A Longitudinal Examination of a SSI-Embedded Experiential Environmental Education Course and Environmental Behaviors

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A Longitudinal Examination of a SSI-Embedded Experiential Environmental Education Course and Environmental Behaviors

by

Mark H. Newton

A dissertation submitted in partial fulfillment of the requirements for the degree of Doctor of Philosophy Curriculum and Instruction Department of Teaching and Learning College of Education University of South Florida

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Date of Approval: November 17, 2016

Keywords: authentic experiences, socioscientific issues, place-based, experiential

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Dedication

To my family. You have always allowed me to chase my dreams.
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<td>Contentious environmental issue</td>
<td>CEI</td>
</tr>
<tr>
<td>Environmental Education</td>
<td>EE</td>
</tr>
<tr>
<td>Genetically Modified Organism</td>
<td>GMO</td>
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<tr>
<td>Greater Yellowstone Area</td>
<td>GYA</td>
</tr>
<tr>
<td>Place-based Learning</td>
<td>PBL</td>
</tr>
<tr>
<td>Science, Technology, Engineering, and Math</td>
<td>STEM</td>
</tr>
<tr>
<td>Science-Technology-Society</td>
<td>STS</td>
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<tr>
<td>Science-Technology-Society and Environment</td>
<td>STSE</td>
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<tr>
<td>Socioscientific Issues</td>
<td>SSI</td>
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<td>Socioscientific Perspective Taking</td>
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<td>Socioscientific Reasoning</td>
<td>SSR</td>
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<td>Socioscientific and Environmental Engagement Dimensions Survey</td>
<td>SEEDS</td>
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<tr>
<td>Yellowstone National Park</td>
<td>YNP</td>
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Abstract

A perennial goal of environmental education is to produce a scientifically literate citizenry capable of negotiating and resulting complex environmental problems. Popular methods of environmental education instruction tend to overemphasize scientific content knowledge and neglect to consider ethical and moral aspects of the problem. This qualitative study examines the longitudinal association between an experiential environmental education course infused with SSI instruction and students’ environmental behaviors. The results indicate that several students’ conceptualizations of contentious environmental issues change after completing the course and specifically. Furthermore, students’ willingness to act to resolve contentious environmental issues was most closely associated with their environmental behaviors. The most significant theoretical implication of the study is the effectiveness of the SSI framework in authentic experiences. Additionally, this study supports the notion that SSI instruction in authentic experiences is an effective alternative approach to teaching environmental education.
Chapter One: The Problem

Introduction

Environmental issues like climate change, wildfire and species management are a pervasive focus in the public and political arenas (Middleton, 2013). As the global population and human development increases, the resulting environmental strain will inevitably cause debates on resolving issues like climate change. The recent oil spill near Yellowstone National Park serves as an example of such a contentious issue with environmental, social, and economic impacts extending locally to globally (Nunez, 2015). Specifically, the natural and built environments surrounding the area will feel the impact from decisions about the construction and management of new oil pipelines through the area. This and many other examples demonstrate the confluence of economic, scientific, and social perspectives related to contentious environmental issues (Robottom, 2012). Problems of this nature are examples of socioscientific issues (SSI) as they are open-ended, ill structured with multiple possible solutions and connections to science (Sadler, 2011).

Contentious environmental issues (CEI), like the pipeline example above, make an ideal topic of study in environmental education (EE). The EE field has traditionally sought to promote environmental science to address complex CEI perpetually affecting the planet (UNESCO, 1978; Middleton, 2013). Many environmental educators advocate implementing CEI into the curriculum as a means to develop environmentally literate citizens with the awareness, knowledge, skills, attitudes, and willingness to resolve CEI (Hart, 2010; Marcinkowski, 2009;
NAAEE, 2010; UNESCO, 1978). Despite the call for a teaching philosophy which fosters the previously mentioned traits, many EE programs continue to focus on only the scientific facets of CEI (Hart, 2010; Robottom, 2004; Stern, Powell, & Hill, 2013). This pedagogical approach toward EE is contrasted by the fact that environmental issues are human created and that environmental protection is value-based because CEI are created by humans who are willing to leverage environmental stability against economic, political, and/or social gains. Thus, there is a need to develop approaches to teaching EE that move beyond content knowledge acquisition that also emphasize the negotiation of the humanistic trade-offs associated with CEI. For example, introducing new legislation may increase environmental protection but at the cost of personal freedoms, like hunting predatory animals. Maintaining an apex predator, such as a wolf, promotes a healthy and balanced ecosystem at the expense of individuals who live in the ecosystem and are negatively impacted by the predator’s behavior. The individuals may not be allowed to protect their property (e.g., cattle) using inexpensive and lethal measures, but instead must suffer economic hardships due to their lack of freedom to protect their property. It is imperative that students be aware that scientific knowledge is one perspective to consider if they are to become effective citizens who will make decisions on CEI.

Attempts have been made to develop curricula which embrace environmental educators’ suggestions and promote the relationship between science, society, and the environment (e.g. Science-Technology-Society-Environment) (Pedretti & Nazir, 2011). While this movement has been a fundamental shift in the way science education is viewed and conducted (Aikenhead, 2003), the opportunity to develop the morals and ethics of the students is often ignored. These approaches often point out the ethical dilemmas associated with societal standards of behavior or moral dilemmas associated with personal struggles with right and wrong, but rarely are they
expanded upon in order to develop well-rounded citizens (Zeidler, Sadler, Simmons, & Howes, 2005). For example, Davies (2004) discusses the connection between science and citizenship by pointing out the need for students to not only understand the scientific knowledge related to current events (e.g., genetic modification), but also how to appropriately address the moral and ethical dimensions that accompany these issues. However, most pedagogical approaches eschew the humanistic considerations presented by Davies (2004). Rather, students are often expected to assimilate or accommodate desired science conceptions regarding environmental issues resolution when they are only shown the scientific evidence regarding those issues. The assumption here is scientific knowledge is all that is required to resolve CEI. Little consideration is given to the moral and ethical implications of the solutions scientific evidence can suggest.

This deficit model largely disregards the sociocultural nature of CEI. For example, Salvado, Casanoves, and Novo (2013) advocate a Science-Technology-Society and Environment (STSE) approach in teaching biotechnology concepts to develop scientifically literate citizens. Their suggestion is flawed as they acknowledge the need for addressing the moral and ethical implications of biotechnologic decisions, such as genetically modified organisms, without offering any explicit instruction for accomplishing this task. Simply put, their suggestions are to provide a real-world context for the biotechnology curriculum, while applying a interdisciplinary method to teaching. The authors’ assume scientifically and environmentally literate citizens will be developed by simply weighing the scientific knowledge associated with the problem. Students are not faced with any cognitive dissonance and forced to reflect on their existing conceptions of the issue; rather, the authors hope students develop the complex and sophisticated perspectives to carefully and thoughtfully examine the many other facets of biotechnological issues without any explicit instruction on how to do so. This is but one example of what is problematic with many
EE programs; namely, the lack of a theoretical framework has created a high level of variability to teaching EE. The shortcomings identified above are consistent with the argument that a scientific understanding of environmental issues is myopic and favors a technocentric solution (Gurevitz, 2000). This variability has resulted in a fractured understanding of environmental issues with citizens who are not equipped to understand the nuanced aspects of such complex issues (Coyle, 2005).

Recognizing issues with extant environmental education efforts, environmental educators desire EE programs that do more than focus exclusively on relevant science content (Coyle, 2005; Gurevitz, 2000; Hart, 2010; Marcinkowski, 2009; NAAEE, 2004; Robottom, 2004; Stern, Powell, & Hill, 2013). Environmental educators emphasize that CEI are human created, socially conceptulaized, and negotiated constructs; and thus, EE curricula needs to shift from a deficit model approach and adopt a more sociocultural view of EE (Hart & Nolan, 1999; Robottom, 2004). To this end, Stern et al. (2013) claim the most effective EE programs provide active and experiential engagement in real-world environmental problems, are issue-based, and are investigation-focused on authentic places and situations in real-world nature settings (place-based). Additionally, social engagement and emotional connections were identified as influencing outcomes in EE programs. Ultimately, effective EE programs should use CEI to provide students the opportunity to draw from their cognitive and affective domains through thorough analysis and reflection of the nuances associated with the issue (Marcinkowski, 2010).

One program that aligns with the above suggestions focused on college students’ experiences in the Sierra-Nevada Mountains. The results indicate that students could easily see the connection between the natural sciences and the humanities as they investigated CEI. Additionally, the place-based design made discussing CEI more relevant because students could
witness the interactions between the humans and the environment directly (Alagona & Simon, 2010). Gurevitz (2000) argues that courses like those in Alagona and Simon’s (2010) study are effective because the courses promote specific types of engagements with the environment that draw on the students’ affect and have the potential to galvanize students to become more involved with the environment.

Empirical evidence from environmental psychology research has also shown that improvements in individuals’ environmental attitude and behavior stems from the attachment the individual forms with a specific location in nature, such as a National Park, after engaging with that location. Additionally, the experiences with nature in a specific location have been associated with overarching changes in environmental attitudes and behavior (Halpenny, 2010; Kudryavtsev, Stedman, & Krasny, 2012). This evidence supports the claim that real-world experiences are vital toward developing environmentally literate citizens because of the role that emotions play in decision-making (Gurevitz, 2000). These experiences add to the individual’s conceptualization of nature and provides a more sophisticated view of CEI, as well as behaviors that will help resolve them. All of this speaks to the need for an EE approach that considers the individual learner’s experiences as well as their ability to weigh various sources of knowledge in order to resolve CEI.

It is imperative to note that experience alone is not as effective at changing environmental attitudes and behaviors as combining first-hand experience with instruction. A combined approach to EE allows individuals to make meaning about a location through both direct experience and deliberate instruction. Individuals are able to create meaning through experiences, while also developing a fuller understanding as a result of discussions, readings, etc. Combining direct experiences with instruction allow students to gain a deeper understanding of a place,
especially if some aspects of the location are not readily visible by visitors (Kudryavtsev, Stedman, & Krasny, 2012).

As an alternative to the dominate EE approach, many authors have argued the value of implementing a SSI approach in the science curriculum which explicitly considers the emotions, values, and ethics of the students in addition to developing content knowledge (Herman, Newton, & Zeidler, 2015; Lee, et al., 2013; Robottom, 2004; Sadler T. D., 2004; Sadler, Barab, & Scott, 2007; Zeidler & Lewis, 2003; Zeidler, Sadler, Simmons, & Howes, 2005; Zeidler & Keefer, 2003). A SSI approach addresses many of the calls for EE reform previously mentioned by developing students who are reflective citizens capable of ethically participating in society (Dewey, 1944; Noddings, 2005). Generally, these works support using SSI as a pedagogical approach to improve students’ ability to become functionally scientifically literate citizens capable of acting as responsible global citizens (Lee et al., 2013). Results show student growth in perspective taking, informal reasoning, skepticism of evidence, social and moral compassion, and feelings of responsibility.

In consonance with the findings in the EE literature, proponents of a SSI approach cite the necessary connection between scientific literacy and real-world events through a sociocultural approach (Herman, Newton, & Zeidler, 2015; Zeidler, Sadler, Simmons, & Howes, 2005). Zeidler et al. (2005) cite several studies that used SSI to develop critical thinking, morals, and ethics through high levels of engagement, discourse, and reflection associated with authentic contentious issues. Additionally, researchers have also identified the value of immersing students in real-world issues as a means to develop citizens willing and able to resolve contentious issues (Lee, et al., 2013; Sadler, Barab, & Scott, 2007). Lee et al. (2013) studied 132 South Korean ninth grade students who participated in a gene modification SSI unit.
Upon completing the unit, students expressed more compassion for groups of people who may be negatively impacted by the increased use genetically modified products as well as feeling more responsible for resolving the genetic modification issue, but lacked the willingness to engage in resolution of the issue within the larger community.

The present study extends the work done by Herman, Newton, and Zeidler (2015), which examined the extent to which 24 post-secondary students engaged in CEI in the Greater Yellowstone Area (GYA). The original study found that students’ ability to consider multiple perspectives, weigh scientific evidence when compared to sociocultural and ethical considerations, feelings of responsibility for resolving CEI and engaging in the resolution of CEI changed after completing the course. The present study examines the residual association that a SSI approach has with students’ ability to consider multiple perspectives, weigh scientific evidence when compared to sociocultural and ethical considerations, feeling responsible for resolving CEI, and engaging in resolving the CEI. Additionally, the present study examines the association between the original experiential environmental education course embedded with SSI instruction and participants’ environmental behaviors. Therefore, the overarching purpose of this study isto examine the association between students completing an experiential enviromental education course embedded with SSI instruction and their ability to negotiate CEI after the course is completed, while determining the extent to which the course can be associated with the transformation of environmental behaviors that extend beyond the immediate completion of the course.

**Theoretical Background**

The present study draws on theory from four major areas: the Socioscientific Issues framework, Neo-Kohlbergian and moral socialization theories, Experiential/Place-based
learning, and Social Development Theory. Each theory addresses a specific component of the course, which in turn, addresses the concerns of environmental educators; namely, the need to consider ways of knowing from outside science proper, acknowledging the sociocultural aspect of CEI, and the value of authentic experiences. It is through the application of these theories that this study fills a gap in the extant literature concerning effective EE instruction, while also examining the residual association that SSI instruction has on students’ ability to negotiate CEI.

**The Socioscientific Issues Framework.** The SSI framework offers a sociocultural approach which considers the intersection of science, culture and character (Zeidler, Sadler, Simmons & Howes, 2005; Zeidler, Berkowitz, & Bennett 2014). Instead of only providing a context for science content or simply pointing out ethical dilemmas, SSI instruction uses a well-designed theoretical framework to capitalize on the pedagogical power of controversial issues to stimulate emotional growth, as well as moral and ethical development (Sadler, Barab, & Scott, 2007; Zeidler, Sadler, Simmons, & Howes, 2005; Zeidler & Kahn, 2014). Students address content knowledge, nature of science, and reasoning while investigating contentious issues (Fowler, Zeidler, & Sadler, 2009) through discourse, research, and critical analysis of the problem (Zeidler & Kahn, 2014). This process simulates both how scientific research is conducted and provides opportunities to develop the skills necessary to become a scientifically literate contributor to society. Zeidler and Kahn (2014) highlight five characteristics of a SSI curriculum:

1. research-based, interdisciplinary,
2. students use real-world problems and data when making decisions,
3. stimulates scientific argumentation and discourse,
4. encourages students to consider the moral and ethical beliefs related to scientific problems,

5. models the features of the nature of science; including tenativeness of science, social influences, and subjectiveness (p. 4).

