wasp, and Fly Diversity** In this lesson, youth applied basic taxonomic skills to identify different types of pollinators. Youth designed a dichotomous key to help them identify bees, wasps, and flies. They were then given an unknown specimen and tested their key to see if they could identify the unknown specimen based on what they created.
3.	**Plant Science** This lesson introduced youth to the concept of photosynthesis. They identified the needs and parts of plants. They then used their senses to identify which part of the plant was an unidentified item inside of a bag.

Table 3.2. *Continued.*

4.	**Pollinators & Flowers** In this lesson, youth were challenged to design their own flower that would attract the most number of pollinators. Once completed, the youth were given the opportunity to add any missing parts of their flowers, based on a provided picture showing specific flower parts. Youth were introduced to the idea of 'pollinator syndromes' which are suites of traits that determine which pollinator would be attracted to which flower. The youth were given a pollinator card and based on the traits that their pollinator needed, they stood by the flower (drawn by students) that they believed would most likely attract their pollinator.
5.	**Planning a Pollinator Garden** Youth used what they have learned to determine what the needs of pollinators are, and applied that knowledge to the design challenge of planning a pollinator garden. Given a scenario, youth (in teams) planned a pollinator garden that will fit the criteria provided. Once completed, each team presented their garden to their peers, practicing their communication skills.
6.	**Big Picture-What's next?** For the last program session, youth put together everything they had learned over the five previous lessons. The youth were challenged to apply what they had learned to create a conservation plan that would help with pollinator populations in their own neighborhood.

Each program session followed the above themes, and each session built upon the previous one. Youth applied the knowledge they learned to future lessons to design a plan as a group/team to help bee populations (Lesson 6). Each of the lessons was developed to align with Next Generation Science Standards (NGSS), Environmental Education Standards, and Agricultural Literacy Outcomes to ensure alignment with relevant concepts. Table 3.3 lists the NGSS standards that were addressed by the program and the standards in which lessons were aligned. Table 3.4 outlines the Environmental Education Standards, and Table 3.5 depicts the Agricultural Literacy Outcomes.

Table 3.3. *NGSS Alignment with STEM Integrated Lesson Plans (NGSS Lead States, 2013)*

Lesson	**NGSS Standard**
• Material Impacts on Nature	MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society. 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.
• Bee, Wasp, Fly Diversity	3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.
• Plant Science	4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction. 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.
• Pollinators and Flowers	MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively. MS-ETS1-2. Evaluate competing design solutions using a systematic process to determine how well they meet the criteria and constraints of the problem.
• Pollinator Garden	MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Table 3.4. *Environmental Education Standard Alignment (NAAEE, 2010)*

Lesson	**Environmental Education Standard**
• Material Impacts on Nature	Strand 1A. Questioning. Generate ideas and questions about objects, organisms, events, places, and relationships in the environment. Strand 2.4A. Human/environment interactions. Learners understand that people depend on, change, and are affected by the environment.
• Bee, Wasp, Fly Diversity	Strand 1E. Organizing Information. Learners are able to describe data and organize information to search for relationships and patters concerning the environment and environmental topics. Strand 2.2A. Organisms, populations, and communities. Learners understand basic similarities and differences among a wide variety of living organisms.
• Plant Science	Strand 2.2A. Organisms, populations, and communities. Describe the basic needs of all living things and explain how organisms meet their needs in different types of environments such as deserts, lakes, ocean, or forests, and across different climates.
• Pollinators and Flowers	Strand 2.2C. Systems and connections. Learners understand basic ways in which organisms are related to their environments and to other organisms.
• Planning a Pollinator Garden	Strand 3.1D. Working with flexibility, creativity, and openness. Learners understand the importance of sharing ideas and hearing other points of view.
• Big Picture-What's Next?	Strand 3.2C. Planning and taking action. By participating in issues of their choosing—mostly close to home—they learn the basics of individual and collective action.

Table 3.5. *Agricultural Literacy Outcome Alignment (Spielmaker & Leising, 2013).*

Lesson	**Environmental Education Standard**
• Material Impacts on Nature	T1.3-5. Recognize the natural resources used in agricultural practices to produce food, feed, clothing, landscaping plants, and fuel. T5.3-5. Provide examples of agricultural products available, but not produced in their local area and state.
• Big Picture-What's Next?	T2.3-5. Understand the concept of stewardship and identify ways farmers/ranchers care for soil, water, plants, and animals.

3.5.1 Outdoor Experience

For the treatment group, each program session included a 20-minute free exploration period in the woods next to a local church in Lafayette. The focus of the outdoor experience was on allowing the youth to explore their environment while having fun with their friends. At the beginning of each outdoor experience, the researcher pointed out specific things to students that could help them make a connection to their real-life. Things like food sources (walnuts), plant identification (poison ivy), and animal habitats (holes in trees) were all things that the students could relate to on a personal level. Youth played games with one another and looked for animals and plants during this time.

3.6 IRB Approval

The protocol for this study was reviewed by the Human Research Protection Program Institutional Review Board at Purdue University and was approved on September 11, 2017 with the protocol number 1707019466 (Appendix A).

3.7 Data Collection Instruments

Data collection instruments consisted of two components: 1) a student questionnaire (pretest and post-test) and 2) a semi-structured interview conducted by the researcher.

3.7.1 Pre-/Post- Program Youth Questionnaire

For this study, quantitative methods included a pre- and post- questionnaire of the youth participating. There were 11 girls in troop one, 5 girls in troop two, and 9 girls in troop three, for a total of 14 in the control group and 11 in the treatment group. Troops two and three constituted the control group while troop one was the treatment group. Research questions #2A, 2B, 2C, and 3 were measured quantitatively through the pre- and post- questionnaire. This questionnaire looked at interest in youth activities, interest in outdoor activities, their affective, cognitive, and behavioral engagement, youth intentions towards participating in pro-environmental behaviors, and demographic questions regarding age and home location. The questionnaire was developed using several different sources. Four interest items were adapted from the Intrinsic Motivation Inventory by Deci & Ryan (n.d.), like 'I enjoy seeing pollinators.' The five affective engagement items were adapted for a younger audience from the Jorgensen and Stedman (2001) place attachment items such as 'I feel happiest when I'm at my lake property' and 'I feel relaxed when I'm at my lake property' to become 'I feel good when I spend time outside' and 'I feel sad when I can't spend time outdoors.' Cognitive engagement items were developed by looking at adapting items from the Learning-Gardens Educational Assessment Package to align with the content youth would learn during the program, such as 'Bees are an important part of my life' and 'I know a lot of information about bees' (Skinner et al., 2012). Five items relating to behavioral engagement were developed to gain an understanding of how youth interact with pollinators and their environment by asking things like 'When I see pollinators, I leave them alone' and 'I help wildlife when I can.' The final section of the instrument, intentions to act, was developed by the researcher after referencing the pro-environmental behavior scale and included items such as 'I want to help pollinators' and 'I want to help the environment' (Markle, 2013). Three items were reverse coded, two in the affective engagement section, and one in the cognitive engagement section. All Likert-type questions had a scale of three, with Yes, Maybe, or No as possible answers. Having three choices was determined to be appropriate for the age group (Shields, 2010). In Table 3.6, each category of question is broken down based on the number and type of question, as well as the inclusion on either the pre-program questionnaire or post-program questionnaire or both.

On one question in Section 1 relating to interest in youth and outdoors activities, 'I like to participate in the following activities (circle all that apply),' the researcher allowed participants to add any activities that were not on the list, as to better understand what activities youth enjoy participating in outside of Girl Scouts. These options were broken down into categories and coded in SPSS to determine how many of the girls enjoyed doing nature-based activities, sports-related activities, technology-related activities, or leisure activities. Nature-based activities included visiting parks, hiking, and camping. Sports-related activities included horseback riding, swimming, soccer, and softball. Technology-related activities included technology (computers, robotics) and playing video games. Leisure activities included Girl Scouts, reading, and music (band or piano).

Table 3.6. *Number of Questions for each measure, questionnaire.*

CATEGORY OF QUESTION	Pre-test	Post-test
Interest	X	X
Three Likert-type Questions One Choose-all-that-apply Question		
Affective Engagement	X	X
Five Likert-type Questions		
Cognitive Engagement	X	X
Five Likert-type Questions		
Behavioral Engagement	X	X
Five Likert-type Questions		
Intentions to Act		X
Five Likert-type Questions		
Demographics (age & location)		X
One Multiple Choice Question One Fill-in-the-Blank Question		

The questionnaire included color picture smiley faces to help youth of this age better understand what the answer choices were. Figure 3.1 illustrates an example of an item found on the questionnaire. The full questionnaire can be found in appendixes E and F.

Figure 3.1. *Example Item from Youth Questionnaire*

The instrument was field and pilot tested at a summer camp in Illinois in July 2017 to determine age-appropriateness, validity, and reliability. Students that attended the five-day summer camp relating to native Illinois wildlife were aged 6-11, and were both male and female. There were 10 students that completed the pre- and post- questionnaire during the summer camp. The pre- and post- instrument was administered on the first day of the camp and on the last day of the camp, respectively. Cronbach's *alpha* was calculated for each section in the pre- and post-program questionnaire. The results were presented in Tables 3.7 and 3.8. Reliability was moderate for the instrument, and was higher for the program participants than for the pilot test. Youth that participated in the pilot study were of a wider age range than those targeted for the study. They also were on summer break and had a perceived low interest level in completing the questionnaire, based on researcher observations. The instrument was modified based on comments from the youth that attended the pilot test program. Modifications were minor, with some changes in wording such as using a simpler word in place of 'anxious.' If an item was to be reverse coded, images were switched oppositely from a regularly coded item to allow for better understanding of the item. In the Interest section (Section 1), the researcher added more activities that girls may participate in based on discussions with the youth who pilot tested the instrument during the five-day summer camp.

Table 3.7. *Cronbach's Alpha, Pilot Test*

Variable	**Pre-program Cronbach's Alpha**	**Post-program Cronbach's Alpha**
Interest	0.60	0.64
Affective Engagement	0.44	0.37
Cognitive Engagement	0.45 (item revCE_5 deleted)	0.66 (item revCE_5 deleted)
Behavioral Engagement	-0.66	0.54
Intentions to act	---	0.78

Table 3.8. *Cronbach's Alpha, Control and Treatment Group Program*

Variable	**Pre-program Cronbach's Alpha**	**Post-program Cronbach's Alpha**
Interest	0.68	0.65
Affective Engagement	0.65 (item revEE_3 deleted)	0.81 (item revEE_3 deleted)
Cognitive Engagement	0.58	0.75
Behavioral Engagement	0.60	0.58
Intentions to act	---	0.82

3.7.2 Semi-Structured Interviews

Through qualitative methods, the researcher aimed to gain a better understanding of any emotions that this STEM integrated program enacted. All research questions were measured through semi-structured interviews. The researcher desired to better understand the prior experiences participants had with nature and the outdoors. The researcher asked open-ended questions of students through during interviews following the completion of the program. The purpose of the interviews was to understand more about the girls' overall experiences with the program and their intentions toward pro-environmental behaviors. Five girls in troop two (control group) and four girls in troop one (treatment group) were interviewed. Interviewees were selected based on their availability and willingness to be interviewed The researcher served as an educator in this study and conducted the program sessions, group discussions, and interviews. Interview protocols can be found in Appendices I and J.

Semi-structured interviews were conducted after the participants completed the program. A semi-structured interview has flexibility with question order and wording, although there is certain information that the interviewer is interested in (Merriam & Tisdell, 2016). Interview questions were designed to better understand the troop experience of each girl, their prior experiences relating to youth activities and the outdoors, engagement during the program (affectively, behaviorally, and cognitively), any increased interest in youth activities and the outdoors, intentions to participate in pro-environmental behaviors, and their overall experiences participating in the STEM integrated program. The researcher looked to past program interview experiences to help shape the way in which to ask questions.

3.8 Data Collection

3.8.1 Quantitative Methods: Questionnaire

Before the first program session began, the researcher delivered the pre-questionnaire at each troop location. All directions were read aloud by the researcher. With there being a small group of participants, the researcher was able to assist with any questions that came up regarding the questionnaire. Youth were allowed to work independently at their own pace, which took approximately 10 minutes to complete. Once completed, youth handed their questionnaire to the researcher. The questionnaires were not examined until a later time and at a separate location. The researcher assigned numbers to each completed questionnaire to ensure confidentiality and so that the pre- and post- questionnaires could be matched for statistical analysis. The participant numbers were assigned a four-digit code, and formatted such as 0102. The first two numbers indicated the troop to which the participant belonged to, and the last two numbers indicated the individual. Identifying numbers were randomly assigned to the individual participant.

During the last week of the program, the researcher administered the post-questionnaire to participants. Similar to the pre-questionnaire, youth were allowed to ask any questions they needed for clarity. Once youth had completed the post-questionnaire, the researcher collected them in an envelope and took them to a secure location for later analysis. The pre- and post-questionnaires were matched for each participant. If a participant only completed one of the questionnaires, their data was excluded from the study.

3.8.2 Qualitative Methods: Post-Program Interviews

The researcher interviewed five girls from the control group and four girls from the treatment group. Each interview lasted approximately 30 minutes and were held at a local elementary school for the control group and at the community library for treatment group. Girls were chosen to participate in interviews based on their availability and willingness. Age was also a factor in the control group, as many of the girls participating were in the lower elementary grade levels, and were not in the target age range of 8-11 years old for the study. However, one seven-year old was included in the data collection for the control group due to her curiosity level in program topics and the ability to focus on completing tasks during the program, when compared to other participants her age. The control group participants all had their interviews during their troop meeting time for ease of scheduling, at a local elementary school in Lafayette. All interviews with girls in the treatment group took place outside of troop meeting times at the downtown Lafayette library, in the children’s area. Based on non-response from a few parents, the researcher reached out to other girls in the treatment group, but was only able to conduct interviews with four girls from the treatment group. The participant identification letter, group, and grade level are shown in Table 3.9.

Table 3.9. *Interview Participant Information*

Participant	Group	Grade Level
Anna	Control	Sixth
Courtney	Control	Second
Danielle	Control	Sixth
Emma	Control	Fourth
Macy	Control	Fourth
Madison	Treatment	Seventh
Maggie	Treatment	Fourth
Natalie	Treatment	Seventh
Sam	Treatment	Fourth

3.9 Role of the Researcher

During this research study, the researcher held a post-positivist paradigm. This paradigm utilizes multiple data collection methods to try to best understand reality (Denzin & Lincoln, 2000). Along with attempting to capture reality, post-positivism looks to discover and verify existing theories. The researcher in this study aimed to gain a better understand of the student experience in a STEM integrated program, and if that experience could be enhanced with the addition of an outdoor experience.

The researcher served as educator during this study. As the educator, the researcher prepared all lesson plans and supplies, and taught the lessons to the Girl Scouts during the six-week program. Due to the researcher's role as educator, there was a potential for bias. The researcher aimed to receive open and honest answers to interview questions, but determined the order of questions, therefore potentially influencing the way in which youth answered questions (Qu & Dumay, 2011). Pre-determined questions leave room for flexibility, but does not allow for off-topic or irrelevant questions to be asked. The researcher was also a participant in the Girl Scouts organization during elementary school, which could add to bias from both familiarity and an investment in the future of the organization.

The researcher's role had some benefits as well. Having an extensive background in conducting environmental education programs allowed the researcher to stay organized and to remain comfortable teaching lesson material. It also allowed for data to be collected in the same manner throughout the duration of the six-week program. The researcher had the opportunity to develop a relationship with participants and was able to get to know them better than being in the role of an observer. This relationship helped youth feel more comfortable and allowed them to share more of their thoughts and feelings about the program and their intentions towards pro-environmental behaviors.

3.10 Data Analysis

3.10.1 Quantitative:

Quantitative data collected during this study included pre- and post- questionnaires. Responses from the questionnaire were entered into Statistical Package for the Social Sciences (SPSS), a statistical software program. Three items were reverse coded, but one was excluded from the data due to reliability issues. Data from this study was analyzed first by looking at the frequencies and means. Table 3.10 shows the level of measurement, central tendency measured, and variance calculated for each research question. There were 25 total participants in the 6-week STEM integrated program, 14 participants in the control group, and 11 participants in the treatment group. Inferential statistics and statistical significance tests were used to determine knowledge claims. Effect sizes for means were calculated using Cohen's (1988) *d* and can be seen in Table 3.11.

Table 3.10. *Quantitative Data Measures*

Research Question	Measures/ Evidence	Level of Measurement	Variables	Data Analysis Procedure
What were students': a. Prior experiences regarding nature and the outdoors? b. Interest level in youth activities prior to participating in the program? c. Interest level in outdoor activities prior to participating in the program?	• Qualitative • Pre-/post-program questionnaire	Item: Ordinal Scale: Interval	• Prior experiences • Interest in youth activities • Interest in outdoor activities	• Frequencies • Means • Standard Deviations

Table 3.10 *Quantitative Data Measures (continued).*

To what extent did students in the control and treatment group: a. Engage affectively with their environment while participating in this 6-week STEM integrated pollinator program? b. Engage cognitively while participating in this 6-week STEM integrated program? c. Engage behaviorally in program activities while participating in this 6-week STEM integrated program? d. Indicate interest in participating in youth and outdoor activities following the program?	• Pre-/post-program questionnaire • Qualitative	Item: Ordinal Scale: Interval	• Cognitive engagement • Affective engagement • Behavioral engagement • Interest in youth activities • Interest in outdoor activities	• Frequencies • Means • SD • Wilcoxon signed-rank test • Mann-Whitney U test

Table 3.10 *Quantitative Data Measures (continued).*

To what extent did students in the treatment group have intentions to participate in pro-environmental behaviors after attending this 6-week STEM integrated pollinator program with an outdoor experience, when compared to the control group without an outdoor experience?	• Pre-/post-program questionnaire • Qualitative	Item: Ordinal Scale: Interval	• Intentions to participate in pro-environmental behaviors	• Frequencies • Means • SD • Mann-Whitney U
What experiences in this 6-week STEM integrated pollinator program motivated students, in both the treatment and control groups, to have a greater interest in nature and the outdoors?	• Qualitative			

Table 3.11. *Effect Sizes (Cohen, 1988)*

Effect Size Coefficient (*d*)	**Interpretation**
0.0-0.2	Trivial Effect
0.2-0.5	Small Effect
0.5-0.8	Moderate Effect
0.8 and above	Strong Effect

3.10.2 Qualitative:

Qualitative data collected during this study was primarily through semi-structured interviews after the program (Shenton, 2004). The researcher looked for data that related to the conceptual framework, including prior experiences, engagement, interest in youth and outdoor activities, the STEM program experience, and intentions to participate in pro-environmental behaviors to answer the research questions. Qualitative data was coded using the In Vivo coding method (Saldaña, 2016; Miles, Huberman, & Saldaña, 2014). This coding method was chosen due to its appropriateness for beginners, and its relation to the conceptual and theoretical frameworks used in the study. Each of the nine interviews were read line by line to refresh the researcher's memory and were highlighted with phrases or quotes that were most relevant to the study. By being familiar with the interview subject matter, the researcher was able to reduce coding errors (Campbell, Quincy, Osserman, & Pedersen, 2013). The researcher took a deeper look at the data and did a two-case analysis for the five participants in the control and four participants in the treatment group. Once all of the interviews were analyzed, the data were organized into patterns relating back to the conceptual framework, and themes emerged from those patterns.

Tables 3.12 and 3.13 shows examples of In Vivo coding and the patterns that emerged from the data. Following this coding, the researcher discussed the results with a doctoral student as well as debriefing with two professors that conduct qualitative research in the same department and then looked to quantitative data to strengthen the results through triangulation. Triangulation of data adds to the trustworthiness (Miles et al., 2014).

Table 3.12. *In vivo coding for control group participants in STEM integrated program*

Participant	**Example quotes**	**In Vivo Coding**	**Patterns**	**Category**
Anna	1. They make us food. 2. Went outside	'food' 'outside'	Bees make food (knowledge recall), would have enjoyed going outside	Engagement (Cognitive), Program Experience
Courtney	1. Yeah because hiking at the Girl Scout camp and stuff like that. I like that. 2. I learned that bugs aren't hurtful. Bugs are scared of us.	'hiking' 'bugs aren't hurtful'	Enjoys spending time outdoors, knowledge recall	Prior experiences, Engagement (Cognitive)
Danielle	1. Depending on where you're at, it's usually quiet. It's nice to have fresh air. You can run around and play. 2. That you shouldn't kill the pollinators, like spiders and also that spiders are pollinators.	'nice to have fresh air and play' 'you shouldn't kill pollinators'	Enjoys spending time outdoors, knowledge recall	Prior experiences, Engagement (cognitive)
Emma	1. Because it's pretty and the air is healthy. 2. We could have went outside, collected flowers, and examined them.	'pretty and healthy' 'could have gone outside'	Enjoys outdoors, interest in going outside	Prior experiences, Program experience
Macy	1. I'd like to know a lot more about pollinators. 2. Well, the pollinator thing, and the part where we got to study insects.	'like to know more' 'study insects'	Interest in pollinators, enjoyed hands-on activities	Interest in youth and outdoor activities, Program experience

Table 3.13. *In vivo coding for treatment group participants in STEM integrated program*

Participant	Example quotes	In Vivo Coding	Patterns	Category
Madison	1. I plan to spend more time outside. 2. I just want to do more things to help the environment because I need my honey for my tea.	'spend more time outside' 'Want to help the environment'	Wants to spend more time outdoors, help the environment	Interest in youth and outdoor activities, Intentions to participate in pro-environmental behaviors
Maggie	1. I like to hear birds and see all the nature-y stuff. 2. I think going outside made it so I kind of wanted to do it more.	'birds and nature-y stuff' 'Going outside made me want to do it more'	Enjoyment of outdoors, interest in youth and outdoor activities	Prior experiences, interest in youth and outdoor activities
Natalie	1. I think the food part, learning about how much food, definitely because that, you know, that's kind of, we need food, we can't not go without food, so we need to help out. 2. I would love to plant a garden at our house and we've tried, but we have a goat	'we need food, need to help out' 'plant a garden at our house'	Knowledge recall, intention to participate in pro-environmental behaviors	Engagement (Cognitive), Intentions to participate in pro-environmental behaviors
Sam	1. It's important to keep the pollinators alive and to help them by planting flowers and other plants that will help pollinators. 2. It might be the same as before the program because I like to stay outdoors a lot of the time.	'important to keep the pollinators alive' 'Same as before, like the outdoors'	Knowledge recall, interest in outdoor activities	Engagement (Cognitive), Intentions to participate in pro-environmental behaviors

Lincoln and Guba's (1985) criteria for trustworthiness include credibility, transferability, dependability, and confirmability, were used when designing the study and determining methods to analyze the data. The researcher gained credibility during the study by working closely with youth to develop a strong rapport, having worked and been trained as a youth educator. This relationship between the researcher and youth allowed them to feel more relaxed during the semi-structured interviews. A doctoral student in the same department as the researcher served to provide intercoder reliability for this study. Both researchers read all of the interview transcripts individually and reconvened a week later to discuss emergent themes from the data. This study is transferrable, with the inclusion of all lesson plans and interview protocols in Appendices H, I, and J, which can be applied in another setting or for a different purpose. With transferability, dependability is another important part of trustworthiness. The way in which the study was done has been described in detail throughout Chapter 3 and would allow future researchers to replicate the work done here (Shenton, 2004). To ensure the last criteria for trustworthiness, confirmability, the true representation of the participants and not the researcher's potentially biased preferences and characteristics, the researcher presents quotes from individual interviewees and shows the results in a way which lends itself to being true to the interviewees in the study (Shenton, 2004).

CHAPTER 4 RESULTS

4.1 Introduction

The findings of this quasi-experimental mixed-methods study are presented in this chapter. SPSS version 24 was used for the data analysis. The results were presented by research question for clarity of understanding.

4.2 Purpose of the Study

The purpose of this study was to explore and describe the effects of a STEM integrated non-formal program, with an outdoor experience, on Girl Scouts' pro-environmental intentions.

4.3 Research Questions

The following research questions, which were informed by the conceptual and theoretical frameworks, guided the study:

1. What were students':
    a. Prior experiences regarding nature and the outdoors?
    b. Interest level in youth activities prior to participating in the program?
    c. Interest level in outdoor activities prior to participating in the program?
2. To what extent did students in the control and treatment group:
    a. Engage affectively with their environment while participating in this 6-week STEM integrated pollinator program?
    b. Engage cognitively while participating in this 6-week STEM integrated

program?

c. Engage behaviorally in program activities while participating in this 6-week STEM integrated program?

d. Indicate interest in participating in youth and outdoor activities following the program?

3. To what extent did students in the treatment group have intentions to participate in pro-environmental behaviors after attending this 6-week STEM integrated pollinator program with an outdoor experience, when compared to the control group without an outdoor experience?
4. What experiences in this 6-week STEM integrated pollinator program motivated students, in both the treatment and control groups, to have a greater interest in nature and the outdoors?

4.4 Results for the Study: Quantitative

The results from quantitative portion of this study are presented below for research questions #1-3. Demographic characteristics (age and home location) for youth are included in Table 4.1. There were eight (73%) girls in the treatment group that live in an urban/suburban setting, and three (27%) that live in a rural/farm setting. In the control group, six (43%) described living in an urban/suburban setting and eight (57%) described living in a rural/farm setting. The ages of participants ranged from 7-13, with a majority of all participants being 10 years old (44%).

Table 4.1. *Ages of youth participants*

Age	Treatment	Control
7	0	1
9	2	5
10	5	6
11	1	2
12	1	0
13	2	0
Total	11	14

4.5 Results for Research Question 1: Youth Prior Experiences and Interest in youth activities and outdoor activities

Research Question #1. What were students':

a. Prior experiences regarding nature and the outdoors?

b. Interest level in youth activities prior to participating in the program?

c. Interest level in outdoor activities prior to participating in the program.

This research question was measured both quantitatively and qualitatively.

4.5.1 Prior Experiences and Interest Levels Prior to Program

The first section of the pre-program questionnaire focused on interest in spending time outdoors and participating in youth activities. Three items on the questionnaire asked youth if they spent time outdoors and if they enjoyed their time outdoors. Their responses are shown in Table 4.2. Sixteen (64%) participants indicated that they spent time outdoors, while one (4%) indicated that she did not spend time outdoors. Twenty (80%) participants indicated that they enjoy spending time outdoors, and nine (36%) participants indicated they enjoy seeing pollinators. The Likert-type scale had three choices for each item, with 1 = no, 2 = maybe, and 3

= yes. Youth had a high interest level in spending time outdoors and low interest in seeing pollinators prior to participating in the program.

Table 4.2. *Frequency and Mean of Students' interest in nature and the outdoors, pre-program (both groups)*

Questionnaire Item	No		Maybe		Yes		Total		Mean (SD) Interest Level
	n	%	n	%	n	%	n	%	
1. I spend time outdoors.	1	4	8	32	16	64	25	100	
2. I enjoy spending time outdoors.	1	4	4	16	20	80	25	100	2.53 (0.46)
3. I enjoy seeing pollinators.	3	12	13	52	9	36	25	100	

The pre-program questionnaire contained a section where youth could select activities in which they enjoy participating. Youth could choose as many or as few activities as they liked. The researcher coded this data as a 1 = yes or 0 = no answer to determine frequencies of interest areas. Out of the activities, each one was placed into one category that included (1) nature-based activities, (2) sports-related activities, (3) technology-related activities, or (4) leisure activities. The specific activities included in each category can be found in Appendix G. Table 4.3 depicts the frequencies of youth participating in these activities prior to completion of the program, for both the control and treatment groups. Twenty-one (84%) participants indicated that they enjoy participating in nature-based activities such as visiting parks and hiking. Twenty-two (88%) participants indicated that they enjoy participating in sports-related activities such as horseback riding and soccer. Fourteen (56%) participants indicated that they enjoy participating in technology-related activities such as robotics or playing video games. Twenty-two (88%)

participants indicated that they enjoy participating in leisure activities such as reading and music (band or piano).

Table 4.3. *Frequencies of participation in youth activities, pre-program (both groups)*

Category of Activity	**No**		**Yes**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**
Nature-based Activities	4	16	21	84	25	100
Sports-related Activities	3	12	22	88	25	100
Technology-related Activities	11	44	14	56	25	100
Leisure Activities	3	12	22	88	25	100

4.6 Results for Research Question 2: Engagement and Interest

Research question #2: To what extent did students in the control and treatment group:

a. Engage affectively with their environment in this 6-week STEM integrated pollinator program?

b. Engage cognitively while participating in this 6-week STEM integrated program?

c. Engage behaviorally in program activities while participating in this 6-week STEM integrated program?

d. Indicate interest in participating in youth and outdoor activities following the program?

This research question was measured both quantitatively and qualitatively.

4.6.1 Engagement (Pre- and Post- Program)

Three sections of the pre- and post- program questionnaire included affective (or emotional), cognitive, and behavioral engagement. Student responses to the items were based on a three-point rating scale: 1 = no, 2 = maybe, 3 = yes. The means and standard deviations from youth pre- and post- program affective engagement is depicted in Table 4.4. Youths' average level of affective engagement prior to the program was the same for both the treatment and control groups (*M* = 2.66, *SD* = 0.39). Behavioral engagement, depicted in Table 4.5, prior to the program was on the high end of the scale with means being 2.46 (*SD* = 0.35) for the control group and 2.36 (*SD* = 0.34) for the treatment group. Cognitive engagement, shown in Table 4.6, prior to the program was between no and maybe for most youth (*M* = 1.97, *SD* = 0.58) in the control group and was maybe for the treatment group (*M* = 2.00, *SD* = 0.39). Following the program, affective engagement was slightly lower for the control group (*M* = 2.61, *SD* = 0.66), but increased for the treatment group (*M* = 2.77, *SD* = 0.21). Similarly, after the program the means for both the control (*M* = 2.53, *SD* = 0.45) and treatment (*M* = 2.51, *SD* = 0.26) groups increased following the program for behavioral engagement. The largest increase in overall mean was in the cognitive engagement section (*M* = 1.98 pre-program, *M* = 2.49 post-program), which would indicate that the youth in both the control and treatment groups gained knowledge during the program. However, the largest gain in means was seen in the treatment group for cognitive engagement (*M* = 2.00 pre-program, *M* = 2.64 post-program).

Table 4.4. *Means and Standard Deviations for Affective Engagement (pre- and post-program)*

Groups		**Affective Engagement (Pre-program)**	**Affective Engagement (Post-program)**	**Change in Mean**
Control	**Mean**	2.66	2.61	-0.05
	N	14	14	
	Std. Deviation	0.46	0.66	
Treatment	**Mean**	2.66	2.77	0.11
	N	11	11	
	Std. Deviation	0.28	0.21	
Total	**Mean**	2.66	2.68	0.02
	N	25	25	
	Std. Deviation	0.39	0.51	

Table 4.5. *Means and Standard Deviations for Behavioral Engagement (pre- and post- program)*

Groups		**Behavioral Engagement (Pre-program)**	**Behavioral Engagement (Post-program)**	**Change in Mean**
Control	**Mean**	2.46	2.53	0.07
	N	14	14	
	Std. Deviation	0.35	0.45	
Treatment	**Mean**	2.36	2.51	0.15
	N	11	11	
	Std. Deviation	0.34	0.26	
Total	**Mean**	2.42	2.52	0.10
	N	25	25	
	Std. Deviation	0.34	0.37	

Table 4.6. *Means and Standard Deviations for Cognitive Engagement (pre- and post- program)*

Groups		**Cognitive Engagement (Pre-program)**	**Cognitive Engagement (Post-program)**	**Change in Mean**
Control	**Mean**	1.97	2.37	0.40
	N	14	14	
	Std. Deviation	0.58	0.64	
Treatment	**Mean**	2.00	2.64	0.64
	N	11	11	
	Std. Deviation	0.39	0.32	
Total	**Mean**	1.98	2.49	0.51
	N	25	25	
	Std. Deviation	0.49	0.53	

A Wilcoxon Signed-Rank test was run on the youth engagement, and is depicted in Table 4.7, with test statistics in Table 4.8. This test is the equivalent of the paired samples t-test, and identifies any significant differences for engagement pre- and post- program. Data were split between control and treatment so that the researcher could identify where differences were between the two groups.

Table 4.7. *Wilcoxon Signed-Rank Test for Engagement*

Groups			**N**	**Mean Rank**	**Sum of Ranks**
Control	AEMeanPost - AEMeanPre	Negative Ranks	2[a]	3.25	6.50
		Positive Ranks	2[b]	1.75	3.50
		Ties	10[c]		
		Total	14		
	BEMeanPost- BEMeanPre	Negative Ranks	3[g]	5.67	17.00
		Positive Ranks	7[h]	5.43	38.00
		Ties	4[i]		
		Total	14		
	CEMeanPost - CEMeanPre	Negative Ranks	0[d]	0.00	0.00
		Positive Ranks	9[c]	5.00	45.00
		Ties	5[f]		
		Total	14		
Treatment	AEMeanPost - AEMeanPre	Negative Ranks	2[a]	5.00	10.00
		Positive Ranks	6[b]	4.33	26.00
		Ties	3[c]		
		Total	11		
	BEMeanPost - BEMeanPre	Negative Ranks	3[g]	3.50	10.50
		Positive Ranks	7[h]	6.36	44.50
		Ties	1[i]		
		Total	11		
	CEMeanPost - CEMeanPre	Negative Ranks	0[d]	0.00	0.00
		Positive Ranks	10[e]	5.50	55.00
		Ties	1[f]		
		Total	11		

Note: a. AEMeanPost < AEMeanPre, b. AEMeanPost > AEMeanPre, c. AEMeanPost = AEMeanPre, d. BEMeanPost < BEMeanPre, e. BEMeanPost > BEMeanPre, f. BEMeanPost = BEMeanPre, g. CEMeanPost < CEMeanPre, h. CEMeanPost > CEMeanPre, i. CEMeanPost = CEMeanPre, j. AE = affective engagement, k. BE = behavioral engagement, l. CE = cognitive engagement.

Table 4.8. *Test Statistics for Wilcoxon Signed-Rank Test for Engagement*

Groups		AEMeanPost - AEMeanPre	CEMeanPost - CEMeanPre	BEMeanPost - BEMeanPre
Control	Z	$-.55^{b}$	-2.68^{c}	-1.12^{c}
	Asymp. Sig. (1-tailed)	0.29	<0.01	0.13
Treatment	Z	-1.16^{c}	-2.814^{c}	-1.79^{c}
	Asymp. Sig. (1-tailed)	0.12	<0.01	0.04

Note: a. Wilcoxon Signed Ranks Test, b. Based on positive ranks, c. Based on negative ranks, d. Significance $p \leq 0.1$, e. AE = affective engagement, f. BE = behavioral engagement, g. CE = cognitive engagement.