SSI instruction is situated within relevant, often ill structured, real-world scientific contexts understandable to students through pedagogical facilitation of key strategies associated with SSI instruction from the teacher (Zeidler, Applebaum & Sadler, 2011; Zeidler & Kahn, 2014). Instruction about SSI includes confronting students with a contentious issue and helping them to develop and contemplate multiple sophisticated viewpoints while weighing scientific evidence and the social, moral, and ethical implications associated with proposed solutions (Zeidler, Sadler, Simmons, & Howes, 2005; Zeidler, Herman, Ruzek, Linder, & Lin, 2013). Furthermore, students debate and justify their reasoning and decision-making regarding the SSI. The analysis of contentious issues can create a state of cognitive dissonance and internal moral dilemma as students confront their existing views regarding those issues (Fowler, Zeidler, Sadler, 2009). To resolve these internal conflicts, students must think reflexively and consider their biases, misconceptions, and emotions. As students engage in the contentious issues, they develop a deeper understanding of the science content, as well as effective communication skills through collaborative problem solving, discussion, and debate.

While similarities exist between effective EE instruction and the SSI framework, the present study focuses on the unique aspects of the SSI framework that promotes the development of environmentally literate citizens; specifically, the association between the emphasis on moral and ethical development during pedagogical decision-making by the instructors and the longitudinal development of environmentally literate citizens. Furthermore, research has shown
that an SSI approach supports the development of character and values (Lee, et al., 2013), but little is known regarding the extent to which this development is longstanding. The present study examines the longitudinal association between character and development and an SSI approach in an experiential environmental course.

**Socioscientific Reasoning.** Socioscientific reasoning (SSR) is a construct that addresses the skills necessary to negotiate a SSI. SSR consists of four components:

- Recognizing the inherent complexity of SSI
- Examining issues from multiple perspectives
- Appreciating that SSI are subject to ongoing inquiry
- Exhibiting skepticism when presented potentially biased information (Sadler, Barab, and Scott, 2007, p. 374).

SSR serves as one of the tangible products of a SSI approach. Students’ SSR development is vital to their ability to navigate CEI, as well as act as scientifically/environmentally literate citizens (Sadler, Barab, & Scott, 2007). As such, it is imperative that a deeper understanding developed of how SSR is cultivated in students and applied to novel situations. The participants in the present study participated in explicit instruction designed to foster SSR. The original study, on which the present study builds, measured dimensions that are consistent with three SSR skills. Table 1 illustrates the relationship between the SSR skills and the dimensions measured in the original study. The present study will seek to understand the extent to which the participants continue to demonstrate aspects of SSR one year after completing the course from the original study.
Table 1 The relationship between socioscientific reasoning skills and dimensions measured in the baseline study

<table>
<thead>
<tr>
<th>Socioscientific Reasoning Skill</th>
<th>Dimension(s) Examined in Baseline Study</th>
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<tbody>
<tr>
<td>Recognizing the inherent complexity of SSI</td>
<td>Complexity/Contentiousness Acuity</td>
</tr>
<tr>
<td></td>
<td>Interconnectedness</td>
</tr>
<tr>
<td></td>
<td>Scope/sophistication</td>
</tr>
<tr>
<td>Examining issues from multiple perspectives</td>
<td>Perspective Taking and Emotive Concerns</td>
</tr>
<tr>
<td>Appreciating that SSI are subject to ongoing inquiry</td>
<td></td>
</tr>
<tr>
<td>Exhibiting skepticism when presented potentially biased information</td>
<td>Scientific Epistemology</td>
</tr>
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**Moral Development and Socioscientific Issues Instruction**

Some authors have used the neo-Kohlbergian model for moral development, which employs a rational lens for moral development. Others have provided an affective lens for moral development, for example, relational ethics or empathy (Austin, 2008; Hoffman, 2000). There are many theories on moral development and this study considers both the neo-Kohlbergian model and Hoffman’s moral socialization theory.

The neo-Kohlbergian model of moral development employs schema, of which individuals exhibit characteristics. Schemas are methods of organizing knowledge based on prior experiences. New phenomenon active individual’s schemas and they try to interpret it through the existing schema. The neo-Kohlbergian model conceptualizes individuals moving between schemas depending upon the context of the situation as opposed to a linear process where individuals are incapable of regressing to previous stages. These schemas subsume Kohlberg’s original stages; for example, the Personal Interest Schema includes Stage 2 and 3 of Kohlberg’s
model, the Maintaining Norms Schema includes Stage 4, and the Post-conventional Schema includes Stages 5 and 6 (Rest, Narvaez, Thoma, & Bebeau, 2000).

Additionally, the neo-Kohlbergian model recognizes the necessity of four psychological processes (moral sensitivity, moral motivation, moral action, and moral judgment) in order for moral behavior to occur, as compared to Kohlberg’s original model, which emphasized moral judgment. Perhaps most importantly for this study, the neo-Kohlbergian model does not adhere to a Piagetian formal operations model for morality; instead, experiences are considered vital to moral development where frequent experiences with moral dilemmas create schemas that are accessed and become more sophisticated (Narvaez, 2005; Narvaez & Lapsley, 2009). These experiences can lead to internal conflict, affect the way students make decisions, and often become apparent when they examine contentious issues, like those used in SSI instruction (Zeidler and Keefer, 2003); students must examine their own beliefs, compare them to others, and defend them when necessary. The dissonance created when students are immersed in resolving contentious issues provides opportunities for the students to develop the type of reflexive thinking necessary for the formation of conscience and is the foundation for the role of citizen and the success of any republic (Green, 1999).

This study also acknowledges the role affect plays in moral development by considering Hoffman’s moral socialization theory (2000). The impact that the direct experiences student had with stakeholders is consistent with Hoffman’s idea that people develop pro-social norms by empathizing with individuals who are harmed by specific behaviors. In the context of this study, students witnessed the repercussions of CEI on stakeholders throughout the GYA.
Experiential Learning Theory and Place-Based Learning

**Experiential Learning Theory.** Experiential Learning Theory (ELT) considers the impact of experience on how knowledge forms and changes (Kolb & Kolb, 2005). ELT approaches embed students in authentic learning scenarios where they examine and modify their existing beliefs. The resolution of the conflict between students’ original beliefs and their emerging refined ideas is what drives learning.

ELT incorporates a constructivist approach to learning where knowledge develops in a social context and is not a simple transmission from expert to novice (Kolb & Kolb, 2005). The type of reflexive thinking fostered by ELT is in consonance with Green’s (1999) description of moral growth necessary to form responsible citizens. In both cases, individuals are comparing their personal beliefs with social norms and beliefs while determining the appropriate ways to resolve contentious issues.

ELT is comprised of four phases allowing students to experience, reflect, think, and act in a cyclic fashion (Katula & Threnhauser, 1999; Kolb, 1984; Kolb & Kolb, 2005). Learning begins with concrete experiences where individuals actively engage in their surroundings. These concrete experiences cause learners to form observations and reflect on the experience. At this point, individuals begin to examine their ideas and beliefs in an attempt to construct new knowledge. This reflection facilitates the individuals to transition to abstract conceptualization where their existing ideas and beliefs are modified based on the experiences. Finally, individuals move to active experimentation when they apply their modified beliefs in new situations, which in turn, will create new experiences and the cycle will repeat (Kolb, 1984).

**Place-Based Learning.** Place-based learning (PBL) aligns with ELT. Like ELT, PBL emphasizes experience in student learning and both are founded in Dewey’s belief that
can be based on experience (Katula & Threnhauser, 1999; Kolb, 1984; Kolb & Kolb, 2005; Smith & Sobel, 2010). Additionally, both approaches cut across disciplinary boundaries and focus on the development of individuals willing to participate in social issues and owning the skills to resolve these issues (Dewey, 1944; Noddings, 2005). As part of PBL, individuals interact with members of the community, which is in consonance with ELT to the extent that students are participating in authentic experiences, which may challenge their prior conceptions of a situation and stimulate reflection, which in turn will stimulate new conceptions.

What makes PBL unique to ELT is PBL’s emphasis on connecting learning specifically with the community to resolve local issues, while ELT does not focus exclusively on the resolution of problems within a given community (Kolb, 1984; Kolb & Kolb, 2005; Smith & Sobel, 2010). In this regard, PBL advocates considering multiple perspectives and various ways of reasoning (i.e., emotive). Additionally, an assumption of effective PBL is that students be able to identify potential biases and underlying motivations exhibited by those community members with whom they interact. For the purposes of this paper, Referencing ELT also includes PBL, as the participants’ interactions with stakeholders in the GYA were an essential component to the course.

**Social Development Theory**

Social Developmental Theory (SDT) describes a sociocultural approach to cognitive development emphasizing social interactions, discourse (with others and self), and context for learning (Howe, 1996; Vygotsky, 1978). Per SDT, conceptual development takes place through social interactions with peers as well as with adults, known as More Knowledgeable Others (MKO). The discourse between individuals is pivotal to the conceptual change. Essentially, the student is not isolated to make meaning using only logical processes. Rather, the collaboration
between the student and the MKO stimulates conceptual change by connecting prior experiences with new information to rectify the dissonance created after the student is exposed to new information. In this process, the MKO acts as a guide, supervisor, co-participant, evaluator, and facilitator (Howe, 1996).

In the original study, the students engaged with several individuals who are considered MKO. Instructors made pedagogical choices intended to foster academic growth, as well develop more refined moral and ethical beliefs. In addition, the students engaged with scientists, hunters, ranchers, tour guides, and other various local towns people who all provided opportunities for the participants to develop a more thorough understanding of the various CEI (Herman, Sadler, Zeidler, & Newton, in press).

**Problem Statement**

The present study fills two gaps in the extant literature addressing both EE and SSI instruction. As previously mentioned, effective EE programs engage students in experiences with real-world environmental issues, are place-based, while considering the emotional and social aspects of the learner. However, little research has been done which addresses how courses with those components are longitudinally associated with individuals’ intended and actual behaviors. Hughes, Packer, and Ballantyne (2011) found that very few studies exist which examine the longitudinal associations between environmental experiences and behaviors.

Halpenny (2010) showed the impact of affective attachment to a National Park and individuals’ shifts in pro-environmental attitudes and potential changes in behavior. In Halpenny’s study, individuals completed a survey by mail after visiting a Canadian National Park measuring three dimensions of the place attachment scale. The significance of Halpenny’s study are twofold. First, it supports the claim that affective reasoning (attachment to a specific
place) impacts intended pro-environmental behavior, which speaks to the need for effective EE programs to contain a place-based component. Second, the findings suggest a potential carry over from attachment to a specific place to the environmental at large, which could lead to pro-environmental behaviors toward other locations. However, Halpenny recognizes the need to conduct additional studies to examine the variables associated with place attachment and general pro-environmental behaviors. The present study examines the association between an SSI approach to teaching EE and changes in participants’ intended and actual environmental behaviors. Participants had an intensively immersive EE experience in Yellowstone National Park and self-reported on and interviewed about their intended and actual environmental behaviors one year after the completion of the course. The present study considered nuanced factors related to participation an experiential EE course embedded with SSI instruction and students’ use of various forms of reasoning when resolving contentious environmental issues.

Developing environmentally literate citizens capable of negotiating and resolving CEI is an essential goal of EE. Likewise, changing environmental behaviors is seen as key to preventing environmental degradation. Environmental educators have identified the components necessary for effective EE instruction, but implementing these components has proven to be challenging. It is hypothesized that the SSI approach can serve as an effective synthesizing framework method of instruction as it considers the affective domain, moral and ethical development, and content mastery. The purpose of this study was to examine the association between an experiential environmental education course embedded with SSI instruction and students’ ability to negotiate CEI after the course is completed. Accordingly, the present study address three research questions.
Research Questions

Research Question 1: How do postsecondary students’ pro-environmental behaviors shift from pre-departure to one-year after participating in an experiential environmental education course embedded with SSI instruction?

Rationale: Positive changes to an individual’s environmental behavior are a perennial goal of environmental education. However, little knowledge exists regarding methods for changing pro-environmental behaviors (Steg & Vlek, 2009). The literature suggests that a connection may exist between an individual’s attachment to a specific place (e.g., National Park) and their environmental behaviors toward both the specific place and in daily experiences (Halpenny, 2010). However, Halpenny (2010) and Hughes, Packer, and Ballantyne (2011) state that there are very few longitudinal EE studies which attempt to consider all of the mitigating variables that may influence environmental behaviors. The present study conducted longitudinally by contacting participants nine to twelve months after their visit and focus on the association of the GYA course with intended and actual environmental behaviors.

Research Question 2: How do postsecondary students’ conceptualizations of CEI shift one-year after participating in an experiential environmental education course with embedded SSI instruction and to what extent are the shifts in CEI conceptualization associated with changes in environmental behaviors?

Rationale: To understand if and how SSI instruction in an experiential setting is associated with changes in CEI engagement, it is vital to identify changes. As environmental educators continue to embrace a socio-constructivist view of learning, it is imperative that the field be aware of what factors are longitudinally associated with individual’s conceptions of environmental issues (Hart & Nolan, 1999). Very little of the extant literature addresses the longitudinal association between
CEI engagement and changes in scientific content knowledge. Additionally, Herman (2015) examined the role of sociocultural factors in secondary students’ ability to mitigate global warming. The results indicated several factors did, in fact, play a role in how students viewed a CEI, specifically global warming.

*Research Question 3: How is SSI instruction embedded in an experiential environmental education course associated with postsecondary students’ socioscientific reasoning (SSR) one year after completing the course?*

**Rationale:** An overarching goal of science and environmental education is to create scientifically/environmentally literate citizens. To that end, it is important to examine how a course of this nature is associated with students’ ability to apply SSR to CEI in order to develop an environmentally literate citizenry. The present study will examine the extent to which students continued to integrate SSR while negotiating CEI after the completion of the course.