As seen in Table 4.8, there were significant differences seen within groups. Significant increases in engagement was seen in both groups for cognitive engagement, and for behavioral engagement in the treatment group.

A Mann-Whitney U test was run to determine any significant differences between the two groups. Table 4.9 shows the ranks, and Table 4.10 shows the test statistics for Mann Whitney U test for engagement. This test indicated that there were no significant differences for affective, behavioral, or cognitive engagement pre- or post- program, between the control and treatment groups. However, a moderate effect size was seen for behavioral engagement. The Cohen's effect size varied for each area of the questionnaire, and is shown in the bottom row of Table 4.10. The highest effect sizes were seen for affective engagement (post-program) (d = 0.31, small), cognitive engagement (post-program) (d = 0.51, moderate), and behavioral engagement (pre-program) (d = 0.29).

Table 4.9. *Ranks for Engagement, Mann-Whitney U test*

	Groups	N	Mean Rank	Sum of Ranks
AEMeanPre	Control	14	13.89	194.50
	Treatment	11	11.86	130.50
	Total	25		
AEMeanPost	Control	14	13.29	186.00
	Treatment	11	12.64	139.00
	Total	25		
BEMeanPre	Control	14	14.21	199.00
	Treatment	11	11.45	126.00
	Total	25		
BEMeanPost	Control	14	13.89	194.50
	Treatment	11	11.86	130.50
	Total	25		
CEMeanPre	Control	14	12.57	176.00
	Treatment	11	13.55	149.00
	Total	25		
CEMeanPost	Control	14	11.57	162.00
	Treatment	11	14.82	163.00
	Total	25		

Note: a. AE = affective engagement, b. BE = behavioral engagement, c. CE = cognitive engagement.

Table 4.10. *Test Statistics for Mann-Whitney U test for engagement*

	AEMean Pre	AEMean Post	BEMean Pre	BEMean Post	CEMean Pre	CEMean Post
Mann-Whitney U	64.50	73.00	60.00	64.50	71.00	57.00
Wilcoxon W	130.50	139.00	126.00	130.50	176.00	162.00
Z	-.71	-.23	-.95	-.71	-.33	-1.14
Exact Sig. [(1-tailed Sig.)]	.25[b]	.43[b]	.19[b]	.25[b]	.38[b]	.15[b]
Effect Size	0.00	0.31	0.29	0.05	0.06	0.51

Note: a. Grouping variable: groups, b. Not corrected for ties, c. AE = affective engagement, d. BE = behavioral engagement, e. CE = cognitive engagement.

4.6.2 Interest following the program

On the post-program questionnaire, youth were given the same items as on the pre-program questionnaire. In order to understand the differences between youth interest pre- and post-program, the researcher first looked at the frequencies. The mean for all youth interest, pre-program, was 2.53, and following the program was 2.76, and increase of 0.23. The frequencies, pre-program, are shown in Table 4.11. The frequencies following the program were depicted in Table 4.12. Following the frequency tables about youth interest in nature and the outdoors were the pre- and post- participation frequencies for youth activities, depicted in Tables 4.13 and 4.14, respectively. These frequencies indicate that there was an increase in participation for all activity categories.

Table 4.11. *Frequency and Mean of Students' interest in nature and the outdoors, pre-program (both groups)*

Questionnaire Item	**No**		**Maybe**		**Yes**		**Total**		**Mean (SD) Interest Level**
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
1. I spend time outdoors.	1	4	8	32	16	64	25	100	2.53 (0.46)
2. I enjoy spending time outdoors.	1	4	4	16	20	80	25	100	
3. I enjoy seeing pollinators.	3	12	13	52	9	36	25	100	

Table 4.12. *Frequency and Mean of Students' interest in nature and the outdoors, post-program (both groups)*

Questionnaire Item	**No**		**Maybe**		**Yes**		**Total**		**Mean (SD) Interest Level**
	n	**%**	**n**	**%**	**n**	**%**	**n**	**%**	
1. I spend time outdoors.	1	4	4	16	20	80	25	100	
2. I enjoy spending time outdoors.	0	0	2	8	23	92	25	100	2.76 (0.37)
3. I enjoy seeing pollinators.	1	4	8	32	16	64	25	100	

Table 4.13. *Frequencies of participation in youth activities, pre-program (both groups)*

Category of Activity	**No**		**Yes**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**
Nature-based Activities	4	16	21	84	25	100
Sports-related Activities	3	12	22	88	25	100
Technology-related Activities	11	44	14	56	25	100
Leisure Activities	3	12	22	88	25	100

Table 4.14. *Frequencies of participation in youth activities, post-program (both groups)*

Category of Activity	**No**		**Yes**		**Total**	
	n	**%**	**n**	**%**	**n**	**%**
Nature-based Activities	0	0	25	100	25	100
Sports-related Activities	0	0	25	100	25	100
Technology-related Activities	5	20	20	80	25	100
Leisure Activities	0	0	25	100	25	100

The researcher then ran a Wilcoxon signed-rank test to determine if the differences in youth interest were significant, split based on group. The results from the analysis for the control group are depicted in Tables 4.15 and 4.16, and indicate that youth had a significant increase in interest in the outdoors and enjoyment in seeing pollinators following the program, and for all youth activities: nature-based, sports-related, technology-related, and leisure activities. For the treatment group, youth had a higher interest in the outdoors and enjoyment in seeing pollinators, similar to the control group. The treatment group only showed a significant increase in participation for technology-related activities.

Table 4.15. *Wilcoxon Signed-Rank Test for Interest (control group)*

Group			N	Mean Rank	Sum of Ranks
Control	Youth Activities1P - Youth Activities1 (Nature-based activities)	Negative Ranks	0[a]	.00	.00
		Positive Ranks	4[b]	2.50	10.00
		Ties	10[c]		
		Total	14		
	Youth Activities2P - Youth Activities2 (Sports-related activities)	Negative Ranks	0[d]	.00	.00
		Positive Ranks	3[e]	2.00	6.00
		Ties	11[f]		
		Total	14		
	Youth Activities3P - Youth Activities3 (Technology-related activities)	Negative Ranks	1[g]	3.00	3.00
		Positive Ranks	4[h]	3.00	12.00
		Ties	9[i]		
		Total	14		
	Youth Activities4P - Youth Activities4 (Leisure Activities)	Negative Ranks	0[j]	.00	.00
		Positive Ranks	3[k]	2.00	6.00
		Ties	11[l]		
		Total	14		
	IntrMeanPost - IntrMeanPre	Negative Ranks	1[m]	4.00	4.00
		Positive Ranks	8[n]	5.13	41.00
		Ties	5[o]		
		Total	14		

Note: a. Youth Activities1P < Youth Activities1, b. Youth Activities1P > Youth Activities1, c. Youth Activities1P = Youth Activities1, d. Youth Activities2P < Youth Activities2, e. Youth Activities2P > Youth Activities2, f. Youth Activities2P = Youth Activities2, g. Youth Activities3P < Youth Activities3, h. Youth Activities3P > Youth Activities3, i. Youth Activities3P = Youth Activities3, j. Youth Activities4P < Youth Activities4, k. Youth Activities4P > Youth Activities4, l. Youth Activities4P = Youth Activities4, m. IntrMeanPost < IntrMeanPre, n. IntrMeanPost > IntrMeanPre, o. IntrMeanPost = IntrMeanPre.

Table 4.16. *Test Statistics for Wilcoxon Signed-Rank Test for Interest (control group)*

	Youth Activities1P-Youth Activities1	**Youth Activities2P-Youth Activities2**	**Youth Activities3P-Youth Activities3**	**Youth Activities4P-Youth Activities4**	**IntrMeanPost-IntrMeanPre**
Z	-2.00[b]	-1.73[b]	-1.34[b]	-1.73[b]	-2.31[b]
Asymp. Sig. (1-tailed)	0.02	0.04	0.09	0.04	0.01

Note: a. Wilcoxon signed ranks test, b. based on negative ranks, c. the sum of negative ranks equals the sum of positive ranks.

Table 4.17. *Wilcoxon Signed-Rank Test for Interest (treatment group)*

Group			**N**	**Mean Rank**	**Sum of Ranks**
Treatment	Youth Activities1P - Youth Activities1 (Nature-based activities)	Negative Ranks	0[a]	.00	.00
		Positive Ranks	0[b]	.00	.00
		Ties	11[c]		
		Total	11		
	Youth Activities2P - Youth Activities2 (Sports-related activities)	Negative Ranks	0[d]	.00	.00
		Positive Ranks	0[e]	.00	.00
		Ties	11[f]		
		Total	11		
	Youth Activities3P - Youth Activities3 (Technology-related activities)	Negative Ranks	0[g]	.00	.00
		Positive Ranks	3[h]	2.00	6.00
		Ties	8[i]		
		Total	11		
	Youth Activities4P - Youth Activities4 (Leisure activities)	Negative Ranks	0[j]	.00	.00
		Positive Ranks	0[k]	.00	.00
		Ties	11[l]		
		Total	11		
	IntrMeanPost - IntrMeanPre	Negative Ranks	0[m]	.00	.00
		Positive Ranks	5[n]	3.00	15.00
		Ties	6[o]		
		Total	11		

Note: a. Youth Activities1P < Youth Activities1, b. Youth Activities1P > Youth Activities1, c. Youth Activities1P = Youth Activities1, d. Youth Activities2P < Youth Activities2, e. Youth Activities2P > Youth Activities2, f. Youth Activities2P = Youth Activities2, g. Youth Activities3P < Youth Activities3, h. Youth Activities3P > Youth Activities3, i. Youth Activities3P = Youth Activities3, j. Youth Activities4P < Youth Activities4, k. Youth Activities4P > Youth Activities4, l. Youth Activities4P = Youth Activities4, m. IntrMeanPost < IntrMeanPre, n. IntrMeanPost > IntrMeanPre, o. IntrMeanPost = IntrMeanPre.

Table 4.18. *Test Statistics for Wilcoxon Signed-Rank Test for Interest (treatment group)*

	Youth Activities1P- Youth Activities1	**Youth Activities2P- Youth Activities2**	**Youth Activities3P- Youth Activities3**	**Youth Activities4P- Youth Activities4**	**IntrMeanPost- IntrMeanPre**
Z	0.00[c]	0.00[c]	-1.73[b]	0.00[c]	-2.07[b]
Asymp. Sig. (1-tailed)	0.50	0.50	0.04	0.50	0.02

Note: a. Wilcoxon signed ranks test, b. based on negative ranks, c. the sum of negative ranks equals the sum of positive ranks.

The researcher ran a Mann-Whitney U test to determine if there were any significant differences between groups. The test indicated that there were no differences in interest level either pre-program or post-program for youth participants. The ranks are depicted in Table 4.19, and the test statistics are depicted in Table 4.20.

Table 4.19. *Ranks for Mann-Whitney U Test for interest*

	Groups	**N**	**Mean Rank**	**Sum of Ranks**
IntrMeanPre	Control	14	12.64	177.00
	Treatment	11	13.45	148.00
	Total	25		
IntrMeanPost	Control	14	12.61	176.50
	Treatment	11	13.50	148.50
	Total	25		

Table 4.20. *Test Statistics for Mann-Whitney U Test for interest*

	IntrMeanPre	IntrMeanPost
Mann-Whitney U	72.00	71.50
Wilcoxon W	177.00	176.50
Z	-.29	-.33
Exact Sig. [1-tailed Sig.]	.40[b]	.38[b]

Note: a. Grouping Variable: Groups, b. Not corrected for ties.

4.7 Research Question 3: Intentions to Participate

Research question #3: To what extent did students in the treatment group have intentions to participate in pro-environmental behaviors after attending this 6-week STEM integrated pollinator program with an outdoor experience, when compared to the control group without an outdoor experience?

This research question was measured both quantitatively and qualitatively.

4.7.1 Intentions

On the post-program questionnaire, youth were asked five items regarding their intentions to participate in outdoor activities as well as pro-environmental behaviors. These items were on the same Likert-type scale as the rest of the questionnaire, with 1 = no, 2 = maybe, and 3 = yes. The means and standard deviations for both the control and treatment group are reported in Table 4.21. The control group had a lower intention to participate in outdoor activities and pro-environmental behaviors (M = 2.71, SD = 0.51), while the treatment group had a higher intention to participate (M = 2.80, SD = 0.22). A Mann-Whitney U Test was run to determine if there were significant differences between the control and treatment group for intentions to participate. The test statistics for the Mann-Whitney U test are depicted in Table 4.22, and there were no significant differences between the control and treatment groups. Both the treatment and control groups were similarly positive regarding their intentions to participate in pro-environmental behaviors.

Table 4.21. *Means and Standard Deviations for Intentions (post-program)*

Groups		**Intentions**
Control	**Mean**	2.71
	N	14
	Std. Deviation	0.51
Treatment	**Mean**	2.80
	N	11
	Std. Deviation	0.22
Total	**Mean**	2.75
	N	25
	Std. Deviation	0.40

Table 4.22. *Test Statistics for Mann-Whitney U Test for Intentions*

	Intentions Mean
Mann-Whitney U	73.00
Wilcoxon W	139.00
Z	-0.24
Exact Sig. [(1-tailed Sig.)]	0.22[b]

Note: a. Grouping variable: Groups, b. Not corrected for ties, c. Significance $p \leq 0.1$.

4.8 Qualitative Case Analyses

This section presents the two-case qualitative analysis. There were five girls that were included in the control group analysis, and four girls in the treatment group analysis. Each case describes the youth's background and activities that her troop participates in followed by each girls' unique interactions with their prior experiences, engagement, interest in youth and outdoor activities, and intentions to participate in pro-environmental behaviors.

4.8.1 Control Group Case Analyses

4.8.1.1 Anna

Anna is a local sixth grader that was in the control group for the STEM integrated program. Her Girl Scout troop participates in many different activities such as camping, community activities like the Christmas parade, and earning badges such as cooking, soccer, and horseback riding. Her favorite activity to do with her troop is camping.

Prior Experiences. Anna participates in school activities as well as some outside of school. She is in 4-H, volleyball, dance, and Girl Scouts. Her favorite activity to participate in is Girl Scouts. Anna said that her enjoyment of outdoor activities depends on what she's doing. She indicated an interest in the social aspects of spending time outdoors with friends, especially while jumping on her trampoline. She also enjoys running and climbing trees. She had familiarity with local parks such as Armstrong Park and Columbian Park and said that she would like to visit the skate park.

Engagement. Anna was engaged throughout the program, even though she did not like bees, as she expressed early on during the program. She said that she learned that bees were good for the world and recalled that bees all have different appearances from one another, with some having "very thick fur." When asked if she could remember why bees were so important to us, she said, "They make us food." This recall of information showed cognitive engagement, however when asked if she saw why doing things to help bees was important, she said, "No…Me and bugs don't get along. I see one, I stomp on it. I stomped out a wasp last night." Even though Anna understood the importance of bees cognitively, she did not plan to change her behavior towards them. However, she did plan on planting a flower garden in the future, although she had planned on doing that before the program. Her favorite activity during the program was the

Pollinator Garden design, which allowed her to use her creative side. When asked if there was anything that could be added to the program, she immediately said, “Went outside.” She also said, “…if I climbed a tree. Had a one-on-one connection with the tree, and I talked to it, and I said, “Don’t let me fall like you did.”” However, she did not enjoy looking at the insects up close, and said it was “a little graphic.”

Interest in youth and outdoor activities. Anna said that after the program she did not plan to spend more time outdoors, because her friends have all moved away. She also did not plan on spending time outdoors during winter. She said that she might be more interested in spending time outdoors during the spring when flowers are blooming.

Intentions to participate in pro-environmental behaviors. Anna currently does not participate in any pro-environmental behaviors, except that she does not litter. However, in the future she would like to have a “roses and pineapples” garden, but not because of her participation in the program.

Anna was a participant that was difficult to reach during this program. She already had many opinions regarding pollinators and was unwilling to adapt her viewpoints, even when presented with information opposing what she thought. This illustrates a challenge that many educators could face when trying to teach older youth, or youth that do not spend much time outdoors. However, she showed a strong interest in participating in group activities with her friends, which was a large aspect of the program experience.

4.8.1.2 Courtney

Courtney is a local second grader that participated in the STEM program as part of the control group. She enjoys doing sports-related activities, including gymnastics, running, and flips. She is also an active member of her Girl Scout troop. She said that her troop does "cool activities" which include camping, hiking, and earning badges. Being a younger member of the troop, Courtney has not had the chance to participate in as many activities as the older girls, due to the short amount of time that she has been involved.

Prior Experiences. Courtney enjoys spending time outdoors and said, "…nature is one part of your life that some people do not like and some people do. But if you like nature, you should spend time outside looking at bees, or stuff like that." When she spends time outdoors, she enjoys playing in the dirt and pretends to make clay. She said something very interesting when asked if there was anything that she would like to do outside but currently is not able to, "nature isn't allowed to get into schools." Courtney wants to spend more time outdoors and feels that her public education does not currently provide her with that opportunity. Her favorite place to spend time is the woods, and she likes to look at leaves, trees, and animals. She has visited many parks in Lafayette, but could only recall the name of Columbian Park at first. Courtney's interest in gymnastics led her to use the monkey bars and playground area when she visits Columbian Park. She also mentioned going to Prophetstown State Park and Armstrong Park.