**Significance of the Study**

**Theoretical Implications.** The present study extends the research in SSI and EE. To this point, most of the SSI research has focused on traditional classroom settings with some exceptions (Burek & Zeidler, 2015; Greely, 2008). This study expands the SSI literature into the non-formal setting which is becoming more of an area of interest because individuals spend 97% of their time outside the traditional classroom experience (Ballantyne & Packer, 2005) and it is vital that more research is done to understand how to better use this time to develop environmentally literate citizens. While infusing an SSI approach can be met with resistance in the traditional school setting (Zeidler & Kahn, 2014), this research helps to guide the copious after school and outdoor programs to better meet the challenges of tomorrow’s environmental issues.
**Pedagogical Implications.** This study also informs the EE field by offering a response, based in theory and empirically tested, to many of the concerns identified by experts in the field (Coyle, 2005; Hart, 2010; Hart & Nolan, 1999; Marcinkowski, 2009). Implementing a SSI approach also addresses Hart and Nolan’s call for environmental educators to step outside of their field and look for solutions from other disciplines. Environmental educators have long acknowledged the need for approaches that explicitly address the learner’s affective domain along with their moral and ethical development (Coyle, 2005; Halpenny, 2010; Kudryavtsev, Stedman, & Krasny, 2012; Robottom, 2004; Stern, Powell, & Hill, 2013), which is an essential component of the SSI framework.

**Summary**

In order for students to become the citizen leaders that are desired by environmental and science educators, modifications need to be made to the existing methods of instruction. As with most of science education, EE tends to focus on content knowledge and neglects to tend to the inherent complexity of environmental issues like the economic, social, and ethical implications of CEI resolution. Some in the field have identified the need to incorporate approaches to teaching which embrace the complexity of environmental issues as well as consider a socio-constructivist framework for how students learn. Considering the needs of EE, it is a natural fit to consider the SSI approach as an alternative approach to EE instruction. The literature base clearly demonstrates that SSI has successfully developed the skills necessary to negotiate complex and ill-defined problems. Furthermore, SSI addresses the assumption made in EE that students need to think and act in a moral and ethical manner. Instead of tacitly addressing the moral and ethical implications of decisions, SSI takes advantage of the pedagogical power of resolving CEI to foster more sophisticated and robust ethical perspectives in students. Coupling
the SSI framework with an experiential component provides an even more authentic experience for the learners which cannot be duplicated in the traditional classroom.

A notable missing piece in both the EE and SSI literature are longitudinal studies which examine the association to changes in attitudes and behaviors. This study will extend the idea of transforming students’ behavior, while also considering the need to equip students with the abilities to engage in change (Hodson, 2010; Levison, 2013). It is well documented that effective EE and SSI approaches have short term changes in participants’ intentions, but little is known about the residual association between the experiences and the transformation of conceptions which will lead to genuine change in behaviors. Zeidler, Applebaum, and Sadler (2011) examined how students’ behaviors and habits of mind changed over the course of a school year while being exposed to a SSI approach. However, this study stopped short of examining the extent any of these transformations extended beyond the end of this specific course. The present study examined the residual association between the SSI approach and new contentious issues in order to provide a better understanding of how to develop scientifically and environmentally literate individuals.
Chapter Two: Review of the Literature

Examining key pieces of literature in environmental education (EE) and science education are vital to frame the present study. This chapter begins by defining EE and outlining its goals as set by the international community. Next, there is a short discussion on the current interpretation of skill development in EE. An examination of two popular issues-based approaches to teaching EE follows. Finally, the chapter ends by discussing the benefits of using a socioscientific issues (SSI) framework to develop socioscientific reasoning skills (SSR) vital for environmentally literate citizens and the benefits of implementing experiential learning to the SSI framework.

What is Environmental Education?

The origins of environmental education (EE) are somewhat clouded, with some proposing that Rousseau (1762) first suggested an educational emphasis on the environment (McCrea, 2006); while others suggest the nineteenth century writings of Emerson (1836), Thoreau (1854), and Perkins (1864) are the beginning of EE (Carter & Simmons, 2010). While the origins are debatable, Stapp (1969) provides a foundational definition of EE that serves the modern EE movement:

Environmental education is the aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, how to solve these problems, and motivated to work toward their Solution (p. 15),
Stapp’s definition clearly points toward three key principles of EE instruction: knowledge, skills, and motivation to act and change behaviors.

For example, The Intergovernmental Conference on Environmental Education, also known as the Tbilisi Conference (UNESCO, 1978) expanded on Stapp’s definition of EE to include the consideration of values and attitudes toward the environment, and made several foundational recommendations as to how EE should take place. Among the recommendations was the need for EE to examine the complex dynamic between the physical, social, biological, economic, and cultural factors associated with environmental issues. To this end, the conference suggested that students should have first-hand, authentic experiences to apply an interdisciplinary approach towards resolving the environmental issues. These recommendations have acted as a guide for future EE organizations, including the North American Association for Environmental Educators (NAAEE), to use as guidelines for successful EE programs.

It is through the lens established by Stapp (1969) and modified by the Tbilisi Conference (1978) that the remainder of this chapter will address the current state of EE, as well as position the present study. The extant literature demonstrates an overemphasis on environmental knowledge, while often neglecting the complexity of the environmental issues. Furthermore, it will be demonstrated that there is limited knowledge on the extent to which individuals demonstrate long-term behavior changes resulting from engaging in EE courses. Finally, literature will be discussed which will provide an alternative approach to EE which encompasses all of the goals and recommendations set forth for EE.

Skill Acquisition in Environmental Education

Within the context of EE, the term *skills* is broadly used. The Tbilisi Declaration (1978) identified the need, “…to help social groups and individuals acquire the skills for identifying and
solving environmental problems” (p. 27). The vagueness of the term leaves the interpretation open to the reader. Some scholars have interpreted this to mean research skills and data collection (Hsu, 2004; 1999; Ramsey, 1993; Hungerford et al., 2003); while others consider it to mean field skills like trail etiquette and intervention strategies (Baur & Haase, 2015; Halpenny, 2010; Mittelstaedt, Sanker, VanderVeer, 1999). There is no argument that these are vital to EE, but this myopic definition of environmental skills is indicative of EE approaches that overemphasize the technocratic role of scientific knowledge and fail to consider the sociocultural impact on CEI. To implement the international goals for EE, it would be beneficial to consider a broader understanding of what is necessary to resolve CEI, which includes scientific knowledge and data collection; but also includes argumentation, weighing of perspectives and the moral and ethical impacts, and understanding the limitations of science. In this regard, it is more appropriate to refer to this collection as abilities necessary for effective CEI resolution.

There has been a call from within EE to broaden the skills taught in order to foster the environmentally literate society required to resolve CEI. The focus on an entirely rational approach has failed to prepare students for the role of democratic citizen, as well as a failure to consider the affective domain when designing EE programs. As a result, there appears to be no sustained impact on students as they are not engaging in environmental issues outside of the classroom (Hart, 2010; Hart & Nolan, 1999; Marcinkowski, 2009; Pooley & O’Connor, 2000; Stern, Powell, & Hill, 2013). Hart (2010) and Marcinkowski (2009) both advocate the need for environmental educators to move beyond emphasizing the acquisition of knowledge and instead develop the skills necessary for students to become contributing members of society able to resolve environmental dilemmas. Marcinkowski discusses the lack of EE programs that immerse students in real-world problem-solving efforts which is problematic because it does not foster a
need to apply information, refine thinking, and reflect on both the knowledge and emotions associated with CEI.

**Issues-Based Approaches to Skill Development in Environmental Education**

**Science-Technology-Society and Environment.** A popular EE curriculum design is the Science-Technology-Society and Environment (STSE) model. The STSE model is difficult to define, as there is not a single definition (Pedretti & Nazir, 2011). STSE shifts from a traditional science curriculum and places CEI at the center of the curriculum. The broad definition and lack of any theoretical framework have allowed STSE to stake claim to a multitude of approaches to teaching, each with a slightly different content emphasis (Kumar & Chubin, 2000; Pedretti & Nazir, 2011). One of the most popular interpretations of STSE emphasizes the use of empirical evidence and logical reasoning as the sole forms of CEI resolution (Pedretti & Nazir, 2011).

Salvado, Casanoves, and Novo (2013) argue the need to incorporate STSE in biotechnology courses. The authors repeatedly cite the need for a scientifically literate society, which is to say; a society knowledgeable in the science related to biotechnology (Zeidler, Herman, Clough, Olson, Kahn, & Newton, 2016). Their position is clearly one that emphasizes empirical evidence and logical reasoning as the key component of STSE. There is no discussion of the importance of any other skills necessary for resolving biotechnology issues. Nowhere in the article are skills like perspective taking, skepticism, discourse, or other informal reasoning identified as necessary to resolve CEI. The issue is that the curriculum is simply used as a hook to engage students and potentially as an application of scientific knowledge.

Examples of STSE studies emphasizing using contentious issues as an organizer of content and a novel method of introducing or apply science content are prevalent in the literature (see Ayyavaao, 2013; Yoon & Ko, 2013). Additionally, these studies continue to demonstrate
that at best, ethical issues are pointed out, but not used for moral growth for the students (Zeidler, Sadler, Simmons, & Howe, 2005). In fact, only Ayyavoo (2013) even points out the ethical implications of a contentious environmental issue although the ethical discussion is limited to only one of the scenarios in the study. At no point is there a discussion of pedagogical decisions aimed at moral and ethical development. Without engaging in a comprehensive examination of the issue, students do not have to consider multiple perspectives, weigh the value of various types of information, or articulate their position on the issue. Students reduce CEI to a simple linear thought process with the result determined by the scientific evidence collected and applying logical reasoning. As a result, STSE is used as just another approach to deliver science content and falls short of the goals set forth by UNESCO (1978).

For example, Ayyavoo’s (2013) study of an online physics course brings to light several of shortcomings of STSE. First, one of the issues used in the study was Formula 1 racing tires as an avenue to discuss static friction. Based on the qualitative responses given by the participants, it is evident that any discussion on racing tires was not an attempt to develop environmentally literate citizens, but rather a convenient way to establish a real-world connection that may or may not be relevant to the students. Furthermore, no connections between static friction and EE were explicitly made throughout the study, which makes it difficult for students to make the subtle connection between friction and any CEI.

Additionally, students were asked to convince their parents of the importance of winter tires in Quebec, Canada based on the cost of winter tires and traffic accident statistics. Like the position paper discussed previously, it does not appear that students were asked to consider the issue from multiple perspectives or argue a position on the issue other than why snow tires
are necessary. The implicit message in this task is that rational, scientific data is superior to other types of knowledge and should be used to resolve CEI.

Yoon and Ko (2013) examined the impact of an STSE approach on teacher candidates at an American university. The authors once again, emphasize the importance of a rational approach to CEI resolution by focusing on the importance of process skills and the application of science skills to new situations. The results of the study indicate that the treatment course fostered an understanding of the importance of technology in society, as well as bringing issues to light for the students. Furthermore, students in the study seemed to place a premium on scientific knowledge and the role that it plays in CEI. Finally, the data indicates that the teacher candidates view the STSE approach as a novel approach to engage students. As with the previous study, there is a rational and logical approach to CEI resolution, as well as a lack of consideration of the irrational components of CEI resolution.

What is problematic is the lack of a clear theoretical framework allowed the authors to claim an STSE approach, when in fact there is little connection to the UNESCO goals. Both studies examplify how the dominant logical reasoning version of STSE minimizes the effectiveness of an issues-based curriculum by failing to capitalize on the controversial nature of the problem and therefore, failing to provide students the opportunity to develop discourse skills, perspective taking, or the ability to consider various types of knowledge.

**Issues Investigation and Action Training.** Issues Investigation and Action Training (IIAT) is a popular model based on the Science-Technology-Society (STS) approach, which emphasizes research design and data analysis skills associated with CEI resolution. For example, Hsu (2004) and Ramsey (1993) implemented the IIAT model, which consists of units:
1. Identifying issues
   a. Developing research questions
   b. Identifying variables

2. Data collection
   a. Developing surveys
   b. Selecting samples

3. Data interpretation
   a. Making inferences
   b. Drawing conclusions (Hungerford, Volk, Ramsey, Litherland, & Peyton, 2003).

Additionally, Hsu’s study included a unit entitled, *Hope and Empowerment* intended to draw students’ attention to the impact of life on the environment, investigating alternative behaviors, examining successful Taiwanese environmental campaigns, and examining environmentalists’ perspective.

Ramsey (1993) used a quasi-experimental, pre/post design to study the impact of an IIAT course on eighth grade students in the United States. The treatment group ($n = 96$) was enrolled in a class taught by middle school science teachers who had received training in the IIAT model. The control group ($n = 86$) were enrolled in classes taught by middle school science teachers without IIAT training and were exposed to the traditional curriculum for the specific school district. The students completed both a Likert instrument and a questionnaire to assess responsible environmental behaviors, individual locus of control, group locus of control, knowledge of action strategies, perceived knowledge of action skills, perceived knowledge of the use of action skills, and environmental sensitivity. The data indicated no changes in individual
locus of control and environmental sensitivity, but demonstrated statistically significant changes in the other variables.

The results indicate that while students felt more knowledgeable of environmental content knowledge and procedures to investigate CEI, ultimately, their actions would make no difference. These findings are in consonance with a pedagogical approach that emphasizes scientific evidence over other forms of knowledge. The IIAT approach focuses heavily on cognitive reasoning, but falls short of developing the affective and intuitive reasoning necessary to mitigate complex environmental issues (Sadler & Zeidler, 2005). Furthermore, the lack of change in individual locus of control demonstrates disconnect between students and the issues. The study took place in a formal education setting where students had no direct interaction with those directly involved with the issue and therefore, could not begin to empathize with the stakeholders or the area (Halpenny, 2010; Noddings, 2005).

It is also interesting to note that students in the course showed no change in their belief that they individually had no control of resolving environmental issues and that they did not come to believe that humans should live in harmony with the environment. The findings of increased responsible environmental behavior without increases in individual locus of control contradicts Tobler, Visscher, and Siegrist' (2012) meta-analysis on locus of control and environmental behaviors. It is possible that the IIAT model might promote a technocentric attitude toward environmental sustainability where by individuals believe that environmental problems will be solved by science, technology, and engineering rather than by reducing human usage or interference with natural resources.
Hsu (2004) studied the impact of a modified IIAT approach on Taiwanese college students. Students enrolled in 16-week course that met three hours per week and the course took place on campus in a traditional classroom setting. Before the students engaged in the IIAT portion of the course, they participated in an *Ecological Foundations* unit intended to develop awareness and sensitivity to environmental issues, along with teaching ecology content knowledge. After the IIAT portion of the course, students engaged in the afore mentioned *Hope and Empowerment* unit. The final unit addressed the affective domain, specifically locus of control and intention to act.

The post-course results indicate that the treatment group showed statistically significant changes in responsible environmental behaviors, environmental responsibility, locus of control, intention to act, perceived knowledge and skills in strategies to mitigate environmental issues, and perceived knowledge and skills of environmental issues. These results are similar to Ramsey’s (1993) findings with the exception of the locus of control variable.