Engagement. Courtney showed a fair amount of cognitive engagement with her comments about what she learned. She started off by saying that bugs are not hurtful, and that they are scared of us. This shows she had some affective engagement towards the insects. Although they cannot have emotions, ascribing human emotions to animals is commonly seen in books and movies. Courtney recalled that bees were important due to the need for honey and food. She remembered a time when she had built a fairy garden and had success in attracting pollinators. She thought she might be able to share the information she had learned during the lessons with her class, which shows both cognitive and behavioral engagement. She enjoyed the

Bee, Wasp, and Fly Diversity lesson the best, specifically the part where she was able to look at insects closely. It was interesting that she chose this part as her favorite, because during the lesson, she did not seem to want to look at them. Courtney mentioned a couple of things that she thought would have helped her make a stronger connection to the outdoors, looking at flowers brought in from home, and going outside during the lessons.

Interest in youth and outdoor activities. Courtney was interested in spending more time outdoors following the program. She said, "…outdoors is more greater than spending time inside because you don't learn that much stuff, but outside you learn lots of stuff about birds and stuff like that, and while you play, you learn more things. And accidents, you learn from them."

Intentions to participate in pro-environmental behaviors. Courtney already tries to conserve water when she can. She said that she wants to do more to help the environment after attending the program. About pro-environmental behaviors, she said, "Outdoors is now sounding important, so I would want to be outside more, instead of inside."

Courtney shared her program experience, which was positive for her. She had multiple types of engagement throughout, and was interested in sharing information with her second grade class. Although she is the youngest girl to be interviewed, she was able to provide some informative comments about the program and her experiences so far.

4.8.1.3 Danielle

Danielle is a sixth grader that enjoys spending time with her friends, reading, drawing, playing with her pets, and archery. She recently began participating in archery, and was eager to share her experience. As a member of the control group, she did not go outside during her program sessions. She participate in multiple activities with her Girl Scout troop such as camping, earning badges, playing games, assisting in community events, and selling Girl Scout cookies.

Prior Experiences. Danielle enjoys spending time outdoors and said, “Depending on where you’re at, it’s usually quiet. It’s nice to have fresh air. You can run around and play.” When spending time outdoors, she likes to draw, read, write, ride bikes, and swim. She also would like to go hunting some time with her family. Danielle has visited a few parks in Lafayette, Columbian Park, Armstrong, and Happy Hollow. At Columbian Park, she visits the zoo and playgrounds.

Engagement. Danielle showed cognitive engagement during the program when she said, “…you shouldn’t kill the pollinators, like spiders. And also that spiders are pollinators.” She recalled why pollinators are of importance to us and said that she would apply what she learned during the program to planting a flower garden that would attract bees and other pollinators. She also said that she learned a lot when they did the Pollinators and Flowers lesson, and got to design their own flowers. Her favorite part of the program was when the girls were able to look at the insects up close. Danielle said that she has not gotten to do things like that very often, and she was very interested in learning more, especially about spiders. About the program, she said that she would have liked to gone outside and look at things first.

Interest in youth and outdoors activities. She indicated her interest in spending more time outdoors following the program and gave the reason, “Because I like the outdoors and also, it’s fun to see all the insects and animals.”

Intentions to participate in pro-environmental behaviors. She has done some pro-environmental behaviors in the past like recycling and planting flowers. In the future, Danielle would like to make a bat box, which shows that she has been thinking about these types of behaviors for a while. She wants to learn more about bats and see them closer, which is why she wants to install a bat box.

Danielle was a reserved Girl Scout who showed excitement when talking about learning about pollinators. She has interests relating to the outdoors, including a unique interest in archery, and would like to participate in pro-environmental behaviors in the future.

4.8.1.4 Emma

Emma is a fourth grader that enjoys gymnastics, dance, playing with her cat, and Girl Scouts. In her Girl Scout troop, they play games, make crafts, earn badges, and go camping. Being a first year member, she has not earned any badges yet, but is enjoying making new friends.

Prior Experiences. Emma enjoys spending time outdoors because "it's pretty and the air is healthy." When spending time outdoors she likes to jump on the trampoline, play at the park, and play sports with her brother. She also likes to swim at the pool during the summer and sit by the fireplace in the winter. She has visited a few parks in Lafayette like Columbian Park, Oakland, and the park at her school. At Columbian Park, similar to the other girls in the control group, she likes to play on the swings and monkey bars.

Engagement. During the program, Emma said that she learned that flowers helped bees. She learned this information from the Pollinators and Flowers lesson where she had to create her own flower that would attract the most pollinators. She was engaged in learning, but her learning seemed more surface level and her understanding was not very deep. About the program, Emma said, "You were trying to teach us not to kill bees or step on any plants." She would apply what she learned in the program to help the environment by growing more plants. Her favorite part of the class was the Designing a Pollinator Garden lesson, where the girls completed a plants characteristic chart first, and then designed a garden based on a given scenario. She enjoyed completing the plants board because learning the traits of certain plants helped her team better design their garden. When asked if there was anything she would like to add to the program, she said that "we could have went outside, collected flowers, and examined them."

Interest in youth and outdoor activities. After the program, Emma said that she would like to spend more time outdoors, but could not give a reason why. She did mention that she would like to catch some insects to look at them closer.

Intentions to participate in pro-environmental behaviors. She currently does some things to help the environment like recycling. She also grows fruit in her garden. She said that she would like to do more to help out, and said that it was "because of the flowers."

Emma showed an interest in the outdoors prior to the program, and after completion of the program. She saw the importance of doing things to help pollinators and was engaged with the lessons.

4.8.1.5 Macy

Macy is a local fourth grader who was an enthusiastic participant in the 6-week STEM integrated program focusing on pollinators. She was part of the control group, whose program did not include an outdoor experience. She has many different interests that include playing sports, studying insects and animals, and watching movies. She also enjoys crafts, painting, and coloring. Being a new member of the troop, Macy had a limited perspective on what activities the troop participates in. She began attending troop meetings at the beginning of the STEM integrated program, and described troop activities as looking at insects (Bee, Wasp, Fly Diversity lesson), matching the pictures to the plant (Pollinator Garden lesson), and putting dye in a cup of water to show how plants absorb liquids/nutrients (Plant Science lesson). In her old troop, the girls went fishing, swimming, and caught frogs.

Prior Experiences. When asked if she enjoyed spending time outdoors, Macy responded with a resounding yes, then clarified her answer adding, “But a yes with three exclamation marks.” She added her reasons why she liked to be outside by saying, “A lot of things. Nature, rivers, water, rocks. Like, one of those little rivers, and that when it goes and when you put your hand through, it feels…I can’t explain it, but it feels calming.” When spending time outdoors, she looks for animals and trees. If she had the opportunity, Macy would like to do crafts like building a birdhouse or model outside. In her local area, the parks that she visits include Columbian Park and Armstrong Park. When she visits these parks, she enjoys playing on the playground. “Well, Columbian Park is really big, and it has these little things where you can sit in, and like if you lean one way or another, it would actually spin, and the more you do it the faster you go, and then you get really dizzy. Then the other one, which was Armstrong Park, is that there’s something that you hold on to and then push yourself, then you swing over to the other side.”

Engagement. Macy demonstrated cognitive engagement with the STEM program when she talked about the importance of bees. She discussed that if we no longer had bees, then we would no longer have honey, and they would not be able to help us with our food. She wants to help the bees by taking flowers and planting them underneath a beehive to make it easier for the bees to collect the pollen. She discussed leaving the bees alone, even though she wanted to look at them, showing positive behavioral engagement towards the bees. Once, she was chased by bees, but still said that she would like to put an injured bee back in its hive. Her favorite part of the program was the Designing a Pollinator Garden lesson, and she enjoyed working with her teammates to design the garden. She stressed the importance of working together saying, “For me, as a team, we can actually figure stuff out than one…more than one is better because if you need help, you won’t have anyone to help you with it.” Macy described what she would change about her group’s design, again showing cognitive engagement and thinking through an engineering design problem, and said she would have added more flowers and some bees to the garden. Being able to use creativity to solve a problem made this an easy challenge for Macy. She also said that when you think of things it can look different on paper, so that was the most difficult part, transforming ideas into ‘reality.’

Interest in youth and outdoor activities. Following the program, Macy said that she had an interest in spending more time outdoors. When asked why she said that, she responded, “Because I like the trees, I like to study the leaves, I love the flowers, and I’d like to see more of some kind of pollinators. I would like to see what different ones that they are.” She also showed an interest in learning more about science. She described an experiment that she would like to do, studying the chemicals that are present in a rain sample. She also was curious about placing a marker in a glass of water to observe how the colors spread, similar to an experiment done during the program. Being a part of the control group, Macy did not have the opportunity to spend time outdoors during the program. However, she felt as though she was able to make a connection with nature during the program, but would like to do more things outside than inside. She said, “I would like to see some things outside.”

Intentions to participate in pro-environmental behaviors. Macy has an interest in participating in pro-environmental behaviors, and has done so in the past through recycling, planting a garden, and picking up litter. She indicated that she would like to do more things to help the planet and said, “I love planting things. I would like to pick up more garbage around the place, because I do not like litter.” She also said that looking at the insects led her to want to participate in pro-environmental behaviors more.

Macy demonstrated an understanding of content presented during the lessons, and engaged multiple ways with the STEM program, particularly with her interest in the engineering design challenges. She came into the program with a strong interest in the outdoors, and continues to show that interest following the program, particularly with her interest and intentions to participate in pro-environmental behaviors.

4.8.2 Treatment Group Case Analyses

4.8.2.1 Madison

Madison is an outgoing seventh grader whose dilemma at the time of her interview was choosing her favorite subject in school, which was between language arts and math. She described her “crazy” family and her upbringing. She was homeschooled until fourth grade, and her first experience in a public school was with standardized testing. Madison’s family camped a lot as a child as well as attended music festivals. Having attended those festivals, she had an interest in doing things that she saw, like climbing curtains at shows, which translated into climbing trees at home. She discussed her twin siblings and their interests, and eventually began talking about herself, with prompting.

Prior Experiences. Madison participates in Girl Scouts outside of school, as well as watches YouTube and plays video games. Her troop activities include camping, whittling to make pocketknives, and wood chopping. She does enjoy spending time outdoors, and said, “I do like spending time outside when I’m camping or just walking the dog, especially when it’s nice outside, because when it's cold outside, not so much." She does like to see how beautiful the freshly fallen snow looks, and then go sledding or make a snowman. Madison also likes the fresh air outside and she used to enjoy raking leaves in the fall. She and her siblings would jump and play in the leaves. They also spend time visiting relatives in California and there they spend time on the beach. Madison recalled several parks that she has visited, Happy Hollow, Tapawingo, Columbian Park, Murdock, Armstrong, and Munger. At the parks, she loves to swing on the swings and go down the slides.

Engagement. Madison was able to make connections between the information she gained during the program as well as her prior knowledge about plants and pollinators. She mentioned a science show that talked about how bees see in the ultraviolet. During the program, Madison learned "…about what different pollinators, what type of flowers they like, and the parts that make up flowers and stuff, because I always thought it was like, "We've got the roots and we've got the stem with some things inside it, we got the leaves and we got the petals and we got the pollen that smells really nice that gives us delicious honey from the bees." She also recalled that, "they're important to us because they are the reason why we can have food…most of the bites we take are from pollinators." Madison saw applicability in the lessons and wanted to use what she learned in her science class to help her better understand more about pollinators and why they are so important. Her favorite lessons were the Pollinators and Flowers and Planning a Pollinator Garden because she was able to use her creativity. For the pollinator garden lesson, she liked having the scenarios to help design the garden because it helped her think towards the future and how an actual planner might be able to do a job for someone else. Being in the treatment group, Madison's troop spent time outdoors each week as part of the program. She said, of the outdoor experience, "I enjoyed just going outside and looking outside at the beautiful woods, especially if the weather was nice.” She thought that going outside helped make the connections clearer between what the girls were learning in the program and the real world. Because of her experience in the program with the outdoor experience, she said that she would like to spend more time outdoors.

Interest in youth and outdoor activities. After the program, Madison said that she would like to continue spending more time outdoors. She has started to appreciate what is around her, especially when her family takes car rides, so she would like to spend more time outside in those spaces.

Intentions to participate in pro-environmental behaviors. When asked about what she has done that is good for the environment, she said that her family used to have chickens and they would give their food scraps to the chickens. She wants to do more to help the environment because, “I need my honey for my tea.” She also described that looking at the insects paired with spending time outside during lessons made her want to participate more in pro-environmental behaviors.

Madison very enthusiastically described her experience in the STEM program, and appeared to have learned some applicable knowledge. She enjoyed the outdoor experience and felt that it added value to the program overall.

4.8.2.2 Maggie

Maggie is a fourth grader who likes animals. One of her favorite things to do outside of school is to play with her dog. She also likes playing on her tablet and reading. She does not enjoy sports, but enjoys spending time on the beach when she has the chance. Maggie’s Girl Scout troop does a lot of outdoor activities like camping, hiking, whittling, and cooking. Once, her Girl Scout troop took a trip to Chicago and took a boating tour of the city to learn about the history.

Prior Experiences. Maggie likes to spend time outdoors because “I like to hear birds and see all the nature-y stuff. I really like to see the wild animals outside.” Sometimes near her house she can see deer running around, even in an urban environment. When she is outdoors, she likes to play games and rake leaves. During the summer time she also enjoys swimming and tubing on the lake. In the past, she has also gone to Renaissance fairs and has dressed up in costume. When thinking about local parks, Maggie mentioned that she enjoys visiting Columbian Park, Happy Hollow, and Turkey Run State Park. Her favorite part about Happy Hollow is the tiny waterfalls and the dry creek bed that is fun to walk through looking for rocks. At Columbian Park, she visits the zoo and playgrounds.

Engagement. Maggie recalled that pollinators pollinate flowers and help them make honey and other food. She also connected that without pollinators, our food supply would look very different and we might not even have beef, milk, or cheese since cows eat grass, which needs to be pollinated. She showed affective engagement when she said, “I think I’ve learned to respect bees even though they have pointy butt things. I’ve learned a lot. I think that every bite we take is something I’ve learned the most that I need to respect them more instead of trying to run away from them.” Behaviorally, Maggie said that she does not smash bees, but instead runs away from them. She thinks that she would like to plant a garden now that she knows which flowers best attract pollinators. Her favorite part of the program was when the girls could look at the insects up close. She had never gotten to do that before in classes, and has not in the wild because she was scared to approach them. Maggie enjoyed spending time outdoors during the program, it allowed her the freedom to explore the area and discover new things like a garden gnome that had been placed in the woods for an unknown reason. She said, "I think going outside made it so I kind of wanted to do it more," and she enjoyed the outside things more than the indoor activities. One thing that Maggie mentioned that she would change about the program would be to have a few independent activities, as she does not work very well in groups.

Interest in youth and outdoor activities. After the program, Maggie plans to spend more time outdoors, "because I thought the program was fun and I want to try to have different experiences more outside because a lot of them were the same thing I talk about. I never really tried to make more experiences, it's just the same thing. I kind of want to try to make more stories and more stuff."

Intentions to participate in pro-environmental behaviors. Currently, Maggie does some things to help the environment such as turning off lights when leaving a room, turning off the water while brushing her teeth, and recycling at school. She would like to do more to help the environment, mostly through gardening. She wants to plant a garden with flowers to attract pollinators.

Maggie was an engaged participant in the treatment group of the STEM program. She had an interest in the outdoors prior to participating and would like to spend even more time outdoors after the program. She has good ideas for how to help the environment and shows an interest in learning about more.

4.8.2.3 Natalie

Natalie is a local seventh grader that is currently involved with the honor society and service projects. She has helped out at a food pantry and clothing drives. She is also a very involved member of her Girl Scout troop. Her troop participates goes camping frequently, has done knife safety, and other things that most troops do not do, which she thinks is pretty awesome.

Prior experiences. Natalie "definitely" enjoys spending time outdoors. She is homeschooled so she tends to have extra time on her hands and says, "Without going outside, I'd probably just sit inside and do nothing." Living in a rural area, on 40 acres of land, she has the chance to go outside every day. During the summer, she helps with the horse barn that is on-site. She also spends a large amount of time reading, as was demonstrated by her stack of books at the library where the interview took place. Natalie has visited a few parks like Murdock and Happy Hollow.

Engagement. During the program Natalie learned that "…we need to protect bees and butterflies and wasps, birds, plants, well ants but yeah, we still need to protect them. And all the pollinators because without them we wouldn't have all of our food. We'd be really stuck." She understood the importance of having a safe place for bees to go so that they are not sprayed with chemicals and killed. In order to apply what she has learned, Natalie would like to plant a garden, but cannot do so because her family has a pet goat. Her favorite part of the program was the Pollinators and Flowers lesson because "I think it's cool that we got to kind of design our own flower. People don't think of, when they're designing stuff they think buildings or buildings computer, designing with computers or designing something electrical but it's amazing how Mother Nature has built the flowers in nature how it is so it will, pollinators that have their way to do things. I think that's cool." She also enjoyed working as a team with her friends because "it helped that we knew each other better so we could fit it together like a puzzle." Natalie enjoyed being able to go outside during the lessons because it allowed the girls to burn off some of their energy, but still being able to look for animals. Natalie showed strong cognitive engagement when she said, "…we don't really think about the pollinators, like I didn't know that without them, we wouldn't have a third of our food. So, it's hard to think about that and then realize that we're not doing anything about it."

Interest in youth and outdoor activities. Natalie said that she plans to spend more time outdoors after the program, but gave no supporting reason as to why.