It is noteworthy that Hsu intentionally added the *Hope and Empowerment* unit to the course to address the affective aspects of CEI. The decision to include the affective domain acknowledges the role that emotions play in resolving CEI and is an important step closer to developing an individual capable of considering evidence beyond empirical data and potentially recognizing the complexity of CEI. However, two months after the course was completed the only statistically significant variable was the perceived knowledge of ecology and environmental science.

Kolstø (2001) identifies the term scientism, where scientific data has more value than other forms of knowledge. A close inspection of the STSE and IIAT approaches uncover that
both promote scientism by placing unequal value on rational and logical approaches to CEI resolution, while privileging scientific knowledge and skills over other forms of knowledge. It is imperative that skills beyond scientific logic and reasoning be developed in students if the goal is to develop individuals who have the ability fully comprehend the risks and trade-offs in resolving CEI. By nature, a science-centric approach attempts to detach the students from the issue in an effort to remain objective, but CEI are inherently subjective because they are man-made problems where individuals’ values and beliefs are in conflict. As such, it is unreasonable to limit the role of the affective domain in the resolution of CEI. Hsu’s (2004) results are encouraging in that, they indicate the value of explicit pedagogical decisions focusing on the affective domain are impactful on students’ perceptions of CEI and also the importance of longitudinal studies on CEI resolution. Hsu exposed students to 15 hours of non-scientific perspectives (e.g. environmentalists, people who pursue love and justice), but it is unclear the extent to which students were immersed in these alternative perspectives. It is possible that the alternative perspectives were presented but never fully examined, which is very similar to the complaints made against the STS(E) approach (Zeidler et al., 2005). Hsu’s findings support this point, two-months after the course was completed students failed to show any significant change in any of the variables other than perceive ecological and environmental science knowledge. Additionally, the researcher selected the perspectives introduced and selected the format in which the students interacted with the perspective, which reduces the authenticity of the experience and may not fully develop the skills for an environmentally literate society (Levinson, 2013). It is imperative that courses be taught in as authentic an environment as possible with overt instruction provided to promote skills beyond empirical research skills. Furthermore, Hsu’s two-month follow up is a valuable point because the extant literature is very limited on
longitudinal studies and the studies that do exist are limited to two or three months post-course. While there is no singular minimum threshold for research to be considered longitudinal, the typical minimum is between 9 and 12 months, of which there are no studies on issues-based EE that meet this suggested period (Saldana, 2003; Young, Savola, & Phelps, 1991).

**Socioscientific Issues as an Alternative Approach for Environmental Education**

Socioscientific Issues (SSI) are ill-structured real-world problems with multiple solutions, which are connected to science either conceptually or procedurally and can be understood by students through pedagogical support from a teacher (Sadler, 2009; Zeidler, Applebaum, & Sadler, 2011; Zeidler & Kahn, 2014). The Socioscientific Issues SSI framework for curriculum design offers a sociocultural approach where students consider science, culture and character (Zeidler, Sadler, Simmons & Howes, 2005; Zeidler, 2014). While SSI take many forms, contentious environmental issues can be categorized as SSI and serve as an ideal format for developing environmentally literate citizens who have the skills, knowledge, attitude, and motivation to resolve these issues; while also considering the connection between the economic, social, political, and ecological factors associated with the issue (NAAEE, 2010). Instead of only providing a context for science content or simply pointing out ethical dilemmas, the SSI framework uses a well-designed theoretical framework to capitalize on the pedagogical power of controversial issues to stimulate emotional growth, as well as moral and ethical development (Sadler, Barab, & Scott, 2007; Zeidler, Sadler, Simmons, & Howes, 2005; Zeidler & Kahn, 2014). Through the investigation of contentious issues, students use “…higher order problem-solving, argumentation, and research skills to analyze challenging, contextualized scientific concepts and issues” (Zeidler & Kahn, 2014, p. 4) in addition to addressing content knowledge, nature of science, and reasoning (Fowler, Zeidler, & Sadler, 2009). This process simulates both
how scientific research is conducted and provides opportunities to develop the skills necessary to become a scientifically literate contributor to society. Zeidler and Kahn (2014) highlight five characteristics of a SSI curriculum:

1. research-based, interdisciplinary,
2. students use real-world problems and data when making decisions,
3. stimulates scientific argumentation and discourse,
4. encourages students to consider the moral and ethical beliefs related to scientific problems,
5. models the features of the nature of science; including tenativeness of science, social influences, and subjectiveness.

Instructing about SSI includes confronting students with a contentious issue and helping them to develop and contemplate multiple sophisticated viewpoints while weighing scientific evidence and the social, moral, and ethical implications associated with proposed solutions (Zeidler, Sadler, Simmons, & Howes, 2005; Zeidler, Herman, Ruzek, Linder, & Lin, 2013). Furthermore, students debate and justify their reasoning and decision-making regarding the SSI. The analysis of contentious issues can create a state of cognitive dissonance and internal moral dilemma as students confront their existing views regarding those issues (Fowler, Zeidler, Sadler, 2009). To resolve these internal conflicts, students must think reflexively and consider their biases, misconceptions, and emotions. As students rectify the contentious issues, they develop a deeper understanding of the science content, as well as effective communication skills through collaborative problem solving, discussion, and debate.

**Socioscientific Reasoning.** Environmentally literate citizens must have a variety of skills to negotiate CEI remediation because CEI are more than simply science problems. Humans who
leverage their needs against the needs of the environment create CEI, which require skills like skepticism, perspective taking, discourse, and weighing multiple forms of evidence in order to be resolved. It is imperative that EE courses develop these skills in addition to science content knowledge. Approaches like STSE and IIAT often accomplish the opposite by narrowing a CEI down to a simple science issue, which limits the perspectives considered and implies that resolution is final because it is supported by scientific fact.

Socioscientific reasoning (SSR) is a construct which appears consistently across SSI studies and is vital to the resolution of CEI. SSR consists of skills directly related to developing scientifically/environmentally literate citizens:

1. Recognizing the inherent complexity of SSI.
2. Examining issues from multiple perspectives.
3. Appreciating that SSI are subject to ongoing inquiry.

A SSI curriculum can foster varying degrees of each aspect (Sadler, Barab, & Scott, 2007), while a recent conceptual analysis has refined the perspective taking aspect to encompass a much more elaborate definition than previously thought (Kahn, 2015). Table 2 provides a more detailed description of student behaviors for each aspect.

Table 2 Description of the aspects of socioscientific reasoning (SSR)

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inherent complexity of SSI</td>
<td>avoids simplifying issue to a single factor</td>
</tr>
<tr>
<td></td>
<td>avoids simple cause and effect reasoning</td>
</tr>
<tr>
<td></td>
<td>refrains from linear thinking</td>
</tr>
<tr>
<td></td>
<td>recognizes numerous, dynamic interactions</td>
</tr>
<tr>
<td>Socioscientific Perspective Taking (SSPT)</td>
<td>engages with others and their circumstances</td>
</tr>
<tr>
<td></td>
<td>shifts from outsider’s view (etic) to an insider’s (emic)</td>
</tr>
</tbody>
</table>
### Table 2: Description of the Aspects of Socioscientific Reasoning (cont’d)

<table>
<thead>
<tr>
<th>Aspect</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>uses informal reasoning (rational, emotive, and intuitive) to think reflectively and reflexively about behavior</td>
<td></td>
</tr>
<tr>
<td>SSI are subject to ongoing inquiry</td>
<td>recognizes the need for additional information</td>
</tr>
<tr>
<td></td>
<td>asks questions about social and scientific dimensions of the issue</td>
</tr>
<tr>
<td></td>
<td>has a plan for retrieving the information</td>
</tr>
<tr>
<td>Skepticism for potentially bias information</td>
<td>acknowledges stakeholders may have biases in the information presented to support their perspective</td>
</tr>
<tr>
<td></td>
<td>does not simply accept information as it appears</td>
</tr>
</tbody>
</table>

(Kahn, 2015; Sadler, Barab, & Scott, 2007)

Sadler, Barab, and Scott (2007) studied 24 American sixth-graders who had just completed an SSI unit using a computer-based program focused on water quality and pollution. Each student was interviewed after reading a scenario dealing with a hypothetical water quality situation, which the authors then reviewed and applied a score of 1 to 4. While students demonstrated all four aspects, including the authors’ original conceptualization of perspective taking, statistical analysis identified a high correlation between students’ ability to recognize the complexity of the SSI and that SSI are subject to ongoing inquiry.

Lee, Yoo, Choi, Kim, Krajcik, Herman, and Zeidler (2013) examined 132 ninth-grade students in Seoul, South Korea who participated in a SSI on genetically modified organisms (GMO). The authors examined the role that a SSI approach had on students’ ecological worldview, social and moral compassion, and socioscientific accountability as a means of developing character and values of global citizens.

It is important to note that the authors made intentional pedagogical decisions to foster SSR, as well as content knowledge and research skills. After a day of introducing the topic and a
day of identifying students’ initial opinions on genetic modification, students were introduced to six perspectives on genetic modification, selected a perspective to research, and then represent that perspective in a group debate. An entire class dedicated to considering the moral aspects of genetically modified children followed this experience. The unit culminated with a town hall-style discussion on GMO. The design implemented by the authors serves as a model of SSI instruction because students face with science content through relevant issues and have opportunities to consider their own beliefs about the issue and compare their beliefs to those around them.

The qualitative exemplars provided in this study afford insight into the underlying SSR skills necessary to achieve the desired outcomes. For example, in a classroom discussion on GMO’s one student identifies concerns over the impact of using GMO technology to save an individual versus the future impact on future generations of people. The data collected demonstrated that students began to consider the complexity of the issue by recognizing that there are many dynamic interactions when considering GMO. The student sees the proximal interaction between GMO and a person in the immediacy, but also the distal interaction of GMO and future individuals. Additionally, this student has not reduced the GMO issue down to just saving an individual because science can do so, rather; the students is beginning to see the moral and ethical implications of such an issue. A second student considers the ongoing nature of GMO by voicing uncertainty over the direction the situation. This student focuses on the inability of scientists to predict how environmental changes will affect human genetics. Furthermore, the student is displays an amount of skepticism by not simply accepting that GMO is the answer to the problem at hand.
The two SSI studies discussed in this section serve as examples of an alternative approach to EE. The SSI approach considers a broader set of skills necessary to development environmentally literate citizens, including, but not limited to SSR. Zeidler (2016) warns of STEM curriculums that emphasize the non-normative aspects of science (e.g. data collection, scientific methods) and minimize the normative aspects (e.g. selecting courses of action, deciding on the resolution of an issue) because of the potential to create a deficit model of instruction where students are void of the skills of an environmentally literate citizenry. Zeidler’s warning of a deficit STEM curriculum is in consonance with the problems with the current EE curriculum. Despite placing CEI at the forefront of the EE curriculum, too many educators are focusing in on the non-normative aspects of science and simply applying them in an environmental context. Environmental educators are failing to take advantage of the opportunities of an issues-based curriculum to move towards Robert’s (2007) Vision II scientific literacy, which emphasizes developing the skills of the individuals who will not become professional scientists.

**Socioscientific Issues and Experiential Education**

Issues-based instruction is an effective pedagogical approach for developing environmentally literate citizens (Hsu, 2004; Lee, et al., 2013; Ramsey, 1999; Herman, Sadler, Zeidler, & Newton, in press; Pedretti & Nazir, 2011; Zeidler, Sadler, Simmons, & Howe, 2005). Critics of SSI claim that despite the effectiveness of the SSI framework to develop a broad range of skills, students are not exposed to the issues in an authentic form, but rather are exposed to the issues through the filter of the teacher. Often, teachers select the perspectives and materials used in SSI due to constraints placed on them by curricula (Levinson, 2013). Levinson continues to question the effectiveness of role-playing and simulation, as he claims these activities divide the
“real world” from the academic world. Likewise, Hodson (2010) calls for more of an emphasis on action to resolve CEI. Hodson argues that environmental rhetoric and values are of little importance if no action is taken. These criticisms are not necessarily criticisms of the SSI framework, instead they are calls to extend SSI into novel contexts. The critiques of Levinson and Hodson point to a need to expand SSI research by incorporating Experiential Education philosophy into SSI curriculum. Experiential Education utilizes Experiential Learning Theory (ELT) and Place-based learning (PBL) to facilitate student engagement with other learners, the teacher, and the environment (including the built, natural, and stakeholders) (Itin, 1999). The additional of Experiential Education will help to remove the divide between academic exercises and authentic opportunities. Furthermore, students will be able to witness the actions taken by stakeholders, as well as the impacts of actions on people and the environment.

**Experiential Learning Theory.** Experiential Learning Theory (ELT) incorporates a constructivist approach to learning where knowledge develops in a social context and is not a simple transmission from expert to novice. ELT utilizes students’ experiences to create new knowledge by forcing students to face situations where their beliefs and ideas are challenged and in doing so, are forced to examine their beliefs to in order to develop more refined ideas on the topic. The resolution of the conflict between students’ original beliefs and their more refined ideas is what drives learning (Kolb & Kolb, 2005).

ELT is comprised of four stages allowing students to experience, reflect, think, and act in a cyclic fashion (Katula & Threnhauser, 1999; Kolb, 1984; Kolb & Kolb, 2005). Students initially actively engage in their surroundings through concrete experiences, which provide opportunities to form observations and reflect on the experience. At this point, individuals will begin to examine their ideas and beliefs in an attempt to construct new knowledge. This
reflection allows the individuals to transition to the abstract conceptualization stage where existing ideas and beliefs will be modified based on the experiences. Finally, individuals will move to the active experimentation stage when they apply their modified beliefs in new situations, which in turn, will create new experiences and the cycle will repeat (Kolb, 1984).

**Place-Based Learning.** Like ELT, Place-based Learning (PBL) emphasizes experience in student learning and both are founded in Dewey’s belief that education can be based on experience (Katula & Threnhauser, 1999; Kolb, 1984; Kolb & Kolb, 2005; Smith & Sobel, 2010). Additionally, both approaches cut across disciplinary boundaries and focus on the development of the cognitive and affective dimensions of the individual. As part of PBL, individuals interact with members of the community, which is in consonance with ELT to the extent that students are participating in concrete experiences, which may challenge their prior conceptions of a situation and stimulate reflection, which in turn will stimulate new conceptions.

The characteristic that makes PBL unique to ELT is the emphasis PBL places on connecting learning specifically with the community to resolve local issues (Noddings, 2005; Smith & Sobel, 2010). Noddings (2005) discusses the importance of place attachment when considering resolutions to CEI. She points out that the inherent complexity of CEI require individuals to think critically about their positions, while also considering the impact of CEI resolution on the individuals attached to these places. Additionally, Noddings points out the ease in which students can slide into complacency and a sense of self-righteousness when examining issues from a distance because it is easy to ignore the person who relies on the location for financial support.
Experiential learning seems to be a natural fit with the SSI approach embedded within an EE course because it provides an authentic context to develop SSR. As pointed out earlier, considering the importance of place requires students to recognize the complexity of environmental issues. Potentially more valuable is the opportunity to develop SSPT through engagement with individuals directly experiencing the impacts of CEI. In an experiential setting student can engage with others and their circumstances in both planned learning interactions, as well as daily life, like eating at a restaurant or buying a morning cup of coffee. Students may also begin to use patterns of informal reasoning to think about potential behaviors and possibly start to view CEI from an insider’s perspective as they begin to engage with the citizens and the natural environment (Kahn, 2015).

For example, Birmingham and Barton’s (2014) study of six students who participated in a community outreach program is an example of PBL in science education. The students, ages 10-13 years, spent over a year learning about electricity production, usage, and alternative energy sources. The students interviewed experts and community members, visited a coal-burning power plant, conducted energy audits, and examined carbon footprints of various groups in the community. After completing the investigation, the students created presentations to inform the public. The findings support the importance of place in CEI resolution, as there appeared to be a connection between scientific knowledge and the students’ understanding of place. It was the understanding of their place (their hometown) that led to action because of the relevance of the issue made meaningful connections between the science and the place. Furthermore, the informal educational experiences extended the notion of where science takes place for the students.
Birmingham and Barton (2014) use educated action in science as, “…the capacity to leverage relevant scientific knowledge and practices to inform action(s) taken” (p. 287) as students seek to resolve socioscientific issues. Individuals exhibiting educated action consider all relevant areas of knowledge and understand how science can work in concert with other forms of knowledge and practices. Educated action in science is pertinent to the present study because the present study seeks to understand how experiential courses fosters an understanding of how scientific knowledge and practices can be useful to resolve CEI, while also understanding that relevant areas of knowledge and various practices should be considered as part of the resolution process.

The intersection of SSI and Experiential Learning, while seemly a natural fit, has drawn little research focus. The interaction of these two frameworks seems to offer the potential for valuable learning outcomes in that students could have the opportunity to develop SSR skills in authentic contexts and witness the actions of the stakeholders. The baseline data for the present study has indicated that an SSI instruction embedded within an experiential EE course has resulted in significant changes in the way post-secondary students conceptualize CEI. What is unknown is the extent to which the changes in conceptualization remain after long periods.

Summary

This chapter examined the goals of EE and some of the shortcomings associated with two of the most popular issues-based approaches, specifically, the myopic interpretation of an environmentally literate citizen’s skills. As an alternative, a SSI approach embedded within and experiential setting is offered as a way for students to develop SSR skills, which expands students’ skills to negotiate CEI. The premise of embedding SSI instruction within an
experiential course addresses criticisms of the SSI framework, while also providing unique opportunities for students to begin to engage in socioscientific perspective taking (SSPT).
Chapter Three: Methods

Introduction

The principal focus of this study is to investigate the extent to which an experiential environmental education course embedded within a Socioscientific Issues (SSI) framework is associated with changes to students’ approaches to contentious environmental issues (CEI), as well as changes in environmental behaviors. SSI are complex, often ill structured, and have multiple solutions; thus, resolving CEI can foster a more sophisticated and nuanced understanding of the issue (Sadler, 2004; Zeidler & Sadler, 2008; Zeidler, 2014). At this time, little research has been conducted on the extent to which these sophisticated positions and understandings become ingrained and if there is an association with behavior changes. The present study will use students’ rich, informal and personally meaningful experiences in the Greater Yellowstone Area (GYA) examining CEI (e.g. elk management, brucellosis in bison) to determine the feasibility of facilitating transfer and long-term changes in environmental behaviors. Like other SSI, these CEI present opportunities for students to consider multiple perspectives, weigh various types of evidence, accept responsibility for the issues, while also considering the sociocultural and ethical implications of their decisions (Colucci-Gray et al., 2006; Herman, Newton, & Zeidler, 2015).

The present study primarily targets potential changes students associate between their experiences in the GYA and their environmental behaviors and attitudes after the completion of the course. The investigator will use a case study analysis approach to examine the association
between the GYA experience and environmental behaviors and attitudes (Creswell & Plano Clark, 2011). Cases for the present study will be selected using data from the baseline study, specifically the responses to questionnaires, surveys, and a semi-structured interview protocol designed for the baseline study, which is located in Appendix A.

The balance of this chapter reviews the research questions that will direct the research the research design and methodology. This includes a description of the course providing the context for the study. The discussion of research design will focus on data collection, population and samples, and data analysis.

**Research Questions**

The guiding questions of this research proposal are:

1. How do postsecondary students’ pro-environmental behaviors shift from pre-departure to one-year after participating in an experiential environmental education course embedded with SSI instruction?

2. How do postsecondary students’ conceptualizations of CEI shift one-year after participating in an experiential environmental education course with embedded SSI instruction and to what extent are the shifts in CEI conceptualization associated with changes in environmental behaviors?

3. How is SSI instruction embedded in an experiential environmental education course associated with postsecondary students’ socioscientific reasoning (SSR) one year after completing the course?

**Research Design and Methodology**

The baseline study focused on the extent to which 24 post-secondary students were able to engage in CEI as a result of SSI instruction embedded within an experiential environmental
issues course in the Greater Yellowstone Area (GYA). Each student participated in a pre- and post-course interview along with completing a pre- and post-course Likert-style survey with open-ended responses to clarify their responses. The responses indicated that students felt more responsible for resolving CEI, that human development will have an unequal impact on nature, and when resolving a CEI scientific evidence must be considered along with sociocultural and ethical implications (Herman, Newton, and Zeidler, 2015; Herman, Sadler, Zeidler, & Newton, in press).

The student responses from the baseline study served as a foundation for the types of questions for this study and as a tool for case selection. A qualitative multiple case study design was implemented in order to answer the research questions (Gall, Gall, & Borg, 2007; Patton, 2002; Stake, 2000). There are multiple reasons why a qualitative approach was appropriate for this study, most importantly, this study placed the participants in the natural world and attempted to use conversations, interviews, and field notes to make sense of the experience (Denzin & Lincoln, 2000). Further, the present study did not pursue statistical generalizability, rather it sought to examine the nuanced and complex experience of negotiating environmental issues in the Greater Yellowstone Area. As a result, there was a need for rich descriptions of the experience in order to build a model to describe the results of the study (Denzin & Lincoln, 2000; Taber, 2000). Additionally, the researcher’s role in the study lent itself to qualitative research. The researcher acted as the primary instrument for data collection and interpretation. Moreover, the researcher was in the field with the students and was able to witness and experience the events associated with the course (Merriman, 1998).
Instrumentation and Instructional Context

Socioscientific and Environmental Engagement Dimensions Survey. The Socioscientific and Environmental Engagement Dimensions Survey (SEEDS) was designed specifically for the baseline study and was modeled after the Character and Values as Global Citizens Assessment developed by Lee, Chang, Choi, Kim, and Zeidler (2013). The SEEDS was designed to address contentious resource management issues and measures the dimensions Interconnectedness, Sustainable Development, Moral and Ethical Sensitivity, Perspective Taking, Empathetic Concerns, Feelings of Responsibility, and Examining Scientific Evidence. Multiple Likert-style items were written to measure each dimension on the SEEDS with negatively keyed items written to limit response bias. The items were based on a five-point scale, 1 = never, 2 = seldom/rarely, 3 = sometimes, 4 = often/frequently, 5 = always. Additionally, students were asked to elaborate on the reasoning for their Likert responses by providing in-depth examples as a means of support for their choices. The SEEDS was distributed and completed using Qualtrics survey software to accommodate the difference in location between the students and the researcher. The SEEDS instrument is located in Appendix B.

Environmental Behaviors Instrument. A questionnaire was designed for the baseline study to determine students’ environmental behaviors over the previous six months. Items included conserving water, purchasing environmentally friendly products, and protesting. The entire instrument can be found in Appendix C. Before the Environmental Behaviors Instrument was used in this study it was piloted with a group of post-secondary students similar to those in this study. The feedback garnered from the pilot study was used to modify the original instrument. The revised instrument was show to the pilot group to ensure the modifications addressed their concerns. Students were given Likert-style prompts to respond the frequency in
which they engaged in a variety of behaviors. The questionnaire was piloted on a sample of post-secondary students with similar education backgrounds and the feedback was considered during the revision of the instrument before it was administered in the study. The questionnaire is located in Appendix C.

**Semi-Structured Interviews.** Semi-structured interviews were also conducted with each student to allow them to expand on their responses to the SEEDS. The interview protocol was developed to mirror the dimensions of the SEEDS, thus allowing for triangulation of data (Patton, 2002). The present study purposefully selected cases from the baseline data that demonstrated three levels of change in environmental behaviors (Denzin & Lincoln, 2000; Patton, 2002).

**Course Participants and Case Selection**

**Participants.** Twenty-four post secondary students competed an experiential environmental education course imbedded with SSI instruction during the Summer 2014 semester. The students attended a small, public university in the southeastern United States. All the students were over 18 years old and varied in their academic major. Prior to the beginning of the course, each student received consent forms from both the researcher’s university and their university. The IRB consent form was read, reviewed, and signed by all students. Additionally, the researcher made himself available to answer any questions about the baseline and longitudinal studies. Pseudonyms were used to protect students’ identities and all recordings and notes will be stored on a password protected computer.

**Case Selection.** The original 24 participants completed the SEEDS and environmental behaviors instrument, along with a semi-structured phone interview. The interview protocol can be found in Appendix A. The data was used to purposefully select individuals for a second semi-
structured interview (protocol found in Appendix D). The researcher identified students who exhibit three distinct levels of environmental behavior: none to low, moderate, high. Seven purposeful cases were selected in order to examine the broad spectrum of environmental engagement without devoting resources examining each individual case (Gall, Gall, & Berg, 2007; Patton, 2002). The researcher used data saturation to determine the appropriate number of cases to include in each category. When it appeared that individuals were not providing unique reasons for demonstrating a given level of environmental behavior, that category was saturated and no additional cases were necessary to explore the phenomena (Saumure & Given, 2008). It is important to note that all seven cases for this study are female and research has suggested that women have been shown to be more emotionally engaged with the environment and show greater concern for preserving the environment (Kollmuss & Agyeman, 2002).

**Instructional Context**

The course was in its eighth iteration and took place over six weeks in the summer of 2014. Twenty-four undergraduates from various majors completed the course. Six instructors from various departments within the College of Arts and Sciences and Student Affairs were responsible for facilitating the course. Additionally, two faculty members from the researcher’s university also helped to facilitate the explicit SSI instruction. As part of the SSI instruction, the researcher and his faculty members intentionally created situations placing students in moral dissonance to promote moral and ethical growth. The course consisted of three components: (1) pre-departure instruction, (2) field experience, and (3) post-trip coursework, summarized in Table 3. Students spent 10 days living in the GYA interacting with stakeholders who must live with the consequences of decisions made regarding various CEI, including wildlife management, invasive species, and land usage. The data from the original study showed an association
between the experiential portion of the course and changes in the way participants negotiated CEI. The present study examines the residual association between the experiences in the GYA and how the participants apply their experiences both in the GYA and their daily lives with CEI longitudinally after completing the course, while also examining the association between the experiences in the GYA and students’ intended and actual environmental behaviors.

Table 3 Summary of SSI-embedded experiential environmental education course

<table>
<thead>
<tr>
<th>Portion of Course</th>
<th>Course Action</th>
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<tbody>
<tr>
<td><strong>Pre-departure</strong></td>
<td>Discuss the analogy that the university is to the town (Farmville, VA) as Yellowstone National Park (YNP) is to the GYA. Interview citizens of Farmville about their feelings about the university and the students. Group discussion on findings (e.g. perspectives, biases) and make connections to the GYA. Introduce the wolf reintroduction and management issue in the GYA.</td>
</tr>
<tr>
<td><strong>Field experience</strong></td>
<td>Interact with Jackson Hole residents and Wyoming Fish and Game Biologists about GYA CEI. Travel through YNP with field stops at nature interpretive areas (visitors’ centers and natural features). View wildlife in YNP and interact with wolf ecologists and tour guides. Interact with Gardiner residents about GYA CEI. Interact with ranchers possessing progressive and traditional perspectives about GYA CEI. YNP nature hike with a naturalist. Interactive presentation with a nature activist/writer. Interact with Gardiner residents about GYA CEI. Students placed into groups based on different perspectives modeled in GYA to prepare arguments for stakeholder council meeting where they assume perspectives encountered in GYA and engage in resolution of wolf reintroduction/hunting issues. Travel through YNP with field stops at nature areas and interactions with Native American about GYA CEI. Students conduct community stakeholder council meeting and come to resolution about wolf issue.</td>
</tr>
<tr>
<td><strong>Post-field work</strong></td>
<td>Town hall style forum on wolf hunting quotas in Montana. Students assume perspectives of GYA stakeholder encountered during experiential field component of course. Online course component where students analyze public documents and complete a major writing assignment on the natural resources management issues they had been assigned at the beginning of the course.</td>
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</table>

**Pre-Departure.** Three days of instruction took place prior to departing for the GYA. The purpose for the instruction was twofold; first, students were introduced to the skills necessary to examine contentious issues in the field, which included identifying potential issues, asking appropriate interview questions, and identifying potential bias. The sociology professor and the
researcher of this study led discussions on effective questioning and bias. Second, the biology and geography professor led discussions on looking for contentious natural resource issues.

Wolf reintroduction to Yellowstone National Park was the vehicle for transitioning the students toward considering contentious natural resource issues. The biology professor led a discussion where students were first asked to identify their personal opinion of whether wolves should have been reintroduced and to defend their position. A video that expanded on the issue and provided the perspectives of wildlife biologists and hunters who work in the GYA followed this. After completing the video, students reconsidered their position and explain the reason for their changes or address the perspectives in the video along with the reasoning behind the support of that perspective. The session concluded with the students writing questions that they would ask of individuals in the video.

Field Experience. Fieldwork took place over nine days, in two locations within the GYA. Students began their fieldwork in Jackson Hole, WY (the area which includes the town of Jackson and the surrounding area) where they spent the first morning in small groups investigating one section of the town of Jackson. During this time, students were expected to note the natural and man-made landscape and ask citizens of the town their perspective on an assigned natural resource management issue.