Intentions to participate in pro-environmental behaviors. In the past, Natalie has tried to recycle, but has had trouble since her family lives in the country. However, they have now figured out a system so that they can recycle on a consistent basis. She also makes sure to turn off the lights when she leaves a room and turns off the water while brushing her teeth. She would like to do more to help out, though. Learning about the importance of pollinators made her realize that it is important to begin doing things to help them out.

Natalie shared her positive experiences with the program. She currently spends time outdoors, but would like to spend more. She also tries to do things to help the environment, but is somewhat limited in her ability due to her home location. Even with this challenge, she remains open to learning more about pollinators and the ways to help them in the wild.

4.8.2.4 Sam

Sam is a fourth grader who enjoys doing things outdoors like swimming and exploring in the woods. She also loves to play with her cats and goes sledding in winter. She does not participate in sports much, partially due to missing the deadline for signing up for soccer. She enjoys being a member of her Girl Scout troop. The girls go camping a lot as a troop. They have also done an etiquette party, sold cookies, and gone sledding.

Prior Experiences. Because the first thing Sam mentioned was her enjoyment of being outdoors, it was no surprise that she likes to spend a lot of time outside. Once she and her dad did a survival camping experience in their backyard just for fun. Living in a rural area provides a lot of opportunities to do things that most youth cannot do, like zip lining or helping out on a horse farm. Sam has cats, goats, chickens, ducks, and cows that she helps care for. When she comes into town, she likes to visit Monster Golf to win prizes. She has also visited Happy Hollow and Columbian Park.

Engagement. Sam recalled one way to help pollinators, planting a garden. She also remembered that pollinators help us with our food. She thought that she might use the knowledge she gained to help her identify other animals, which was a part of the Bee, Wasp, and Fly Diversity lesson. This lesson was her favorite part of the class because it was a new experience. She was not as impressed with the outdoor experience as some of the other interviewees, due to her already having a space to explore at home, but she enjoyed hiking because it reminded her of the deer trail at her house. Sam liked being able to spend time exploring with her friends.

Interest in youth and outdoor activities. Sam indicated her interest in spending time outdoors following the program, but thought that she was as interested as when she started the program because she already spends a lot of time outside. She is also looking forward to trying out some new equipment in the winter.

Intentions to participate in pro-environmental behaviors. When asked about what she has done that is good for the environment, Sam said that she once tried to plant corn from the leftover bits in the field to see if they would sprout. She also has sunflowers at her house, but the goats try to eat them, so they do not grow very tall. She would like to plant more flowers in the spring to see if she could get them to grow, for the pollinators. Sam said that because of the outdoor experience and looking at the rain garden, she wanted to plant a garden at her house. Sam had an interesting story to tell about her outdoor experiences and life at home. She already spends a great deal of time outdoors, but is interested in doing more, and in doing more to help the environment.

4.9 Qualitative Patterns and Themes

From the qualitative case analyses, the researcher was able to identify patterns from the data. These patterns are presented in Table 4.23. The patterns were then transformed into qualitative themes. These themes are presented in Table 4.24.

Table 4.23. *Patterns that emerged from interview participants*

Categories	Participants	Patterns
Prior Experiences	**Control**	
	Anna	1. Moderate enjoyment of outdoors, depends on what she is doing 2. Sports-related activities 3. Social interactions 4. Armstrong & Columbian Park
	Courtney	1. Enjoys spending time outdoors 2. Sports-related activities 3. Columbian Park, Armstrong Park, Prophetstown State Park
	Danielle	1. Enjoys the outdoors 2. Sports-related activities, leisure activities 3. Columbian Park, Armstrong Park, Happy Hollow
	Emma	1. Enjoys the outdoors 2. Sports-related activities, leisure activities 3. Columbian Park, Oakland Park
	Macy	1. Enjoys the outdoors 2. Sports-related activities, leisure activities 3. Columbian Park, Armstrong Park
	Treatment	
	Madison	1. Enjoys the outdoors 2. Technology-related activities, leisure activities 3. Columbian Park, Happy Hollow, Armstrong, Murdock, Munger, Tapawingo
	Maggie	1. Enjoys the outdoors 2. Technology-related activities, leisure activities 3. Columbian Park, Happy Hollow, Turkey Run State Park
	Natalie	1. Enjoys the outdoors 2. Service-related activities 3. Murdock, Happy Hollow
	Sam	1. Enjoys the outdoors 2. Leisure activities 3. Happy Hollow, Columbian Park

Table 4.23. *Patterns that emerged from interview participants (continued)*

Engagement	**Control**	
	Anna	1. Affective engagement: felt negatively towards bees before and after program 2. Behavioral engagement: acts negatively towards pollinators before and after program 3. Cognitive engagement: knowledge recall; enjoyed engineering design challenges (pollinator garden lesson)
	Courtney	1. Affective engagement: ascribed emotions to insects 2. Behavioral engagement: interest in sharing information with class 3. Cognitive engagement: knowledge recall; enjoyed hands-on activities (looking at insects)
	Danielle	1. Cognitive engagement: knowledge recall; enjoyed engineering design challenges (pollinators and flowers) and hands-on activities (looking at insects)
	Emma	1. Behavioral engagement: indicated interest in growing plants to apply what she learned 2. Cognitive engagement: knowledge recall; enjoyed hands-on activities (pollinator plants chart) and engineering design challenges (pollinator garden lesson)
	Macy	1. Behavioral engagement: chose to leave bees alone when outside; enjoyed working with a team 2. Cognitive engagement: knowledge recall; enjoyed engineering design challenges (pollinator garden lesson)
	Treatment	
	Madison	1. Behavioral engagement: indicated interest in sharing information with class 2. Cognitive engagement: knowledge recall; enjoyed engineering design challenges (pollinators and flowers; pollinator garden lesson)
	Maggie	1. Behavioral engagement: does not kill bees, runs away from them; does not enjoy working in groups 2. Cognitive engagement: knowledge recall; enjoyed hands-on activities (looking at insects)
	Natalie	1. Behavioral engagement: enjoyed working with her friends 2. Cognitive engagement: knowledge recall; enjoyed engineering design challenges (pollinators and flowers)
	Sam	1. Cognitive engagement: knowledge recall; enjoyed hands-on activities (insect identification) and engineering design challenges (create dichotomous key)

Table 4.23. *Patterns that emerged from interview participants (continued)*

Interest in youth and outdoor activities	**Control**	
	Anna	1. Following the program, did not have interest in spending more time outdoors, unless the weather was nice
	Courtney	1. Wanted to spend more time outdoors following the program
	Danielle	1. Wanted to spend more time outdoors following the program
	Emma	1. Wanted to spend more time outdoors following the program
	Macy	1. Wanted to spend more time outdoors following the program. 2. Indicated interest in doing more science experiments relating to the outdoors
	Treatment	
	Madison	1. Wanted to spend more time outdoors following the program
	Maggie	1. Wanted to spend more time outdoors following the program (wanted to make stories)
	Natalie	1. Wanted to spend more time outdoors following the program
	Sam	1. Wanted to spend a similar amount of time outdoors as before the program
Intentions to participate in pro-environmental behaviors	**Control**	
	Anna	1. Would like to have garden in the future, but not because of program experience
	Courtney	1. Would like to participate in pro-environmental behaviors more after the program
	Danielle	1. Would like to participate in pro-environmental behaviors more after the program (gave example of bat box)
	Emma	1. Would like to participate in pro-environmental behaviors more after the program (because of the flowers)
	Macy	1. Would like to participate in pro-environmental behaviors more after the program
	Treatment	
	Madison	1. Would like to participate in pro-environmental behaviors more after the program (looking at insects and outdoor experience)
	Maggie	1. Would like to participate in pro-environmental behaviors more after the program (plant garden)
	Natalie	1. Would like to participate in pro-environmental behaviors more after the program (learning of the importance of pollinators)
	Sam	1. Would like to participate in pro-environmental behaviors more after the program (plant garden because of outdoor experience and looking at rain garden)

Table 4.23. *Patterns that emerged from interview participants (continued)*

Other (Outdoor experience during program)	**Control**	
	Anna	1. Indicated interest in going outdoors during program
	Courtney	1. Indicated interest in going outdoors during program
	Danielle	1. Indicated interest in going outdoors during program
	Emma	1. Indicated interest in going outdoors during program
	Macy	1. Indicated interest in going outdoors during program
	Treatment	
	Madison	1. Because of outdoor experience, she wants to spend more time outdoors
	Maggie	1. Because of outdoor experience, she wants to spend more time outdoors
	Natalie	1. Enjoyed spending time outdoors during program
	Sam	1. Enjoyed spending time outdoors during the program because it reminded her of home

Table 4.24. *Qualitative Themes from Girl Scout Interviews*

Research Question	**Theme(s)**
#1- Youth Interest Pre-program	Local Girl Scouts participate in outdoor activities with their troops such as camping, hiking, and community activities. Youth in both groups were familiar with and interested in local parks and recreation areas. All five participants in the control group mentioned Columbian Park, three in the treatment group did. All four participants in the treatment group mentioned Happy Hollow, one in the control group did. Youth that participated in the program, both groups, have positive attitudes about spending time outdoors, prior to and following the program.
#2- Engagement/Interest Post-program	Youth participants were engaged with the program, affectively, behaviorally, and cognitively. Cognitive engagement was seen in all nine interviewees, through engineering design challenges and hands-on activities. Youth in both groups indicated an interest in spending more time outdoors following the program.

Table 4.24. *Qualitative Themes from Girl Scout Interviews (continued)*

#3- Intentions to participate in pro-environmental behaviors	Youth had a desire to participate in pro-environmental behaviors following the program, with members of the treatment group providing reasons why relating to the program experience.
#4- STEM Program Experience	The outdoor experience was an important part of the program that motivated those in the treatment group to spend more time outdoors, and those in the control group indicated a desire to have gone outside during the program. The STEM integrated and hands-on activities during the program motivated youth to participate in outdoor and pro-environmental activities.

4.9 Summary of Chapter 4

Chapter 4 presented the results from both the quantitative and qualitative data from this study. Through both quantitative and qualitative methods, the researcher gained a better understanding of the impacts of the STEM integrated program. Youth participants in this study came into the program with a high level of interest in the outdoors, from their backgrounds as well as experiences in their Girl Scout troops. The girls in both groups showed an increase in their interest in participating in outdoor and youth activities following their participation in the STEM program. The control group showed significant differences for participation in all youth activities: nature-based, sports-related, technology-related, and leisure activities. The treatment group showed significant differences in technology-related activities. Both groups showed a significant increase in interest in spending time outdoors following the program, as well as enjoyment of seeing pollinators. Girls also showed engagement during the program, and had significant increases in cognitive engagement for both groups, and behavioral engagement for the treatment group. Girls were interested in spending more time outdoors and participating in pro-environmental behaviors following the program. The quantitative results in this study mirror what was seen in the qualitative analysis, with girls discussing their experiences prior to the program as being largely outdoors, having cognitive engagement through engineering design challenges and hands-on activities, and a positive attitude towards participating in pro-environmental behaviors.

CHAPTER 5 CONCLUSIONS & DISCUSSION

5.1 Purpose of the Study

The purpose of this study was to explore and describe the effects of a STEM integrated non-formal program, with an outdoor experience, on Girl Scouts' pro-environmental intentions.

5.2 Research Questions for the Study

The following research questions, which were informed by the conceptual and theoretical frameworks, guided the study:

1. What were students':
    a. Prior experiences regarding nature and the outdoors?
    b. Interest level in youth activities prior to participating in the program?
    c. Interest level in outdoor activities prior to participating in the program?
2. To what extent did students in the control and treatment group:
    a. Engage affectively with their environment while participating in this 6-week STEM integrated pollinator program?
    b. Engage cognitively while participating in this 6-week STEM integrated program?
    c. Engage behaviorally in program activities while participating in this 6-week STEM integrated program?
    d. Indicate interest in participating in youth and outdoor activities following the program?

3. To what extent did students in the treatment group have intentions to participate in pro-environmental behaviors after attending this 6-week STEM integrated pollinator program with an outdoor experience, when compared to the control group without an outdoor experience?
4. What experiences in this 6-week STEM integrated pollinator program motivated students, in both the treatment and control groups, to have a greater interest in nature and the outdoors?

5.3 Conclusion 1

Girl Scout participants, both control and treatment groups, described being more interested in nature and the outdoors after participating in this STEM integrated program.

5.3.1 Discussion

Youth participants in this STEM integrated program came into the program with a high interest in level in nature and the outdoors. Local Girl Scouts participate in outdoor activities with their troops such as camping, hiking, and community activities. Youth in both the control and treatment groups were familiar with and interest in local parks and recreation areas. All five participants in the control group mentioned Columbian Park, and three in the treatment group did. All four participants in the treatment group mentioned having visited Happy Hollow, and one in the control group mentioned it. Though youth in different Girl Scout troops have different outdoor experiences, they are still having experiences that can influence their interests. Youth that participated in the program, both groups, have positive attitudes about spending time outdoors, prior to and following the program. Although the girls started the program with a high interest level, this interest in the outdoors did show an increase following completion of the program. However, it is hard to determine the amount of interest that came from the program, and how much the girls had before the program. Prior to the program, participants indicated that they spent time outdoors, that they enjoyed spending time outdoors, and a few participants indicated that they enjoyed seeing pollinators. After the program, there was a 12% increase in enjoyment of spending time outdoors and a 28% increase in enjoyment of seeing pollinators. The qualitative data also support this increase in interest, as all but one interviewee expressed interest in spending more time outdoors following the program. Being interested in the outdoors is an important first step in actually spending more time outdoors. Youth who have meaningful experiences outdoors are more likely to care about issues affecting the environment (Pozzoboni, Sikand, Reist, & Roberts, 2014).

Following the program, youth indicated that they participated more in nature-based activities, sports-related activities, technology-related activities, and leisure activities. The largest difference was seen in technology-related activities. However, during the program, there was no usage of technology, so any increase in youth participating in this type of activity was likely not due to the program experience.

An increase in interest supports both the theoretical and conceptual frameworks, and bodes well for development of a well-developed individual interest. It appears that overall, the youth that participated in the program had their interest triggered situationally by the program experience, with the design component being of largest interest to the girls. Their interest was maintained throughout the program through both the pollinator content and design activities, shown as engagement. By the end of the program, youth demonstrated emerging individual interest, interest categorized by having positive feelings, knowledge, and seeing value in the topic (Hidi & Renninger, 2006). They looked forward to the lessons and enjoyed the opportunity to work with their friends on a design challenge. Through the interviews, it was clear that the participants were still largely interested in learning more about pollinators, indicating an emerging individual interest. Danielle, a sixth grader in the control group, said that she would like to continue learning more about pollinators, especially about spiders. Madison, a seventh grader in the treatment group, wanted to apply her knowledge and interest in the content to educating her science class about the importance of pollinators.

It is difficult to say how much this program increased youth interest in outdoor and youth activities, due to a high prior interest level. Girl Scout participant prior experiences influenced interest in nature and the outdoors prior to the program, but the program did appear to have had an impact on the interest level of girls. Even though they had a high interest level in nature and the outdoors, many of the Girl Scout participants did not have much familiarity with pollinators before the program. Following the program, girls did indicate an increased interest in seeing pollinators and did seem to be more interested in learning more about them. Looking back at the conceptual framework, engagement leads into an increased interest in youth activities and the outdoors. This idea is supported by a study on youth motivation in programs by Dawes and Larson (2011). Forming a personal connection was the most important part of engagement for youth in the study. By understanding how the topic or activity related to them on a personal level made it easier to make connections, thus increasing their interest level through engagement (Dawes & Larson, 2011). This program aimed to connect youth to a real-world problem, and having that connection can help youth become more interested in the problem.

5.4 Conclusion 2

Girl Scout participants in both the control and treatment group for the STEM integrated program were cognitively engaged and the girls in the treatment group with the outdoor experience were behaviorally engaged when compared to their peers that had their program entirely indoors.

5.4.1 Discussion

Youth were engaged during this program. They showed moderate affective, or emotional, engagement, before and after the program. Girls in the treatment group showed a larger increase in their behavioral engagement after the program, but nearly all of the participants already act positively towards pollinators so the effect of the program on their behavioral engagement was small. The largest effect of the program was seen on participants' cognitive engagement. There were significant increases within both groups, and the effect size was moderate (d = 0.51) for post-program cognitive engagement. The youth enjoyed the lessons in this program, and they learned information and were able to apply that information to the real-world problem of pollinator decline while participating in the program. In the future, they may be able to take this knowledge and apply it to their real lives.

Affective engagement did not show a change in either group, meaning that the youth did not see an increase in emotional attachment following the program. This could be due to a couple of different reasons. First, the length of the program was too short. Bogner (1998) found in a study looking at the influence of a short-term program on environmental perspectives that both treatments (1-day program and 5-day program) had influences on youth knowledge, but that the longer program had an impact on attitudes. Second, youth were not exposed to a true nature experience. They were not able to develop an affective relationship with the natural world. This conclusion is different than what Suryanti, Sinaga, and Surakusumah (2018) found when using integrated science teaching materials to increase environmental literacy in junior high students. They saw an increase in the affective test, and showed that when students discuss environmental issues such as pollution, they gain a sensitivity towards the environment. By not going outdoors at all, for the control group, and only spending a short time in an urban setting, for the treatment group, the opportunity to make an emotional connection was very limited. In a study by Wals (1994), youth in an urban setting enjoyed being able to spend relaxing time outdoors to think freely about their emotions; however, these emotions did not necessarily relate to their environment. Having an emotional investment helps to shape one's attitudes, values, and beliefs about the environment (Kollmuss & Agyeman, 2002). Affective engagement has been shown to be critical to the development of lasting pro-environmental behaviors (Pooley & O'Connor, 2000). However, a small affective engagement did not seem to limit the interest level of the youth participants.