The afternoon was comprised of meeting with two wildlife biologists who ran the National Elk Refuge for the Wyoming Department of Fish and Wildlife. At this time, the group was introduced to the issue of elk management; specifically, determining the number of elk to be allowed on the winter range. It was at this time that effective questioning strategies were modeled for the students, which reflected many of the aspects of SSI resolution including, skepticism, considering multiple perspectives, and the subtleties between scientific evidence and
morals. The first day was completed with a group discussion intended to point out and reflect upon the complex and contentious nature of the natural resource management issues in Jackson Hole.

Day two was a travel day, as the group relocated to Gardiner, MT. This migration led the course through Yellowstone National Park, where the students had the opportunity to experience several of the tourist sites and visitor’s centers. Students were encouraged to analyze these tourist destinations with a critical eye towards human impact on the natural environment and how nature was being framed in terms of its relationship with mankind (i.e. nature subservient to humans, nature equally valuable as humans, nature more valuable than humans).

The next three days, students interacted with various stakeholders in the Gardiner, MT area. Gardiner is a town of 875 people and is the northern entrance to Yellowstone National Park (U.S. Census Bureau, 2011). The town has limited accessibility due to its remote location and position within the Rocky Mountains. The closest airport is Bozeman Yellowstone International, which is 83 miles north of Gardiner (Gardiner Chamber of Commerce, 2012). Several interactions were arranged by the faculty to ensure students would be exposed to as many perspectives on CEI as possible. Additionally, students were required to explore the town in groups and engage with as many local citizens as possible.

The culminating activity for the field experience component was a town hall-style discussion on wolf hunting quotas in Montana. Heterogeneous groups were formed based on students assigned natural resource issue. This allowed for the most diverse set of perspectives possible and mimicked the complexity of the wolf management issue. Each heterogeneous group was then assigned a stakeholder’s perspective to adopt. The students then worked together within their groups during dedicated meeting times to form a position on wolf management based on
their experiences during the pre-departure and field experience. By assigning a perspective to each group, students were forced to separate themselves from their personal perspective on the issue and attempt to see the issue from opposing perspectives, and defend that perspective using various forms of evidence (scientific research, moral concerns, traditional and cultural perspectives). Each group prepared a five-minute opening statement, which presented their suggestion for wolf management to the same panel of three peers. After the opening statement, the panel asked each group probing questions to elicit deeper considerations and evidence based examples. Upon completion of the all the opening statements and panel questions, each group was encouraged to rebut any positions and claims that were made during the opening statements. Closing arguments from each group followed.

The peer panel was then sequestered to deliberate and reach a decision on how to manage wolves, along with specific evidence-based reasons why they made their decision. An extensive process was required by the peer panel to complete their recommendation. First the members of the panel needed to carefully evaluate each group’s argument and consider the evidence presented by each group, which included scientific statements along with intuitive and emotive reasoning. Panel members then had to synthesize the various arguments and search for overlaps that could be supported and finally, generate an explanation for their decision that could be supported with evidence.

**Interactions with Stakeholders**

*Wildlife Photographer.* The first planned interaction was with the tour guides that were paid to escort the group into YNP and a wildlife photographer who makes a living photographing and videoing animals in and around YNP. The lead guide earned a Ph.D. in wildlife biology and was raised in and around YNP. The second guide holds a M.S. in wildlife biology, while the
third guide is a longtime resident of Gardiner and has been trained by the previously mentioned guides. Guides one escorted a third of the students into YNP to view wildlife, as well as discuss natural resource management issues related to the area. The second guide escorted another third of students east through the Lamar Valley portion of YNP to Cooke City to visit the studio of the photographer. The photographer shared his experiences in the GYA, as well as his opinions on the CEI related to the area. Throughout the drive, the group made several stops to view wildlife and listen to discuss CEI with the guide. The final third of the students spent several hours hiking in the Mammoth Hot Springs area of YNP with the third guide. The students learned about the history of the park, wildlife biology, and local CEI. The groups rotated each day until each group had participated in all three experiences. What are unique about these experiences are the complex perspectives of the guides. On one hand, they are scientists and as such, understand the need to consider predator-prey relationships and trophic cascades; but they are also business people who make their livelihood because of predators like wolves.

**Ranchers.** A planned meeting with two ranchers accounted for another planned experience. The first rancher held more traditional beliefs regarding predator management. While he did not actively seek out predators on his property to kill, he was comfortable killing any predator that appeared to be applying any emotional or physical stress on his herds. The second rancher took a more progress approach to managing predators by implementing a process known as range riding. She would ride on horseback and with dogs to keep the herds together, while also firing blank shots to scare away predators.

The next planned meeting was with the manager of a ranch that focuses on attracting hunters from out of state. These hunting experiences focus on elk, which are also a favorite prey of wolves. The manager discussed environmentally friendly ways to manage the range, which
was a priority for the owners, as well as his observations of the impact of wolves on the ranch and the ecosystem. Furthermore, students had the opportunity to participate in a service-learning project at the ranch. The students and faculty helped remove an invasive weed from the pasture of the ranch, which was preventing a natural food source for grazing animals.

**Member of the Crowe Nation.** Students traveled into YNP with the Native American and learned his perspective on the natural resource issues under examination in the course. Frequently, the group would stop at locations within the park and the Native American speaker would share his experiences growing up in and around the park, the significance of the park and its contents to his people, and his personal philosophy toward wildlife management. Additionally, he shared traditional songs and stories that are significant to YNP and the Native Americans in the area. The overarching message of his presentation revolved around engaging in small behaviors to promote change and improve the health of the environment.

**Wildlife Biologists.** Students met with two wildlife biologists who managed the National Elk Refuge in Jackson Hole, Wyoming. At this time, students were exposed to the process of determining the number of elk allowed in the winter herd. The biologists discussed balancing the concept of carrying capacity with the impacts of having too many elk can have on the local community. This was also a time when the instructors modeled questioning strategies aimed at considering the more nuanced aspects of CEI. This experience allowed students to gain firsthand experience regarding the complexity of the winter elk herd issue because they were able to about the opposition to an overabundance of elk directly from the biologists who have to suggest the limits.

**Wildlife Guides.** The wildlife guides played multiple roles in the field experience. First, they served as guides to facilitate observation of wildlife in and around the park. Students
watched wolves, bears, moose and many other animals. Second, the guides acted as scientists to expose students to science content explaining the CEI. One guide grew up in YNP, as his father was a park administrator and holds a PhD. in ecology, the other a M.S. in ecology with an emphasis in wolf behavior. The guides were valuable resources because they were impacted in multiple ways by CEI. As business owners, their financial stability relies on the revenue generated by tourist who visit the park to observe apex predators like bears and wolves. On the other hand, they are both scientists who understand the complexity of CEI and the far reaching impacts CEI can have on the larger ecosystem.

*Environmental Activist.* The environmental activist shared with students a message of love and caring for the environment. His high-energy message promoted living by a set of rules to guide individuals through life. He shared his experiences of working for the park service and living around the park, as well.

*Naturalist.* The naturalist worked for the wildlife guides and led the students on a five-mile hike through a park of YNP. Along the hike, he would stop and tell stories about the history of the park and explain natural phenomena that were visible along the trail. Unlike many of the other stakeholders, the naturalist was not from the GYA and grew up on the east coast, near many of the students’ homes.

*Post-Field Work.* The final three weeks of the course were conducted online after the students return to their homes where students analyze public documents and complete a major writing assignment on the natural resources management issue they had been assigned at the beginning of the course. Students synthesized the information that garnered during the field experience, as well as conduct additional research, to create a position paper discussing the management of their specific resource.
Data Collection

Table 4 summarizes the types, time, and methods of data collection related to both the baseline study and the present study. The data collected in the previous study served as a foundation to examine the residual association between the course and how students’ attitudes and behaviors have changed one year after the completion of the course. The present study used student responses to the SEEDS, semi-structured interviews, and environmental behaviors questionnaire to select cases to explore in more depth.

Two methods were used to collect the data for the baseline study. Qualtrics Online Survey Software was utilized for the SEEDS and environmental behavior surveys because of proximity issues; namely, the researchers were located in a different state than the students and the data needed to be collected before the students’ experience began. The researchers decided that it was more valuable to conduct face-to-face semi-structured interviews in the limited time before the class started in order to have the opportunity to explore any emerging themes in the data. Likewise, the researchers were in a different state than the students and utilized Qualtrics again to collect the post-course and longitudinal survey data. Semi-structured phone interviews were conducted to complete the post-course and longitudinal interviews. The present study conducted semi-structured interviews with the selected cases via phone using an interview protocol based on the responses on the longitudinal data from the baseline study.

Table 4 Description of data sources, collection methods, and baseline/present

<table>
<thead>
<tr>
<th>Baseline/Present</th>
<th>Data Source</th>
<th>Collection Method</th>
</tr>
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<tbody>
<tr>
<td>Baseline (pre-course)</td>
<td>Semi-structured interview SEEDS</td>
<td>face-to-face</td>
</tr>
<tr>
<td></td>
<td>Environmental behaviors questionnaire</td>
<td>Self-reported survey (online)</td>
</tr>
</tbody>
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Table 4 Descriptions of data sources, collection method, and baseline/present (cont’d.)

<table>
<thead>
<tr>
<th>Baseline/Present</th>
<th>Data Source</th>
<th>Collection Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline (post-course)</td>
<td>Semi-structured interview</td>
<td>phone</td>
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<tr>
<td></td>
<td>SEEDS</td>
<td>Self-reported survey (online)</td>
</tr>
<tr>
<td>Present</td>
<td>Semi-structured interview</td>
<td>phone</td>
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<tr>
<td></td>
<td>SEEDS</td>
<td>Self-reported survey (online)</td>
</tr>
<tr>
<td></td>
<td>Environmental behaviors questionnaire</td>
<td>Self-reported survey (online)</td>
</tr>
<tr>
<td></td>
<td>Case study semi-structured interview</td>
<td>phone</td>
</tr>
</tbody>
</table>

Data Analysis

Semi-inductive analysis was used to examine students’ responses (Lincoln & Guba, 1985) to determine the extent to which students engage in CEI, use socioscientific reasoning (SSR), and engage in environmental behaviors one year after completing the experiential course. Additionally, constant comparative methods (Glaser & Strauss, 1967) were implemented to identify emerging themes in students’ responses.

Trustworthiness. Unlike quantitative research, which seeks to establish credibility through statistical measures (internal validity, generalizability, reliability, and objectivity); a qualitative research paradigm seeks to ensure trustworthiness through a different, but parallel set of criteria (Shenton, 2004). Lincoln and Guba (1985) identified four criteria to consider when establishing trustworthiness: credibility, transferability, dependability, and confirmability. The present study takes these criteria into account when considering the research design. The following sections describe specific measures the researcher will implement to address each of the criteria.

Credibility. Credibility can be thought of as how confident the researcher is in the findings and can be compared to internal validity (Lincoln & Guba, 1985; Shenton, 2004). The
present study implemented prolonged engagement, triangulation, and member checking to increase the credibility of the study.

**Prolonged Engagement.** Lincoln and Guba (1985) and Creswell (2013) emphasize the need for the researcher to spend enough time in the field to understand and appreciate the environment and culture. This time allows the researcher to build trust with the participants, as well as be comfortable accounting for any potential abnormalities in the data. Additionally, copious time in the field allows the researcher to recognize and account for preconceptions about the study.

The researcher of the present study spent three weeks in the field with the student participants. In two of those weeks, the researcher lived in the field with the student participants and shared in their experiences. The researcher was able to foster a trusting relationship with the student participants during the long van rides through the GYA and living in the same hotel. Additionally, sharing these experiences and having taught this course four previous times allows the researcher to understand and explain any potential irregularities in the data. Finally, the researcher was able to recognize his preconceptions regarding the students, address them, and ultimately rise above them.

**Triangulation.** Triangulation refers to the use of multiple methods and techniques to understand a phenomenon (Creswell, 2013, Lincoln & Guba, 1985). As such, triangulation allows the researcher to gain a deeper understanding because methods and techniques each expose only specific aspects of the phenomenon. Triangulation in qualitative research searches for consistency within the phenomenon and not the same results from different methods, which produces deeper comprehension of the phenomenon being studied.
The present study incorporated a variety of triangulation techniques. The author coded the data for all students in the study. A member of the science education faculty acted as a second coder to verify the author’s coding of the student responses to establish interrater reliability with at least agreement on 80% (Miles & Huberman, 1994) with any discrepancies resolved by the author. This researcher triangulation ensured a more accurate representation of the data. Additionally, the participants’ responses to the one-year follow-up surveys and one-year interviews were triangulated. For example, each question on the interview protocol is written to align directly with dimension on the SEEDS. This design allowed the researcher to compare the Likert responses ad open-ended responses on the SEEDS with the responses from the interview.

**Member Checking.** Member checking allows participants to review the interpretation of the data that was collected regarding their experiences. A common member checking approach is to ask participants to confirm the researcher’s interpretation of the interview via reading the transcripts from the interview (Lincoln & Guba, 1985, Merriam, 1998), while Creswell (2009) suggests giving participants “polished” (p. 191) interpretations of the interview with overall themes and patterns described rather than a complete transcript of the interview. Additionally, Merriam (1998) suggests that researchers might integrate member checking within the interview process by frequently asking clarifying questions. Regardless of which approach is implemented, the participant should have the opportunity to evaluate the researcher’s interpretation and make edits, clarifications, elaborations, or deletions (Creswell, 2009; Lincoln & Guba, 1985; Merriam, 1998).

The present study implemented multiple forms of member checking. First, students were the opportunity to review and edit the partial transcripts with an explanation of what was removed and the reasoning for omissions (e.g., conversations not related to study, small talk to
establish the relationship). The researcher intended to capture the Yellowstone experience through the eyes of the students; therefore, it was imperative that their words were accurately captured in the data. The research also included directions on how the transcripts were used, and how precise their language needed to be for the study (Carlson, 2010). Furthermore, the students were able to review the transcripts to ensure that the researcher interpreted the responses correctly, while also providing the opportunity to add information that was roused by reading the transcripts (Lincoln & Guba, 1985).

Additionally, the researcher paused frequently during the interviews to seek clarification and provide the student with an opportunity to edit the interpretation. The reason for implementing this process was because the thought was fresh in the student’s mind and there would be less likelihood the student forgot the context of the conversation, where waiting for the transcripts might have caused the student to forget what the intended message of their response. Additionally, this approach was less time consuming and required fewer contacts between the researcher and the students. This is important because the interviews were conducted during the school year and the students’ time was limited because of their course work. It was the researcher’s hope that this courtesy was well received by the students and helped to establish a higher level of trust, which lead to richer responses. Furthermore, by asking for clarification during the interview this might have tempered the students’ desire to focus on grammar and be less self-conscious of their responses (Carlson, 2010).

**Transferability**

Researchers are often concerned with the ability to apply their findings to other contexts. Unlike quantitative research, qualitative research can be difficult to replicate, it is the researcher’s responsibility to provide enough context for the reader to potentially transfer any
results from the study. Stake (1994) points out that while cases may be unique, they fall into broader categories allowing for the possibility of transferability to new cases. The qualitative research can support the reader in determining the transferability by providing a thick description of the phenomenon being studied that provides ample detail for readers to determine for themselves the level the results are transferable (Creswell, 2013; Lincoln & Guba, 1985).

Specifically, the researcher should include,

1. the number of organizations taking part in the study and where they are based;
2. any restrictions in the type of people who contributed data;
3. the number of participants involved in the fieldwork;
4. the data collection methods that were employed;
5. the number and length of the data collection sessions;
6. the time period over which the data was collected (Shenton, 2004, p. 70).

It is imperative that the present study provides an elaborate description of the phenomenon because the students’ experiences in the course are the focus of the study. The experiences in the course were complex and abundant. There were many people involved in the implementation of the course and several experiences, which took place over multiple locations. It is possible that the experiences become convoluted if a thorough description of the events is not provided void of any context for the reader.

**Dependability**

Dependability is parallel to reliability in the quantitative paradigm. Reliability seeks to measure the likelihood that the results produced in a study could be duplicated with the same sample of participants. Qualitative researchers recognize the impossibility of exact replication due to variation in interpretation of the interview questions by the participants, as well as
analysis by researchers. The present study implemented constant comparative analysis to limit any variations. The author along with a member of the science education faculty independently coded 50% of the student responses and compared results to establish interrater reliability with at least 80% agreement (Miles & Huberman, 1994).

**Confirmability**

Confirmability seeks to substantiate how the data collected supports the findings in a qualitative study. Measures of confirmability seek to address potential researcher bias. Many of the same techniques for insuring credibility also insure conformability and the present study implemented measures of triangulation and member checking to address both. Additionally, an audit trail was established to support the confirmability of the study. For the present study, the researcher maintained detailed records of the data collection and analysis products with an emphasis on explaining any potential modifications. The audit trail also included raw data, data reduction, and information on the development of the instruments that were used (Lincoln & Guba, 1985).

**Summary**

This chapter has discussed how the design of the present study aligns with the research questions, as well as defining the participants of the study and how cases will be selected. This was followed by a thorough discussion of the data collection methods that will be implemented including a timeline of when the baseline data and new data will be collected. Next, a detailed instructional context was provided because the context is directly involved with the outcomes of the study. The chapter is completed with an in depth discussion of how the data will be analyzed and the measures that will be taken to ensure the trustworthiness, credibility, dependability, and confirmability.
Chapter Four: Results

Introduction

Chapter four presents the analysis of student responses, while chapter five will discuss the major themes from the study. This study addressed three research questions and each are considered in the original order. All three questions were investigated using qualitative data from interviews and open-ended responses on surveys. Multiple sources were used to triangulate the data, including SEEDS and the EBI responses to ensure clear and deep answers to each research question.

Research Question 1: How do postsecondary students’ environmental behaviors shift from pre-departure to one-year after participating in an experiential environmental education course embedded with SSI instruction?

Environmental Behaviors

Environmental behaviors are actions whose consequences have an impact on the natural environment (Halpenny, 2010). In order to consider the broad spectrum of environmental behaviors, students reported the frequency they engaged in environmental behaviors ranging from recycling to participating in demonstrations. Data collection occurred using the Environmental Behaviors Instrument (EBI) during the pre-departure and one-year collection periods. As discussed in chapter three, the EBI was piloted and modified using a similar population to the group of students investigated here. Suggestions from the pilot group led to
modifications to the original EBI. The pilot group was then given the modified EBI to ensure the modifications had addressed the students’ concerns.

Table 5 presents the students’ EBI scores arranged from highest one-year score to lowest. Three students were selected for closer examination based on these scores. Hillary provided both the highest score and the largest change over the study. Chloe was selected because she was the middle score during the one-year collection period. Finally, Kelly was selected because she provided the lowest one-year score and because her score regressed over the study.

Table 5 Students’ EBI Scores Pre-Departure and One-Year

<table>
<thead>
<tr>
<th>Student</th>
<th>Pre-departure EBI Score</th>
<th>One-year EBI Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hillary</td>
<td>33</td>
<td>52</td>
</tr>
<tr>
<td>Susan</td>
<td>46</td>
<td>51</td>
</tr>
<tr>
<td>Emily</td>
<td>43</td>
<td>45</td>
</tr>
<tr>
<td>Chloe</td>
<td>33</td>
<td>44</td>
</tr>
<tr>
<td>Lisa</td>
<td>46</td>
<td>42</td>
</tr>
<tr>
<td>Naomi</td>
<td>25</td>
<td>28</td>
</tr>
<tr>
<td>Kelly</td>
<td>29</td>
<td>26</td>
</tr>
</tbody>
</table>

Changes in Environmental Behaviors

In addition to using EBI scores, the researcher examined students’ qualitative data to gain a clearer understanding of individuals’ environmental behaviors. Below is a qualitative description of Hillary’s, Chloe’s, and Kelly’s backgrounds and their pre-departure and one-year environmental behaviors. The statements below specifically address experiences within the course, but it is imperative to recognize the role that students’ prior experiences played the changes in this study. To provide more context, a short profile of each student is included that summarizes the case’s background.
Hillary. Hillary was Psychology major in the third year of her Bachelor’s degree. She grew up in a coastal area where her family worked in the fishing industry. After completing her degree, Hillary was accepted into a graduate program where she continued to study psychology after completing her bachelor’s degree. Hillary demonstrated moderate environmental behaviors during pre-departure. During her pre-departure interview she stated, “I recycle things that aren’t renewable, like metal, and my family is always careful of what lawn care products we use and clean out the storm drains, as they can directly impact our waterways.” It is important to consider Hillary’s background when interpreting this quote because her family harvests oysters and her quote directly addresses a choice that she makes, recycling, but it is less clear whether the decision to worry about lawn care products and the storm drains were hers or her family. It is possible that her parents elected to consider the waterways and she is simply assisting them in the process. Her quantitative results support a moderate rating, as well.

One-year after the course, Hillary displayed a high level of environmental behaviors. She provided several examples of her dedication to environmental behaviors. For example,

…I was unaware of our direct effect on our surroundings, and in turn, on the others in the environment. I am much more aware of my use of disposable materials, engaged with the idea of sustainability, and am interested in sharing my learning experience with others. Since the trip, I have implemented a recycling system for myself and my neighbors and friends, and have been a vegetarian ever since my trip to Yellowstone…I live right by a hospital and there was no place for employees to smoke, which is very unhealthy anyway, but I put up a place for them to at least put their trash in so they weren’t just throwing their butts into the grass. (one-year interview)
Hillary’s one-year comments indicate a level of personal commitment that was absent in her pre-departure data. One-year after the course, Hillary has clearly made choices to support the environment regardless of the additional effort that she must put forth. Hillary’s quantitative responses support her high rating, as she scored 50, which was the highest score of all 24 of the participants in the baseline study.

**Chloe.** Chloe was in the final year of her Bachelor’s degree where she was studying Criminology and Sociology. She was raised in a rural Virginia. Chloe remained at the university to pursue a Master’s degree in Criminology during this study. Chloe began the study with a moderate environmental behaviors rating. She offered the following during the pre-departure data collection period,

> I don’t recycle as much as I should. If a bin is available, I do recycle. I don’t liter, I don’t do anything like that. I make a point to pick up after other people who can’t walk a piece of trach to a trash can. (pre-departure interview)

Chloe’s statement indicates a level of personal willingness to endure moderate personal inconvenience in order to engage in pro-environmental behaviors. One-year later, Chloe remained similarly moderately committed to environmental behaviors. She discussed this during her one-year interview,

> I’m all about it, I recycle. You know, if I’m going to do a load of laundry, it’s going to be a full load so I don’t use as much water. Little things like that I do, but, unfortunately, I haven’t really taken a stance in the actual issue as much as I probably could…my neighbor and I carpool. We have the same graduate classes. It just seems really dumb for us both to drive, both waste gas money, both have the fumes messing up the environment. (one-year interview)
Congruent with her “middle-ground” one-year EBI score of 42, Chloe was still willing to invest time and energy into actions that would benefit the environment. Likewise, her EBI score was 42, which was the median score for the one-year data.

**Kelly.** Kelly was in the final year of her Bachelor’s degree studying English. After completing her degree, Kelly went on to begin a Master’s degree in English in Illinois. She was raised in rural Virginia where her family operated a small farm to supplement their income. Kelly was rated as low during the pre-departure data collection period. She demonstrated very little pro-environmental behavior in her qualitative responses. For example, “My family doesn’t recycle and so in some ways I guess I am really skeptical,” (pre-departure SEEDS) and “…my roommate really likes recycling and so I hate recycling,” (pre-departure interview). Kelly’s responses not only indicate a lack of pro-environmental behavior, but also a distrust and dislike.

One year later, Kelly showed no change in her environmental behaviors. During her one-year interview she said,

…I’m just really lazy and that’s sad, but it’s not that I don’t think about them. It’s just that I prioritize things. If I was going to take out the recycling on my way to school, that means that I have to leave probably an extra five minutes early, which means that I wouldn’t have five extra minutes to sleep. That’s a really horrible, but honest answer and I think that it’s not that I don’t think about them. I’m just too lazy, maybe, to do anything about it. (one-year interview)

As with her pre-departure statements, Kelly showed no pro-environmental behaviors, despite acknowledging that it was a poor decision for the environment. Kelly’s EBI score remained low relative to her peers and decreased over the course of the study, her EBI score was 26 out of 75
one year later. It appears that despite completing a place-based SSI course focused on CEI she is unwilling to endure inconvenience to take environmentally friendly actions.

**Summary of Research Question 1**

The data indicates students’ environmental behaviors shifted over the course of the study. Five students’ EBI scores increased, while two students’ scores decreased. The qualitative data supports the findings of the EBI with students who demonstrated that large EBI changes also provide qualitative statements to corroborate the EBI scores.

*Research Question 2: How do postsecondary students’ conceptualizations of CEI shift one-year after participating in an experiential environmental education course with embedded SSI instruction and to what extent are the shifts in CEI conceptualization associated with changes in environmental behaviors?*

Research Question 2 considered four dimensions of CEI engagement: perspective taking, feelings of responsibility, empathetic reasoning, and willingness to act. A pilot study using the same data set to address related questions from a previous project found the pre-course to post-course changes significant in the dimensions identified above (Herman, Newton & Zeidler, 2015). Qualitative responses from both the SEEDS open-ended responses and the semi-structured interviews, which had been coded for each dimension, were assessed as high, medium, or low examples of the dimension. This process was implemented for data at all three collection periods. Table 6 below provides exemplars of each rating level for all SEEDS dimensions. Additionally, Tables 7 and 8 provide each students’ rating for each dimension, as well as their environmental behaviors rating. Each dimension will be addressed separately, first by providing the general trends for all seven students, and then Hillary, Chloe, and Kelly will be examined in closer detail.
To prevent any confirmation bias, conceptual definitions were necessary to identify low, moderate, and high statements. Statements rated low showed an absence of the dimension or minimal effort/inconvenience. Moderate statements contained broad or general expressions of the dimension with no specific detail. High statements provided specific details, demonstrated an understanding of the nuances of CEI, and/or demonstrated high levels of inconvenience.

Table 6 Exemplars of SEEDS Dimensions Ratings

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Willingness to act</td>
<td>While I do not believe that I can make much of a difference, I think others who are more passionate about issues can and I am willing to help if I can (Emily, post-course)</td>
<td>I recycled before, but I am going to be more conscious about it. I will put more effort in now than before I went on the trip… (Lisa, post-course)</td>
<td>…so I sat down with a couple of them (members of dad’s hunt club) and told them what I know about Chronic Wasting Disease and they explained why they feel certain ways about how it is frustrating when they kill a certain animal… (Emily, post-course)</td>
</tr>
<tr>
<td>Perspective taking</td>
<td>Everybody can give insight on a different perspective (Chloe, pre-departure)</td>
<td>I think it is important to consider the opinions and perspectives of others when it comes to natural resource management, as this can cause a huge impact on the environment and must be looked at from numerous angles (Naomi, pre-departure)</td>
<td>I had to think about why the hunters wanted to kill the wolves. Well this is my livelihood… and coming up with that argument made me really think in a way that I had already decided I didn’t want to. The time I was getting to present with my group I was starting to think… I can understand where this person is coming from. This is how they make their living. This is their life…I felt attached to this new perspective that I trained my mind to look through. That experience made me consider in depth new perspectives that I had already dismissed (Kelly, post-course)</td>
</tr>
<tr>
<td>Feelings of responsibility</td>
<td>So I have the mindset along with many people in the world. If it doesn’t affect me I don’t need to do something for that (Kelly, pre-departure).</td>
<td>I realize that we must be good stewards of our environment and do what we can to give back… (Hillary, post-course)</td>
<td>I believe that preserving the earth for future generations is important and I often think about my impact and what that will mean for the future… (Susan, one year interview)</td>
</tr>
</tbody>
</table>
| Empathetic concern | I personally do not (relate).… I guess it has not affected me | …even if I’m not in the place for those things that are affecting me | Listening to that person, seeing their facial expression, their body expressions… and listening to them talking about the issues made
Table 6 Exemplars of SEEDS Dimensions Ratings (cont’d.)