Behavioral engagement was seen in both groups. Youth demonstrated behavioral engagement during the program by being active participants in the activities and through their actions toward pollinators (not killing them, etc.). Maggie, a fourth grader in the treatment group, talked about her plan to run from bees, so that she does not smash them, showing a positive behavior towards the bees. The treatment group showed an increase in behavioral engagement after the program, whereas the control group did not. The control group did not spend any time outdoors during their program, the treatment group did. Although there was no seen effect of the outdoor experience when looking at affective engagement, there may have been an impact on behavioral engagement from the outdoor experience. An increase towards positive behaviors relating to nature was seen in adults after participating in both "wild" (hiking, camping, fishing) and "domesticated" (picking flowers, looking at plants) nature activities as children (Wells & Lekies, 2006). Having experiences in any nature setting as a child is important for making connections to the natural world, and can have lasting impacts on youth as they get older and reach adulthood.

Cognitive engagement was shown in youth by their knowledge recall and ideas for the application of concepts learned. There was no significant differences between the control and treatment groups for cognitive engagement, leading to the conclusion that both groups were equally engaged in the program cognitively. This indicates that the pollinator content and design activities of the STEM program experience were most impactful on youth, and the outdoor experience in the treatment group did not have a large effect on cognitive engagement in youth. The high level of cognitive engagement seen in this study is consistent with the findings of a study looking at the influence of engagement on intentions toward pro-environmental behaviors, in which a similar educational program was seen to have an influence on students' intentions (Frölich et al., 2013). Another study conducted by Suryanti et al. (2018) supported what was seen in this program, with the highest increase from an integrated program being in knowledge gained.

Although there were not increases in all three types of engagement, the results from the study support the conceptual framework. Youth must be engaged for them to have an increase in interest in outdoor and youth activities, and for them to have intentions to participate in pro-environmental behaviors. Girl Scouts in this program had no trouble being engaged because of their high interest level to begin with. Although there were not significant differences seen for all areas of engagement, girls came into the program with high levels of affective, behavioral, and cognitive engagement, which shows the importance for increasing their interest levels overall. Future research could focus more on the affective engagement piece, and look at an audience with a low level of interest prior to the program. Cognitive and behavioral engagement are built-in with the pollinator content and design activities, therefore making affective engagement the most challenging type of engagement to see and for youth to experience. Having a higher level of affective engagement would have supported the three parts of engagement seen in the conceptual framework, but it did not appear that the low level of affective engagement affected Girl Scout participants' interest levels following the program or their intentions toward pro-environmental behaviors.

Engagement is important when talking about the success of a non-formal program in general, and when talking about its' relationship with participation in pro-environmental behaviors. Youth in both groups were engaged during this program. They were both most cognitively engaged with their interest in learning about pollinators and their ability to apply what they learned to a design challenge. For them to be cognitively engaged and learning, they had to have been behaviorally engaged during the program, as suggested by the results. They also showed behavioral engagement towards pollinators and the environment. Affective engagement may have been seen more had the program been a longer length of time or if the youth had been able to spend more time outdoors in a nature setting, urban or "wild." Skinner and her colleagues (2012), saw connections between behavioral and emotional engagement as being related to one another in a school-based garden program, and suggested that garden-based programs differ from schoolwork providing a different level and type of motivation.

In this study, the types of engagement were examined individually, and it did not seem that there was a lower overall engagement from students, even though there was a low level of affective engagement.

5.5 Conclusion 3

Girl Scout participants in both the control and treatment groups described similarly positive views toward their intentions to participate in pro-environmental behaviors.

5.5.1 Discussion

Following the STEM integrated program, youth participants had intentions to participate in pro-environmental behaviors. Both groups had positive intentions, and there were no differences seen between the groups. Even with the time and location constraints of the program, the goal to influence the intentions of youth towards pro-environmental behaviors appears to have been successful. Youth had a desire to participate in pro-environmental behaviors following the program, and the reasons for these intentions related back to the STEM program experience. Natalie, a seventh grader in the treatment group, explained that her interest for participating in pro-environmental behaviors was due to learning about the importance of pollinators. Two other girls in the treatment group indicated that their interest in participating in pro-environmental behaviors was due to their outdoor experience during the program (Madison, a seventh grader, and Sam, a fourth grader). Macy, a fourth grader in the control group, said that her interest in pro-environmental behaviors came from looking at the insects up close.

Similar to the interest level of the girls, many youth participants already conducted themselves in a way that is pro-environmental, prior to participation in the program. They had knowledge of ways to help the environment (install bat box, conserve water, turn off lights), before the program. However, through the interviews, it was clear that the girls had gained knowledge in different ways to help the environment related to pollinators, such as planting a garden or installing a bee nest. For example, Maggie, a fourth grader in the treatment group, said that she wanted to plant a garden with flowers to attract pollinators.

This finding of an intention to participate in pro-environmental behaviors is consistent with a study by Fröhlich et al. (2013), in that initially following a program the intention to participate is high. However, the study by Fröhlich et al. (2013) also showed that this interest does not last and did not lead to a change in behavior. Other studies have shown cognitive engagement to be a factor in affecting participation in pro-environmental behaviors. A study conducted by Kaiser, Wölfing, and Fuhrer (1999) showed that having knowledge of the environment is an important piece that individuals must have in order to have intentions to act positively towards the environment. Youth that participated in this program were cognitively engaged, but it is unknown if they were engaged enough to participate in pro-environmental behaviors following the program. However, even though the goal of environmental education is to change behaviors, the goal of this program was for youth to have intentions to participate. This is reflected in the conceptual framework. Since youth were engaged and their interest levels increased following the program, they were more interested in participating in pro-environmental behaviors.

5.6 Conclusion 4

Girl Scout participants in both the control and treatment groups shared positive experiences during the STEM integrated program, and described the parts of the program that motivated them to participate in outdoor activities and pro-environmental behaviors.

5.6.1 Discussion

The experience Girl Scouts had in this STEM integrated program was positive and had an impact on their views towards pollinators. Supporting the theoretical and conceptual frameworks, girls had triggered situational interest from the program. This triggered situational interest began with the engineering design activities that the girls participated in during the program through exposure to new information and a new way of thinking, and helped their interest to grow through maintained situational interest and emerging individual interest. Youth participants that were interviewed indicated several ways through which the STEM program experience led them to want to spend more time outdoors and to participate in pro-environmental behaviors. The most commonly mentioned part of the program that was mentioned was the Planning a Pollinator Garden lesson where youth were given a scenario, as a team, that they were challenged to follow to create a design for a pollinator garden. This lesson was the most integrated and focused heavily on science (biology), engineering design (garden design), and mathematics (area/size of garden). Several interviewees also expressed their enjoyment of the Pollinators and Flowers lesson that challenged them to create a flower to attract the most pollinators. They then tested their flower by assuming the identity of a pollinator and learned about pollinator syndromes that outline which type of flowers certain pollinators are attracted to. For example, a butterfly is attracted to bright red and purple flowers with a faint odor and hidden nectar. These activities provided a new way for youth to look at the real world and test out their ideas. In an engineering design challenge, youth are encouraged to discuss their ideas with their peers and review and redesign their product (Wendell & Rogers, 2013).

STEM education can focus on many things, but it should help youth become interested and curious about a relevant topic (Vasquez et al., 2013). This curiosity relates back to the Four-Phase Model of Interest Development, and the program goal of reaching an emerging individual interest, when an individual chooses to reengage with a topic over time (Hidi & Renninger, 2006). Macy, a fourth grader in the control group, indicated her interest in continuing to learn more about the program content by saying, "I'd like to know a lot more about pollinators." She held maintained situational interest during the program by working closely with her teammates on design challenges, but she asked questions and wanted to learn more about the topic.

Another impactful experience for the girls was looking at insects up close. Many of them had not had this opportunity and they expressed their excitement for being able to try something new, and hands-on. From past research, hands-on active learning has been shown to help youth learn material better and can help them acquire new knowledge faster (Waliczek & Zajicek, 1999). By helping youth to understand the connections between an activity and the real-world, programs will have a greater influence over their future actions (Ballantyne, Fien, & Packer, 2001). Much of environmental and STEM education is hands-on, and helps youth to apply the knowledge instead of learning it for test taking (Vasquez et al., 2013; Poudel, Vincent, Anzalone, Hunter, Wollard, Clement, DeRamus, & Blakewood, 2005). Even though youth were not tested on their knowledge gained, they were able to apply what they learned to the design challenges and relate that to the real-world.

The outdoor experience had by the treatment group seemed to have an impact on youths' motivations toward spending time outdoors and participating in pro-environmental behaviors.

Madison, a seventh grader in the treatment group, described that her experience looking at insects indoors paired with the opportunity to spend time outdoors during the program made her want to participate in more pro-environmental behaviors. About the outdoor experience, Maggie, a fourth grader in the treatment group, said, “I think going outside made it so I kind of wanted to do it more.” Girls in the control group said that they wish they could have gone outside during the program. When asked if there was anything that would have helped them make a stronger connection with the outdoors, Courtney, a second grader in the control group, and Danielle, a sixth grader in the control group, both suggested going outdoors and looking around. The outdoor experience provided to the treatment group was not meant to replicate a “wild nature” area, but could be significant to urban youth who may not know what a “wild nature” area looks like. Nature looks different to everyone, and Wals (1994) discovered that to urban youth in Detroit, nature had many different meanings. Youth said that nature was entertainment, nature was a place for learning, nature was a place to reflect, nature was threatening/dangerous, and that nature is a threatened place. Youth in the current study showed similar results in their thinking, but thought that spending time outdoors was a generally positive experience. More and more youth are growing up in urban environments and have limited exposure to nature of any type (Waliczek & Zajicek, 1999). However, according to Ewert et al. (2004), experiences outdoors early in life are critical to encourage pro-environmental behaviors, supporting the need for more environmental education programming to incorporate an outdoor experience.

Overall, the STEM program experience had an impact on youth. This is supported by the findings of a study focusing in the environmental literacy of youth following an integrated science program relating to pollution (Suryanti et al., 2018). Regardless of the addition of an outdoor experience, youth from both groups were able to be engaged and showed interest in the activities and engineering design challenges. Having hands-on activities along with design challenges that really make youth work together and think critically about a problem is crucial to the success of any STEM program, especially in a non-formal setting. The Girl Scout participants were motivated primarily through the pollinator content and design activities through the STEM program experience. Although the girls in the control group mentioned having a desire to have gone outside, the results did not indicate that the outdoor experience had much of an effect on the pro-environmental intentions for either the control or treatment group.

5.7 Implications for Practice

STEM continues to be a growing area of interest and research in education. By providing youth in the elementary grades with exposure to STEM concepts and challenges, they can become more confident and interested learners (DeJarnette, 2012). This study indicated that youth participants enjoyed participating in hands-on activities and engineering design challenges. The most memorable parts of the program for them were the ones where they were challenged. Many informal learning environments such as zoos, museums, and nature centers, are redesigning their programs to align with NGSS standards and focus more on integrated STEM. Along with informal and non-formal settings, this program could also be used in a formal classroom setting. The lessons can stand alone, and were designed so that they could easily be transferred to a different learning environment. Teachers may be able to incorporate the hands-on activities and engineering design challenges into their developed lesson plans. Developing curriculum that is transferrable to other venues makes it relevant to a large audience of educators and students. Although the lessons were developed for upper elementary students, small adjustments in the depth of content could make them relevant for middle or high school students that may have not been exposed to STEM concepts and environmental education topics.

Although this research aimed to look at the effects of an outdoor experience on Girl Scouts' pro-environmental intentions, the most important finding was that there were not many differences seen between the control and treatment group. This is important because many programs are taught entirely indoors, or could be taught in seasons where the weather is not ideal for outdoor activities. There are many locations across the U.S. and beyond where weather conditions might not allow for youth to spend time outdoors, or may only be good conditions for a portion of the year. Utilizing curriculum, such as the one in this STEM integrated program, that can be used in multiple settings, regardless of location or weather conditions, is useful to reach more youth and have similar impacts on pro-environmental intentions, as seen in this program.

A way to have a greater reach with STEM programs is to utilize volunteers, particularly adult volunteers. According to Rouse & Clawson (1992), adult volunteers can fill roles related to youth development, and they are willing to do so, motivated by their interest in achievement and affiliation, development of relationships with others. There are many organizations that work with youth, and they are always looking for more ways to get involved. The STEM program in this study had been previously taught by Master Gardener volunteers, who enjoyed working with youth and helping them learn about pollinators while participating in engineering design challenges. Expanding to include Master Naturalist volunteers and other volunteer groups would allow for a larger number of youth to be reached with this type of STEM programming, whether or not there was an opportunity to incorporate an outdoor experience.

Because many youth are constantly in an urban environment, this program may help them make connections with the world around them. Even in an urban setting for both treatment and control groups, the youth in this study were able to make connections and were more interested in participating in pro-environmental behaviors following completion of the program. Utilizing hands-on activities along with engineering design piques their interests and can help youth have all levels of interest, triggered, maintained, emerging, and well developed, as Hidi and Renninger (2006) presented in their Four-Phase Model of Interest Development.

This program is just one way that the Girl Scouts organization is working to expand their STEM programming. Over the past couple of years, STEM has become a priority in the Girl Scouts, and the badges relating to STEM have been updated to reflect interests of members and challenge girls (Girl Scout Research Institute, 2016). Not only are these STEM programs interactive and fun, they also help girls to develop STEM-related skills such as building/designing things, solve problems, and research a problem. One badge in particular, Naturalist, encourages girls to explore the outdoors while making STEM connections. Working closely with the Girl Scouts would ensure curriculum meets the goals of their organization, while meeting to goals of environmental education.

5.8 Recommendations for Future Research

This study was exploratory in nature. The researchers learned valuable information regarding Girl Scouts experiences with a STEM integrated program and the inclusion of an outdoor experience, but it is important to recognize the limitations of the study. Future research should consider focusing on providing a more in-depth program experience, specifically regarding the length of the program. Six weeks may be ample time to provide youth with an impactful program, but the effects of such a program may be seen more clearly if the program is longer, which would be consistent with the recommendation from Fröhlich et al. (2013) to have a longer program experience. Another limitation was the amount of time the treatment group spent outdoors during the program, 20 minutes each lesson. A future study could modify the program structure to allow more time outdoors to see if there were stronger impacts on youth participants in the treatment group. Having only measured the intent to participate in pro-environmental behaviors in this study, an additional piece could be added to future studies to follow-up with participants to see if their intentions to participate in pro-environmental behaviors translated into actual behaviors. A follow-up could be done three months, six months, and even one year following the program to determine any lasting effects of the program.

By only having 25 total participants, all of whom were female, statistical power was limited as is the ability to make claims that can be generalized to a larger population (Shadish et al., 2002). Coordinating with other informal education learning centers, such as the YMCA or Boys & Girls Club, would be a way to increase the number of participants in a similar study, and to examine any differences between genders. Along with completing the program at other locations, it would be interesting to see if there were any differences seen between locations. For example, youth that attend afterschool programs at the YMCA or Boys & Girls Club may not have a choice in their program, whereas youth who attend programs outside of school at places like zoos often already have an interest in nature and the outdoors (Shields, 2010). Taking a look at socioeconomic status would be another avenue of investigation. This would include completing the program places where underrepresented minorities (URMs) are represented. Looking at differences between groups could provide some insight into ways of getting more URMs to participate in not only environmental education, but STEM programs.

Employing a mixed-methods research design served the purpose of this study well. Using a quantitative base to provide simple results with a qualitative look into the reasons behind the interests and experiences of youth provided a more in-depth, holistic look at the program experience. Future research may expand on this study's methods by employing in-depth interview methods. By looking deeper into the youth program experience, researchers could better understand youth thinking and understanding of the problem of pollinator decline.

Future research could continue to look at the interaction between STEM and environmental education for the purpose of influencing youth to participate in pro-environmental behaviors, specifically looking at motivation. There are few studies that have looked at the effects of a STEM integrated curriculum, particularly in the context of environmental education. However, there are limited studies that have looked at the motivations behind youth pro-environmental behaviors. With an ever changing world, programs that have an impact on youth pro-environmental behaviors and interests towards nature and the outdoors are critical and the way to understand their success is to continue conducting research that looks more in-depth at the interests and motivations relating to pro-environmental behaviors.

5.9 Research Summary

In summary, this research study aimed to better understand the way youth are motivated to have intentions to participate in pro-environmental behaviors. Through a STEM program experience, there were differences seen in interest in youth and outdoor activities, cognitive engagement, behavioral engagement, and intentions to participate in pro-environmental behaviors. The program was successful in its goal of affecting Girl Scouts' intentions to participate in pro-environmental behaviors, but is limited in the ability to make strong assertions. Had there been an opportunity to have a longer program at more locations, the results from this study would have been more significant. This study adds to the current literature by opening the door to looking at how STEM programming can be applied in a more non-formal setting and how STEM and environmental education interact. Spending time outdoors may be the most effective way to influence youths' pro-environmental behaviors, but an interactive STEM integrated program may have the opportunity to make a similar impact. This study provides a starting place for the integration of STEM into a non-formal setting as a way to increase pro-environmental intentions.

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APPENDIX A. IRB APPROVAL

PURDUE UNIVERSITY

HUMAN RESEARCH PROTECTION PROGRAM
INSTITUTIONAL REVIEW BOARDS

To:	HUI-HUI WANG AGAD
From:	JEANNIE DICLEMENTI, Chair Social Science IRB
Date:	09/11/2017
Committee Action:	**Expedited Approval - Category**(7)
IRB Approval Date	09/08/2017
IRB Protocol #	1707019466
Study Title	STEM Integrated Pollinator Program
Expiration Date	09/07/2018
Subjects Approved:	40

The above-referenced protocol has been approved by the Purdue IRB. This approval permits the recruitment of subjects up to the number indicated on the application and the conduct of the research as it is approved.

The IRB approved and dated consent, assent, and information form(s) for this protocol are in the Attachments section of this protocol in CoeusLite. Subjects who sign a consent form must be given a signed copy to take home with them. Information forms should not be signed.

Record Keeping: The PI is responsible for keeping all regulated documents, including IRB correspondence such as this letter, approved study documents, and signed consent forms for at least three (3) years following protocol closure for audit purposes. Documents regulated by HIPAA, such as Authorizations, must be maintained for six (6) years. If the PI leaves Purdue during this time, a copy of the regulatory file must be left with a designated records custodian, and the identity of this custodian must be communicated to the IRB.

Change of Institutions: If the PI leaves Purdue, the study must be closed or the PI must be replaced on the study through the Amendment process. If the PI wants to transfer the study to another institution, please contact the IRB to make arrangements for the transfer.

Changes to the approved protocol: A change to any aspect of this protocol must be approved by the IRB before it is implemented, except when necessary to eliminate apparent immediate hazards to the subject. In such situations, the IRB should be notified immediately. To request a change, submit an Amendment to the IRB through CoeusLite.

Continuing Review/Study Closure: No human subject research may be conducted without IRB approval. IRB approval for this study expires on the expiration date set out above. The study must be close or re-reviewed (aka continuing review) and approved by the IRB before the expiration date passes. Both Continuing Review and Closure may be requested through CoeusLite.

Unanticipated Problems/Adverse Events: Unanticipated problems involving risks to subjects or others, serious adverse events, and serious noncompliance with the approved protocol must be reported to the IRB immediately through CoeusLite. All other adverse events and minor protocol deviations should be reported at the time of Continuing Review.

Ernest C. Young Hall, 10th Floor - 155 S. Grant St. - West Lafayette, IN 47907-2114 - (765) 494-5942 - Fax: (765) 494-9911

APPENDIX B. INITIAL CORRESPONDENCE WITH TROOP LEADERS

Sent 6/16/2017
Good morning!

My name is Miranda Furrer and I am a Master's student at Purdue University. I work with Dr. Hui-Hui Wang in the Department of Youth Development and Agricultural Education.

The reason I am contacting you is because this past spring you indicated having an interest in STEM programming for your Girl Scout Troop. My study is looking at the effects of an integrated STEM curriculum on elementary students' pro-environmental behaviors, with regards to pollinators. I am interested in seeing if a STEM integrated program that focuses on pollinators can help students make a connection to their environment and increase their interest in pollinators. The program will include hands-on activities and will incorporate a design challenge, such as planning a pollinator garden and pollinator flower design, for the students. I would like for this program to be 6 weeks in length, with each session lasting one hour.

This research project could be a great addition to your fall troop meetings. The program is fun and interactive for the students. There will be a data collection portion, which will include a pre- and post- survey, recording of class sessions, and possibly a short interview at the conclusion of the program. Participation is optional, and confidentiality of students is of utmost importance.

If possible, I would like to set up a short meeting with you in the next few weeks to discuss this project more and to determine if this would be a good fit for your Girl Scout troop. You can email me, or if easier, call me at 309-251-2321 to set up a time to meet.

Thank you, and I look forward to hearing from you!

Sincerely,
Miranda Furrer

Miranda Furrer
Graduate Research Assistant
Purdue University
Department of Youth Development & Agricultural Education
221 Agricultural Administration Building
West Lafayette, Indiana

APPENDIX C. PARENT CONSENT FORM

Purdue IRB Protocol #: 1707019466 - Expires on: 07-SEP-2018

RESEARCH PARTICIPANT CONSENT FORM
A Native Pollinator STEM Integrated Youth Program
Hui-Hui Wang, PhD
Youth Development and Agricultural Education
Purdue University

Purpose of the study:
In their everyday lives, scientists and engineers conduct experiments and test products to answer their questions or solve problems. We designed our program to simulate how scientists and engineers do their job. The program activities focus on asking questions, analyzing and interpreting data, and reasoning and constructing explanations. For this research project, we want to explore in what ways youth are motivated to participate in pro-environmental behaviors such as recycling and planting a pollinator garden. In addition, we also want to explore how youth use what they learn to solve a real-world problem of the reasons bees are dying.

If you choose to be in the study:
Your child will do the following things:

- Your child will participate in the program. **The program will begin late September 2017 and will end in November 2017**. Your child will meet at least once per week for a total of 1 hour to learn about bees, interactions between the material and natural world, and a plan for a native pollinator-friendly garden. Although there is no cost or penalty if your child misses a program meeting, in order to get the best result for the research study, we would like your child not to miss more than two educational meetings for the entire program.
- **Interview:** We will conduct one interview with your child. One interview will be conducted at the end of the program. Each interview will be about 30- 45 minutes. The interview will focus on your child's knowledge around conducting scientific experiments/testing plans and how they use skills, such as asking questions, analyzing and interpreting data and reasoning and constructing explanations to help them make decisions.
- **Activity videos**: When your child is doing activities, we will videotape the small group and the whole class discussion (presentation). The video recordings will be used only for educational purposes.
- **During-program discussions**: We may conduct few discussions during each day's activity with your child. The conversations will focus on your child's thoughts on that day's activity.

Risks of being in the Study:
The study has minimal risks: First, your child may feel frustrated if their design/experiment does not work. However, that is part of the learning process. In the real world, scientists and engineers rarely achieve success on their first attempt. If your child feels frustration, our instructors are trained to direct your child positively by encouraging them to seek different solutions for the problems. Second, your child may not wish to be included in the video or photos during some activities. If that happens, we will not videotape your child's image.

Benefits of being in the Study:
Please note that there will be no direct benefits for your child to participate in this study. A possible benefit of this study would be the participants learning more information about pollinators while increasing their confidence in their ideas.

Alternatives to the Study:
There are no alternatives to this study. The participants will be receiving the same program with the same lesson topics.

Confidentiality:
All information will be kept confidential. The project's research records may be reviewed by departments at Purdue University responsible for regulatory and research oversight. The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify your child. Research records will be stored securely and only researchers will have access to the records. Study data will be encrypted according to current University policy for protection of confidentiality. Only the Principal Investigator (Dr. Hui-Hui Wang) and the graduate research assistant will have access to the audio and video recordings. The audio and video recordings will be used for educational purposes. Two years after your child finishes the program, the data will be destroyed.

Your Rights if your child participates in the Study:
Participation in this study is voluntary. Your child may choose to not participate or, if they agree to participate, you can withdraw their participation at any time without penalty or loss of benefits to which you are otherwise entitled.

Contacts and Questions:
The researchers conducting this study are: Dr. Hui-Hui Wang and Miranda Furrer, Graduate Research Assistant. If you have questions, comments, or concerns about this research project, you can talk to one of the researchers. Please contact Dr. Hui-Hui Wang at Purdue University, (765) 494-6897, huiwang@purdue.edu. You may also contact Miranda Furrer, furrer@purdue.edu.

If you have questions about your rights while taking part in this study or have concerns about the treatment of research participants, please call the Human Research Protection Program at Purdue University at (765)-494-5942, email (irb@purdue.edu) or write to:
Human Research Protection Program- Purdue University
Ernest C. Young Hall, 155 S. Grant Street, West Lafayette, IN, 47907-2114

Documentation of Informed Consent:

I have had the opportunity to read this consent form and have the research study explained. I have had the opportunity to ask questions about the research study, and my questions have been answered. I am prepared to have my child participate in the research study described above. I will be offered a copy of this consent form after I sign it.

Participant Signature: ____ Date: __________________

Printed Participant Name: ____

Researcher's Signature: ________________________________ Date: __________________

APPENDIX D. YOUTH ASSENT FORM

Purdue IRB Protocol #: 1707019466 - Expires on: 07-SEP-2018

ASSENT FORM (Youth)

A Native Pollinator STEM Integrated Youth Program

Our names are Hui-Hui Wang and Miranda Furrer. We work at Purdue University, and would like to learn more about how a program that focuses on engineering design and hands-on activities can encourage you to participate in activities like recycling and planting a pollinator garden. To do this, we are inviting you to participate in a research study. The results of the study will help us understand what motivates you to spend time outdoors and participate in activities like recycling and planting a pollinator garden.

If you agree:

1) You will be asked to share your drawings and designs that you created during the program.
2) You will be videotaped when you work with your team during the program.
3) You will also be asked to participate in an interview that will last approximately 30 to 45 minutes.
4) You will be asked to participate in group discussions. These discussions will be informal and will take place during the program.

The interview questions will focus on what you know about your experiences outdoors and the reasons why you like spending time outdoors. During the interviews, we would like to video-record our conversation.

Participation in this study is voluntary. You are free to not share your drawings and your design. Your qualification to participate the program will NOT be affected, if you do not wish to participate in this study. Your decision whether or not to participate will not affect your current or future relations with Purdue University and the Girl Scouts. If you decide to participate, you are free to not answer any question that make you feel uncomfortable. You are also free to withdraw from the study at any time without affecting those relationships.

The records of this study will be kept private. All records will be stored securely and only we (Hui-Hui and Miranda) will have access to the records. If we use this study to write an article about what we learn from you, we will not use your real name.

Before you decide to take part in this study, I will answer any questions you have. You can also talk to your parents or guardians. You will be given a copy of this form to keep for yourself.

For any questions, please contact Hui-Hui Wang at 765-494-6897, or huiwang@purdue.edu.

If you decide to be in the study, please sign your name below.

__________________________________ __________________

Subject's Signature Date

APPENDIX E. PRE-PROGRAM QUESTIONNAIRE

Name____

Section I.

1. I spend time outdoors (at parks, at home, in the woods).

No **Maybe** **Yes**

2. I enjoy spending time outdoors (at parks, at home, in the woods).

No **Maybe** **Yes**

3. I enjoy seeing pollinators (bees, birds, bats) (at parks, at home, in the woods)?

No **Maybe** **Yes**

4. I like to participate in the following activities (circle all that apply):

Reading
Visiting parks
Girl Scouts
Camping
Horseback Riding
Swimming
Playing video games
Hiking
Soccer
Softball
Music (band or piano)
Technology related activities (computers, robotics)

Section II.

1. I want to spend more time outside.

No **Maybe** **Yes**

2. I feel good when I spend time outside.

No **Maybe** **Yes**

3. I feel sad when I can’t spend time outdoors.

No **Maybe** **Yes**

4. When I do things outdoors, I feel relaxed.

No **Maybe** **Yes**

5. Spending time outdoors makes me feel anxious/nervous.

No **Maybe** **Yes**

Section III.

1. Bees are an important part of my life.

No **Maybe** **Yes**

2. I plant flowers for bees in my garden.

No **Maybe** **Yes**

3. I care about the number of bees in the place where I live.

No **Maybe** **Yes**

4. I know a lot of information about bees.

No **Maybe** **Yes**

5. The well-being of bees is not my concern.

No **Maybe** **Yes**

Section IV.

1. I put up a bee nest to help bees survive.

No **Maybe** **Yes**

2. When I see pollinators, I leave them alone.

No **Maybe** **Yes**

3. I plant plants (flowers) in my garden that are good for pollinators.

No **Maybe** **Yes**

4. I recycle when I can.

No **Maybe** **Yes**

5. I help wildlife when I can.

No **Maybe** **Yes**

APPENDIX F. POST-PROGRAM QUESTIONNAIRE

Name____

Section I.

1. I spend time outdoors (at parks, at home, in the woods).

No **Maybe** **Yes**

2. I enjoy spending time outdoors (at parks, at home, in the woods).

No **Maybe** **Yes**

3. I enjoy seeing pollinators (bees, birds, bats) (at parks, at home, in the woods)?

No **Maybe** **Yes**

4. I like to participate in the following activities (circle all that apply):
Reading
Visiting parks
Girl Scouts
Camping
Horseback Riding
Swimming
Playing video games
Hiking
Soccer
Softball
Music (band or piano)
Technology related activities (computers, robotics)

Section II.

1. I want to spend more time outside.

No **Maybe** **Yes**

2. I feel good when I spend time outside.

No **Maybe** **Yes**

3. I feel sad when I can’t spend time outdoors.

No **Maybe** **Yes**

4. When I do things outdoors, I feel relaxed.

No **Maybe** **Yes**

5. Spending time outdoors makes me feel anxious/nervous.

No **Maybe** **Yes**

Section III.

1. Bees are an important part of my life.

No **Maybe** **Yes**

2. I plant flowers for bees in my garden.

No **Maybe** **Yes**

3. I care about the number of bees in the place where I live.

No **Maybe** **Yes**

4. I know a lot of information about bees.

No **Maybe** **Yes**

5. The well-being of bees is not my concern.

No **Maybe** **Yes**

Section IV.

1. I put up a bee nest to help bees survive.

No **Maybe** **Yes**

2. When I see pollinators, I leave them alone.

No **Maybe** **Yes**

3. I plant plants (flowers) in my garden that are good for pollinators.

No **Maybe** **Yes**

4. I recycle when I can.

No **Maybe** **Yes**

5. I help wildlife when I can.

No **Maybe** **Yes**

Section V.

After attending this program,

1. I want to spend more time outdoors.

No **Maybe** **Yes**

2. I want to help pollinators.

No **Maybe** **Yes**

3. I want to visit parks where I have not been before.

No **Maybe** **Yes**

4. I want to help the environment.

No **Maybe** **Yes**

5. I want to do everything I can to help save the planet.

No **Maybe** **Yes**

Section VI. Demographics

1. What is your age?

   ____

2. Where do you live (choose one)?
   a. City (Urban)
   b. Suburban
   c. Rural
   d. Farm

APPENDIX G. QUESTIONNAIRE CODEBOOK

Section I. Interest in outdoors/pollinators
1. I spend time outdoors (at parks, at home, in the woods). **INTR_1**

No **Maybe** **Yes**

2. I enjoy spending time outdoors (at parks, at home, in the woods). **INTR_2**

No **Maybe** **Yes**

3. I enjoy seeing pollinators (bees, birds, bats) (at parks, at home, in the woods)? **INTR_3**

No **Maybe** **Yes**

4. I like to participate in the following activities (circle all that apply):

Interest in Youth Activities

1 Visiting parks
1 Hiking
1 Camping
2 Horseback Riding
2 Swimming
2 Soccer
2 Softball
3 Technology related activities (computers, robotics)
3 Playing video games
4 Girl Scouts
4 Reading
4 Music (band or piano)

1 Nature-based activities
2 Sports-related activities
3 Technology-related activities
4 Leisure activities

Section II. Affective engagement

1. I want to spend more time outside. **AE_1**

No **Maybe** **Yes**

2. I feel good when I spend time outside. **AE_2**

No **Maybe** **Yes**

3. I feel sad when I can’t spend time outdoors. **AE_3 (reverse code)**

No **Maybe** **Yes**

4. When I do things outdoors, I feel relaxed. **AE_4**

No **Maybe** **Yes**

5. Spending time outdoors makes me feel anxious/nervous. **AE_5 (reverse code)**

No **Maybe** **Yes**

Section III. Cognitive engagement

1. Bees are an important part of my life. **CE_1**

No **Maybe** **Yes**

2. I plant flowers for bees in my garden. **CE_2**

No **Maybe** **Yes**

3. I care about the number of bees in the place where I live. **CE_3**

No **Maybe** **Yes**

4. I know a lot of information about bees. **CE_4**

No **Maybe** **Yes**

5. The well-being of bees is not my concern. **CE_5 (reverse code)**

No **Maybe** **Yes**

Section IV. Behavioral Engagement
1. I put up a bee nest to help bees survive. **BE_1**

No **Maybe** **Yes**

2. When I see pollinators, I leave them alone. **BE_2**

No **Maybe** **Yes**

3. I plant plants (flowers) in my garden that are good for pollinators. **BE_3**

No **Maybe** **Yes**

4. I recycle when I can. **BE_4**

No **Maybe** **Yes**

5. I help wildlife when I can. **BE_5**

No **Maybe** **Yes**

Section V. Intentions

After attending this program,

1. I want to spend more time outdoors. **INT_1**

No **Maybe** **Yes**

2. I want to help pollinators. **INT_2**

No **Maybe** **Yes**

3. I want to visit parks where I have not been before. **INT_3**

No **Maybe** **Yes**

4. I want to help the environment. **INT_4**

No **Maybe** **Yes**

5. I want to do everything I can to help save the planet. **INT_5**

No **Maybe** **Yes**

Section VI. Demographics

3. What is your age? **Age**

____

4. Where do you live (choose one)? **Location**

a. City (Urban) **0**
b. Suburban **0**
e. Rural **1**
f. Farm **1**

APPENDIX H. GIRL SCOUT LESSON PLANS

<u>Material Impacts on Nature</u>

Lesson Learning Objectives

1. Students will describe the differences between the designed world and the natural world.
2. Students will be able to analyze the impact of agricultural practices on nature (specifically pollinators).
3. Students will be able to recognize key food products that rely on bees for pollination.

NGSS Alignment

1. MS-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
2. 5-ESS3-1. Obtain and combine information about ways individual communities use science ideas to protect the Earth's resources and environment.

Activity 1 (Introduction & Pre-assessment)

1. **Materials**
    a. Picture of material world
    b. Picture of natural world
    c. Picture of agricultural world
2. **Activity steps**
    a. Discuss plan for the lesson, including activity outline and schedule for class
    b. Ask questions to encourage critical thinking and activate schema (prior knowledge).
    c. Ask Students if they know how human activities can impact the natural world and the food we eat.
    d. Display Nature vs. Material pictures. Ask students to identify the differences between the pictures.
    e. Ask students to share their ideas.
    f. Ask students, 'Is there any relationship between the two sides of the picture? What? How? Do the items on the right have any impact on the items on the left? How?'
    g. Ask students how the items (man-made) come into existence. Who comes up with these ideas? What process do they use? What is the goal of these products?
    h. The goal is to meet human needs and wants and allows humans to be more efficient.
    i. Have students come up with a list of products or things in agriculture that have been designed.

Activity 2 (Identifying a Potential Problem- Challenge)

1. **Materials**
    a. Post-it paper
    b. Markers
    c. Technology (computers, phones)
    d. Bee-Free Barbeque Activity Sheets
    e. List of foods pollinated by bees
2. **Activity steps**
    a. Once students have identified fertilizer, pesticides, or insecticides as designed products in agriculture, ask them to analyze the positive and negative impacts these products have on nature.
    b. Allow a class discussion and have students voice any impacts they see.
    c. There are some clear positive impacts of these products. There must be enough food to feed many people in the world.
    d. What about runoff? What nutrients do plants need? Discuss the impact of the nitrogen cycle.
    e. Do bees really feed that many people? Ask students to discuss what they think will happen if there are no bees.
    f. Once students have discussed, have them write down their three favorite fruits/vegetables.
    g. Use cell phone or computer to pull up list of crops pollinated by bees.
    h. Complete the bee-free barbeque activity to illustrate the importance of bees to students.

Activity 3 (Reflection)

1. **Activity steps**
    a. Ask students how they would modify their barbeque based on the loos of some fruits/vegetables if there were no bees to pollinator our food.

<u>Bee, Wasp, and Fly Diversity</u>

Lesson Learning Objectives

1. Students will apply basic taxonomy skills to identify bee, wasps, flies, and spiders by observing different characteristics.
2. Students will construct a system to identify bees, wasps, flies, and spiders.

NGSS Alignment

1. 3-LS4-4. Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there may change.

Activity 1 (Introduction & Pre-assessment)

1. **Materials**
   a. Dichotomous Key example
   b. Pencil
   c. Paper
2. **Activity Steps**
   a. Discuss plan for the lesson, including activity outline and schedule for class.
   b. Ask questions to encourage critical thinking and activate schema (prior knowledge)
   c. Help students to think about how people organize things systemically in their everyday life. For example, ask students "If you want to find Harry Potter in a library, which book section, like documentary, fiction, or tool books, you think you will find Harry Potter?"
   d. "Why do people classify and put things into order?" or "You are trying to find marshmallows for your hot chocolate in Walmart, which section do you think you can find marshmallows? Why do people classify and put things into order?"
   e. "If a scientist wants to identify an unknown pollinator, such as bees, butterflies, beetles, wasps, and flies, what would they do? How scientists organize pollinators?"
   f. Introduce the concept of dichotomous keys to students. You can show examples of types of dichotomous keys, such as a series of number type and tree branch structure type, as visual aids to help students understand what dichotomous keys are.
   g. Tell students that they are going to work together to identify animal by using a dichotomous key. Ask students how are they going to identify which animal that the letter represents?
   h. Give the animal Dichotomous key to students and ask them to identify the name of the animal.
   i. Ask students to share their results.
   j. Students will repeat the process on a Greek Mythology Dichotomous key.

Activity 2 (Design Dichotomous Key Challenge)

1. **Materials**
    a. Bee, wasp, fly, and spider specimens
    b. Pencil
    c. Paper
    d. Poster with insect body parts
2. **Activity Steps**
    a. Group students into groups of 2-3.
    b. Ask students to list all their **hypothesis or prediction** on how bees, wasps, flies and spiders are different from each other.
    c. Give 1 bee, 1 wasp, 1 fly, and 1 spider specimens, in a sealed container.
    d. Ask students to examine the specimens carefully and write down their similar and different characteristics.
    e. Ask students to come up a system that can help people to identify bees, wasps, flies, and spiders.
    f. After students come up with a system, show the poster/pictures to students and talk about the three main body parts of insects.
    g. After students have their systems ready, give an unidentified specimen (a bee, wasp, fly, or spider) to students, and ask students to identify the specimen by using the system they created.
    h. Ask students what they claim about the unknown specimen and how they came up with that claim.
    i. After that, ask students to share their observations and why their evidence supports their claim.

Activity 3 (Reflection)

1. **Activity Steps**
    a. Ask students if there are any changes they would like to make to their dichotomous key to make it easier to identify insects.
    b. “Friends or family members want to identify bees, wasps, flies, and spiders, what could you share with them about how to identify pollinators?”
    c. Have students share their answers.

<u>Plant Science</u>

Lesson Learning Objectives

1. Students will identify the basic plant needs including pollination, light, air, nutrients, thirst (water), and soil.
2. Students will develop an understanding of plant parts and plant uses by observing and touching live plants.

NGSS Alignment

1. 4-LS1-1. Construct an argument that plants and animals have internal and external structures that function to support survival, growth, behavior, and reproduction.
2. 5-LS1-1. Support an argument that plants get the materials they need for growth chiefly from air and water.

Activity 1 (Introduction and Pre-assessment)

1. **Materials**
    a. Markers
    b. Post-it paper
    c. Photosynthesis poster
    d. Celery
    e. Mason Jar
    f. Water
    g. Food coloring
2. **Activity Steps**
    a. Discuss plan for the lesson, including activity outline and schedule for class.
    b. Ask questions to encourage critical thinking and activate schema (prior knowledge).
    c. ‘What do all living things need to survive?’ ‘What do you need to survive?’
    d. ‘What do plants need to survive?’ As students come up with answers, have them come up and write their answers on the large Post-it paper.
    e. Explain the process of photosynthesis. Carbon dioxide + water = sugars + oxygen (using chlorophyll and sunlight).
    f. Cut celery (short with leaves still attached).
    g. Fill jar with water and add food coloring. Let students vote to decide what color to pick.
    h. Place celery in the jar and check back to see if the experiment worked at the end of the class session.

Activity 2 (Touch and Tell)

1. **Materials**
    a. Various vegetables, fruits, flowers, and seeds
    b. Paper bags
    c. Paper
    d. Markers
2. **Activity Steps**
    a. Show students examples of vegetables and flowers. Ask students if they can figure out what the different parts do for the plant.
    b. Have five bags with different parts of plants inside. Students will pass around

the bags and try to feel or smell what type of plant it is and what function it serves.

c. Once all students have had the opportunity to feel inside each bag, reveal what was inside and discuss what function those parts have for the plant.

Activity 3 (Reflection)

1. **Materials**
    a. Celery
    b. Mason Jar
    c. Water
2. **Activity Steps**
    a. Show the students the celery that was placed in the colored water.
    b. Ask students ‘If family or friends want to know what a plant needs to survive, what would you tell them?’

<u>Pollinators and Flowers</u>

Lesson Learning Objectives

1. Students will be able to explain the importance of pollinators
2. Students will be able to identify female and male parts of flowers
3. Students will be able to name flower characteristics that help attract pollinators
4. Students will be able to provide a reason about their dream flower being able to attract the most number of pollinators.

NGSS Alignment

1. MS-LS1-4. Use argument based on empirical evidence and scientific reasoning to support an explanation for how characteristic animal behaviors and specialized plant structures affect the probability of successful reproduction of animals and plants respectively.

Activity 1 (Introduction and Pre-assessment)

1. **Materials**
   a. Pencil
   b. Paper
2. **Activity Steps**
   a. Discuss plan for the lesson, including activity outline and schedule for class**.**
   b. Ask questions to encourage critical thinking and activate schema (prior knowledge).
   c. Have students list the things that they already know about flowers. If students don't know how to answer the questions, the educator can give some examples to help students.
   d. Have students share their answers.
   e. Listen carefully and try to have a conversation/discussion with students to find out how they know what they knew.

Activity 2 (Flower Design Challenge)

1. **Materials**
   a. Markers
   b. Large Post-it paper
   c. Parts of flower poster
   d. Pollinator Syndrome Cards
   e. Pollinator Syndrome Chart
2. **Activity Steps-Part 1**
   a. Group students into groups of 2 to 3.
   b. Give each group Post-it paper, and color pencils or color markers.
   c. Tell students that they are going to design/draw a flower that they think can attract the most of pollinators. Students need to label each part of their flowers.
   d. After students finish their drawings, show students a figure/image of parts of a flower. Briefly discuss the function of each part of a flower by using the figure/image with students. Ask students to check if they are missing any part of a flower, particularly if they miss the male and female parts. Give students the opportunity to add parts of a flower that are missing from their drawings.

If students decide they don't want to add the missing parts, ask students to justify why they think their flowers do not need these parts in their drawings.

e. Ask students to share their design/drawings.

3. Activity Steps-Part 2

a. Ask students to hang their flowers on the wall around the classroom.
b. Give each group a pollinator syndromes table. Explain to students what pollinator syndromes are.
c. Prepare a stack of pollinator cards and ask students to pick out a card from the stack. The cards represent who they are.
d. Ask students to use the pollinator syndromes table and walk around the classroom to find the flowers that attract them the most. After they find the flower, they stay there beside the flower.
e. Ask students to explain why they chose the flower that they think it attracts them.
f. At the end, educators and students can see which flower(s) attracts the most pollinators.
g. If time allows, have students redesign their flowers to see if they can apply what they've learned about what pollinators are attracted by.

Activity 3 (Reflection)

1. Activity Steps

a. "If friends and family member want to attract pollinators in their gardens, what suggestions could you give them to think through the problem?"

<u>Planning a Pollinator Garden</u>

Lesson Learning Objectives

1. Discuss the needs of pollinators that should be incorporated into a pollinator garden design.
2. Discuss differences in shape, flower color, form, bloom time, height, behavior and other plant characteristics for selected pollinator garden plant species.
3. Complete a simple pollinator garden design to practice including the essential elements for pollinators in a home garden.
4. Practice presentation skills by talking about their garden design in front of their classmates.

NGSS Alignment

1. MS-ETS1-1. Define the criteria and constraints of a design problem with sufficient precision to ensure a successful solution, taking into account relevant scientific principles and potential impacts on people and the natural environment that may limit possible solutions.

Activity 1 (Introduction & Pre-assessment)

1. **Materials**
   a. Foam core board
   b. Velcro
   c. Photos of pollinator plants
   d. Printed poster with pollinator plant characteristics
2. **Activity Steps**
   a. Discuss plan for the lesson, including activity outline and schedule for class.
   b. Ask questions to encourage critical thinking and activate schema (prior knowledge).
   c. What do students know about pollinator gardens? What does a pollinator garden need in order to attract pollinators?
   d. Ask students to share their answers.
   e. Divide the students up into 2-4 teams.
   f. Ask the students to think about their own physical characteristics, skills, and interests. How do their personal characteristics differ from the other people in their group? How would these differences in the personal characteristics serve as a strength? For example, if someone is tall, they might be able to help reach an item at home on a tall shelf. If a person is smaller, they would be able to fit into small areas to help with a home project, etc.
   g. Ask each group to take out the pollinator plant characteristics list. Give a brief introduction of each plant species pointing out some of the import characteristics and the strength of their differences for protecting pollinators.
   h. Set up the pollinator personalities boards.
   i. Ask students to work as a team to match the photos and other characteristics for the pollinator plants with the appropriate spot on the chart.

Activity 2 (Garden Design Challenge)

1. **Materials**
    a. Large Post-it paper
    b. Markers
    c. Pollinator Garden Scenarios
    d. Colored pencils
2. **Activity Steps**
    a. Divide the students up into groups to work together.
    b. Each group of students will have a different pollinator garden scenario with parameters to help guide their garden design.
    c. Ask students individually to imagine they are garden designers. Write down the criteria to design their garden based on the scenario. For example, if they need flowers, how are they going to select the flowers? If they need soil, what type of soil that they need and why? If they want to attract pollinators, what type of pollinators do they need to attract and why?
    d. Ask students to share and discuss their answers with their teammates. After discussion, instruct the students to use what they have decided to draw a pollinator garden.
    e. Each group should be ready to share their plant selections and garden design features with the other students.

Activity 3 (Reflection)

1. **Activity Steps**
    a. Friends or family members want to design a pollinator friendly garden, what could you share with them about pollinator friendly gardens?

<u>Big Picture-What's Next?</u>

Lesson Learning Objectives

1. Discuss the value of pollinators in our society.
2. Develop a conservation plan as a team focused on pollinators such as bees and butterflies.
3. Present conservation plan to class.

Activity 1 (Introduction & Pre-assessment)

1. **Materials**
    a. Example conservation plan
2. **Activity Steps**
    a. Discuss plan for the lesson, including activity outline and schedule for class.
    b. Ask questions to encourage critical thinking and activate schema (prior knowledge).
    b. Ask students what some of the things they have learned over the course of the last six weeks.
    c. Introduce the idea of conservation (ask questions about what their idea of conservation is) and that biologists have to make conservation plans when an animal or plant is threatened/endangered.
    d. Introduce conservation plans and describe the parts that are needed in a successful plan.
        i. Statement of purpose
        ii. Goals
        iii. References that support the problem
        iv. Conservation Information/status of that animal/plant
        v. Recommendations

Activity 2 (Conservation Plan Design Challenge)

1. **Materials**
    a. Large Post-it paper
    b. Markers
    c. Colored Pencils
    d. Technology (if available)
2. **Activity Steps**
    a. Divide students into teams of two or three.
    b. Provide them with the opportunity to choose a pollinator that is in danger of becoming endangered to focus their conservation plan.
    c. If available, provide students with technology so they can do research on their chosen pollinator.
    d. Have each group write/draw/design a conservation plan which includes all parts:
        i. Statement of purpose
        ii. Goals
        iii. References
        iv. Conservation Information
        v. Recommendations
    e. Have each group present their plan to their peers.

Activity 3 (Reflection)

1. **Activity Steps**
    a. "If family or friends want to participate in conservation, what advice would you give them?"

APPENDIX I. INTERVIEW PROTOCOL- CONTROL GROUP

Interview Questions for students (interview at the end of the program)

1. I would like you to tell me a bit about yourself.
    a. What grade are you in?
    b. What activities do you do outside of school?
2. What types of activities does your Girl Scout troop participate in? Can you name a few examples?
3. Do you enjoy spending time outside? Why or why not?
    a. What do you like to do outdoors?
    b. If not, is there anything you would like to do outdoors?
4. How many days of the week do you spend time outside?
    a. Have you spent time outdoors, during the summer, hiking, etc.?
5. What is your favorite place in Lafayette to spend time?
6. Have you visited any parks in Lafayette before?
    a. What parks in Lafayette do you visit?
    b. Are there any parks that you have not visited but would like to?
7. You attended the program that I taught that related to STEM integration and pollinators. Could you tell me some of the things that you learned during the program?
    a. Why are pollinators so important to us?
    b. Do you see why things like planting a pollinator garden and providing shelter to bees is important?
    c. How will you apply what you’ve learned from the program?
8. Which area of this program was your favorite? Why do you say that?
9. After attending this program, do you plan to spend more time outdoors in nature? Why or why not?
    a. Is there anything that you think would’ve been helpful during the program for you to make a stronger connection to nature?
10. Have you done things to help the planet such as recycling, planting a garden, saving water?
    a. If so, what types of things have you done?
    b. After attending this program, do you want to do more things to help the planet?
    c. What parts of the program made you want to do those things?
11. Is there anything else you’d like to add about the program or the outdoor experiences?

APPENDIX J. INTERVIEW PROTOCOL- TREATMENT GROUP

Interview Questions for students (interview at the end of the program)

1. I would like you to tell me a bit about yourself.
    a. What grade are you in?
    b. What activities do you do outside of school?
2. What types of activities does your Girl Scout troop participate in? Can you name a few examples?
3. Do you enjoy spending time outside? Why or why not?
    a. What do you like to do outdoors?
    b. If not, is there anything you would like to do outdoors?
4. How many days of the week do you spend time outside?
    a. Have you spent time outdoors, during the summer, hiking, etc.?
5. What is your favorite place in Lafayette to spend time?
6. Have you visited any parks in Lafayette before?
    a. What parks in Lafayette do you visit?
    b. Are there any parks that you have not visited but would like to?
7. You attended the program that I taught that related to STEM integration and pollinators. Could you tell me some of the things that you learned during the program?
    a. Why are pollinators so important to us?
    b. Do you see why things like planting a pollinator garden and providing shelter to bees is important?
    c. How will you apply what you've learned from the program?
8. Which area of this program was your favorite? Why do you say that?
9. Each week we explored the woods around the church.
    a. What were some of the things that you enjoyed about that?
    b. Or things that you didn't enjoy?
    c. Did spending time outdoors with make you want to spend more time outdoors at other times and at other places in Lafayette?
10. After attending this program, do you plan to spend more time outdoors in nature? Why or why not?
11. Have you done things to help the planet such as recycling, planting a garden, saving water?
    a. If so, what types of things have you done?
    b. After attending this program, do you want to do more things to help the planet?
    c. What parts of the program made you want to do those things?
12. Is there anything else you'd like to add about the program or the outdoor experiences?