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>personally. I am not a farmer or something like that where it’s affected me…(Chloe, pre-departure SEEDS)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>that I can understand where somebody would stand or why they would be affected by those issues (Hillary, one-year interview)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>me more invested and made me kind of imagine what it would be…When Hillary was talking about finding a (dead) calf. I was playing in my mind this image of her coming up on this calf and me thinking, well, you know this is more money I have lost. What do I need to do?...It made me embrace her story a little more. (Kelly, post-course interview)</td>
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<td></td>
</tr>
</tbody>
</table>

Table 7 Pre-departure SEEDS Dimensions Qualitative Ratings and Environmental Behaviors Ratings

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Chloe</th>
<th>Emily</th>
<th>Hillary</th>
<th>Kelly</th>
<th>Lisa</th>
<th>Naomi</th>
<th>Susan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perspective Taking</td>
<td>M</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Empathetic Concern</td>
<td>M</td>
<td>L</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>L</td>
<td>M</td>
</tr>
<tr>
<td>Feelings of Responsibility</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Willingness to Act</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Environmental Behaviors</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>

Table 8 One-year SEEDS Dimensions Qualitative Ratings and Environmental Behaviors Ratings

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Chloe</th>
<th>Emily</th>
<th>Hillary</th>
<th>Kelly</th>
<th>Lisa</th>
<th>Naomi</th>
<th>Susan</th>
</tr>
</thead>
<tbody>
<tr>
<td>Perspective Taking</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Empathetic Concern</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>M</td>
<td>M</td>
<td>M</td>
<td>M</td>
</tr>
<tr>
<td>Feelings of Responsibility</td>
<td>M</td>
<td>M</td>
<td>H</td>
<td>M</td>
<td>L</td>
<td>M</td>
<td>H</td>
</tr>
<tr>
<td>Willingness to Act</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
<tr>
<td>Environmental Behaviors</td>
<td>M</td>
<td>H</td>
<td>H</td>
<td>L</td>
<td>L</td>
<td>L</td>
<td>H</td>
</tr>
</tbody>
</table>
Changes in Perspective Taking

For this study, perspective taking is the ability to consider CEI from multiple positions. Table 9 below categorizes the students during each data collection period. Students demonstrated low to moderate levels of perspective taking in the pre-departure period, three of the students received a low rating, three received moderate rating, and one received a high rating. After completing the course, students generally were more likely to consider a wider array of opinions and perspectives related to CEI. All seven students’ ratings for Perspective Taking are provided in Table 10. Overall, the students were able to appreciate the impact of CEI on various participants and emphasized the role perspective taking plays in CEI mitigation better after completing the course, as well as one-year later.

Table 9 Students’ Perspective Taking Ratings

<table>
<thead>
<tr>
<th>Perspective taking</th>
<th>Pre-departure</th>
<th>Post-course</th>
<th>One-year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>Emily</td>
<td>Chloe</td>
<td>Naomi</td>
</tr>
<tr>
<td></td>
<td>Hillary</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Kelly</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Lisa</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Naomi</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate</td>
<td>Chloe</td>
<td>Emily</td>
<td>Chloe</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Susan</td>
<td>Susan</td>
</tr>
<tr>
<td>High</td>
<td>Susan</td>
<td>Hillary</td>
<td>Emily</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kelly</td>
<td>Hillary</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lisa</td>
<td>Kelly</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Naomi</td>
<td>Lisa</td>
</tr>
</tbody>
</table>

**Hillary.** During the pre-departure period, Hillary offered, “I think I try to see other people’s point of view, but you can’t argue with scientific facts. Opinions only matter so much,” (Hillary, pre-departure). This statement was considered an example of a moderate statement of perspective taking because she acknowledges considering various points of view, but does not
describe the importance of taking perspectives, and in fact, favors a scientific perspective over other perspectives. Minimalizing opinions indicates Hillary did not value other forms of knowledge people might use when considering CEI.

Hillary’s responses indicate she developed a greater appreciation for others’ positions, as well as a more nuanced understanding of CEI immediately after the course, as well as one year later, which resulted in a high rating. This can be seen in the following response:

As human beings, we have historically exploited natural resources. Reversing this pattern will ruffle feathers and bring up social and ethical concerns because lifestyles will have to change, ancestral businesses will have to change, and some will be challenged to change viewpoints. Only through considering others’ points of view can we find a midpoint to change for the better without uprooting lifestyles and alienating others. (one-year SEEDS)

Hillary’s one-year response exemplifies the responses of the students in this study rated high for perspective taking. They were far more aware of the diverse stakeholders involved, as well demonstrating a more nuanced understanding of those perspectives.

Hillary offered the following response when asked the extent to which her experiences in the course were associated with her opinions regarding perspective taking,

I would say that before the trip, I was not aware of all the different stakeholders in any given situation. Being encouraged to reach out to all different community members really helped me to put things in perspective. As we role played as different members of the community, we were introduced to the complex web of intersecting, and often opposing, opinions, needs, perspectives and values. I was able to take this new skill
Hillary cited specific examples from the course in the above quote, some planned by faculty and others spontaneous as most significant on her perspective taking. The role playing to which she referred was the mock town-hall style discussion. This experience required groups of students to assume an assigned perspective and recommend a wolf management plan to a mock state committee, which was also composed of students. Additionally, Hillary referenced various interactions with members of the GYA community. The interactions were sometimes planned by the faculty (e.g., wildlife biologists), but sometimes occurred as a result of spending time in the community (e.g., waitress in a restaurant, motel desk staff).

**Chloe.** Chloe demonstrated a moderate ability to consider various perspectives at the pre-departure collection period.

I think having an opinion from all dimensions is important. The natural sciences or social sciences would only benefit. I am very open to anybody’s opinion…It is very important to see everyone’s side. It may bring up something you never thought of before or change your opinion. (pre-departure interview)

Compared to those students rated low, Chloe’s response indicates she places more value in diverse perspectives and does not privilege one set of knowledge over others. Likewise, Chloe was open to modifying her thoughts on CEI if new information was presented.

Chloe’s ability to take multiple perspectives remained unchanged immediately after completing the course. She stated, “I am open minded when looking at social issues and consider many viewpoints before taking a stance and making an opinion,” (post-course interview) and “We can make assumptions, but we do not know what may cause what, so me
must consider all sides in order to avoid bad situations,” (post-course SEEDS). As with her pre-departure responses, Chloe was willing to consider many perspectives and did not place unequal value on any particular type of knowledge.

Finally, one year after the course was completed; Chloe stated the following, which resulted in a moderate rating,

This course really opened my eyes to how many stakeholders there may be on one natural resource issue. It allowed me to have an open mind on others’ opinions and perspectives regarding many different issues, including natural resource issues…I thought I was pretty open-minded prior to the Yellowstone trip, but the Yellowstone trip kind of allowed me to really see that I probably wasn’t. I maybe a little more naïve than I realized. (one-year interview)

As with the previous examples, Chloe was open to many sources of knowledge and did not privilege any perspective over another. However, unlike students who were rated as high perspective takers, Chloe was only able to view the perspectives as an outsider. There is no indication that she was began to see the various perspectives as if she was the stakeholder, but did not express any pity for those impacted by CEI.

Kelly. Kelly entered the study less able to consider various perspectives related to CEI. Her qualitative responses during the pre-departure data collection period indicated that she did not consider environmental issues enough to think of other’s perspectives.

I am not very familiar on environmental issues, but it has never really been a priority for me nor do I have these type of conversations on a regular basis. Most of the people I know are not necessarily concerned with these types of issues. (pre-departure SEEDS)
Kelly’s pre-departure quantitative data indicated she was more open to multiple perspectives; however, primarily due to her ability to recognize the social, moral, and ethical impacts on CEI resolution.

Immediately after completing the course, Kelly was better able to consider various perspectives, which is the reason why she received a high rating. She offered the following two key responses during her post-course interview:

1) I would say before the trip; I was pretty narrow-minded. I don’t think I felt very vested in the issue. I didn’t know a lot about the issue. I didn’t think it was something I had a say in it. After this trip and going through the community council… I think that I am more interested in looking at other people’s perspectives. The community council was a great way to get everyone to listen at other people’s perspectives and opinions. To see what all these groups are saying before basing my own opinion. Considering the whole picture, not just my portion of the picture.

2) I had to think about why the hunters wanted to kill the wolves. Well this is my livelihood… and coming up with that argument made me really think in a way that I had already decided I didn’t want to. The time I was getting to present with my group I was starting to think… I can understand where this person is coming from. This is how they make their living. This is their life. This made it complicated to me. I felt attached to this new perspective that I trained my mind to look through. That experience made me consider in depth new perspectives that I had already dismissed. (post-course interview)

It is evident in these two selected post-course quotes that Kelly changed her perspective taking as a result of the experience. The biggest difference between Kelly’s perspective taking abilities and
One year later, Kelly was still able to consider multiple perspectives at a high level. For example, she stated, “I feel very comfortable stepping back from my subject position now in order to recognize and evaluate someone else’s voice, and I don’t think I was as willing to do that before LU@YNP,” (one-year interview). Additionally, Kelly added, “I felt like the class kind of put me in the right kind of mindset and just willing to learn different things and be open-minded hearing the different possibilities especially since my background had nothing to do with that,” (one-year interview). Furthermore, she stated

…I think I had a better perspective on these laws and things and on these people who had to deal with these natural science issues all the time, rather than someone like me who was like, you know, I don’t have to worry about, if there is a deer in my backyard, my dad is probably going to shoot at it. But in Yellowstone, you can’t just shoot at a wolf and scare it off because people will get up-in-arms about that. So I think I had a greater, a better perspective on all of that after I’ve been in Yellowstone. (one-year interview)

These quotes demonstrate Kelly’s understanding of the importance of perspective taking when considering CEI. As with her post-course responses, the one-year responses indicate that Kelly was not just viewing the perspectives as an outsider, but was at least partially able to see the perspectives as if she was the stakeholder.

**Changes in Empathetic Concern.** Empathetic concern is, “the ability to empathize with or feel pity for those who experience negative impacts because of science-related social issues,” (Herman, Newton, & Zeidler, 2015, p. 16). For this study, the researcher did not consider the
subject of the empathy or if there were limitations placed on the empathy, (e.g., conditional, unconditional (Hoffman, 2000)). Rather, the focus was on whether the students could consider stakeholders’ points of view from the perspective of an insider and assume the emotions and values of the stakeholders. Students’ changes in empathetic reasoning varied. There was an increase in empathetic reasoning during the post-course data collection and many students returned to moderate empathetic reasoning one-year later. Generally, at the one-year period, most students felt a limited ability to empathize with stakeholders because they had not had the exact experiences of the stakeholders. Table 10 summarizes the categorization of the students during each data collection phase.

Table 10 Students' Empathetic Reasoning Ratings

<table>
<thead>
<tr>
<th>Empathetic reasoning</th>
<th>Pre-departure</th>
<th>Post-course</th>
<th>One-year</th>
</tr>
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<tbody>
<tr>
<td>Low</td>
<td>Emily</td>
<td>Chloe</td>
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<td>Kelly</td>
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<td>Moderate</td>
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_Hillary_. Hillary entered the course with direct experience with CEI. She grew up on the water and her family made their living by harvesting oysters. She had witnessed the impact policy changes had on her family. As a result, prior to the course beginning of the course, Hillary
was already able to empathize at a high level with individuals impacted by CEI. During her pre-departure interview, Hillary stated,

I grew up in Virginia Beach on the water and have witnessed many new laws being put into place regarding the protection of the water. I have had to deal with the ordinances requiring my family to dredge the shoreline in order to maintain the integrity of the landline. Although it is clearly important to do this, as we have a house near the shoreline which natural shifts, the city manages this being done and people say that they do it more often than necessary in order to scrape up extra funds. Also, more restrictions are put on oyster farmers every year as people think it harms the environment, which is not true.

(SEEDS pre-departure)

Hillary’s response indicates she could empathize with the stakeholders in the GYA. She was able to take their experiences and see them as her own.

During her post-course interview, Hillary made the following statement that indicated a high rating,

Personally, I have been impacted by policies and laws made regarding natural resources as my family farms oysters on the coast of Virginia Beach. I know what it is like to have to suddenly drop everything to dredge the coastline to meet new codes, laws made with seemingly no regard for the residents of the community. I also understand that these seemingly pointless laws and policies are made for the protection of the environment, and eventually, our oyster crop. Although it is expensive, inconvenient and seemingly unfair, it makes sense that this needs to be done to maintain the health of the bay. I was reminded of this and my family’s anger when conversing with stakeholders in the community who were unhappy with the laws made to protect the animals of Yellowstone,
but not the year-round residents and their livelihood. (one-year interview)

Hillary was able to connect her personal experiences with those in the GYA. She had little problem not only understanding the frustrations of the stakeholders, but could view the problem as an insider and feel their emotions as her own.

One year after the course, Hillary was still able to empathize with the stakeholders in the GYA. During her one-year interview Hillary stated,

…I think seeing things personally, even things that aren’t for the environment, but change is hard, so when people have their land taken or have to change drastically their way of business, it’s a huge deal. So, I think that I definitely can empathize and see every point. In order for change to happen, ways that businesses operate will have to change and through that change, economic stress will occur. I absolutely can empathize. Not only does my family deal with it with their business, but businesses make it known when they are supporting environmentally sustainable products and their prices reflect that. I often go out of my way to support these businesses myself. (one-year interview)

While not explicitly stated, based on her previous comments and the history with the researcher, it can be assumed that Hillary was referencing her family’s experiences once, again. Furthermore, Hillary extends her ability to empathize by connecting the financial impact CEI resolution can have on stakeholders when she referenced pay higher prices for goods that are more environmentally friendly.

Chloe. Chloe moderately expressed empathy during the pre-departure data collection period.

…I guess it has not affected me personally. I am not a farmer or something like that, where it’s affected me in what I know, I guess. But, I do live around farms where, as stuff
comes in, they are tearing down farms. They are building things. Their whole life has been flipped upside down. I can relate because I see it happening, but it is not personally happening to me. But, I think it is very sad seeing stuff like that and people’s lives getting flipped upside down. That’s all they have known and animals getting their homes taken away from them. (pre-departure SEEDS)

In her responses, Chloe demonstrated a limited ability to experience other’s feelings as her own, despite not being directly impacted by CEI. As a result, there is an absence completely understanding the perspective of other and internalizing those feelings.

During the post-course data collection process, Chloe expanded on her example from the pre-departure data by saying,

I have a lot of neighbors and that’s their income. They farm and sell stuff. It would suck if someone came in and tried to ruin it somehow for them. I feel like I can identify with them. But, not specifically for the wolf example, I guess. But as far as someone coming in and flipping your world upside down and it’s not what you are used to. I can feel for them, but me personally I never had that happen to me. It’s harder for me to put myself in their shoes, but I can imagine how hard it can be.

As with the pre-departure example, Chloe could feel a limited amount of empathy. She acknowledged her inability to empathize with those impacted by wolf management, but expressed a general feeling of caring for those who are impacted.

One year later, Chloe offered the following response related to empathetic concern, which are consistent with her previous responses.

Every case is different and I do feel remorse for those who suffer losses due to things like the reintroduction of the wolves. However, the wolves have more of a right to be there…
I don’t think I can fully identify with it, but I definitely think that we all can do some level just because this is our planet and we should all at least try somewhat, or even just something just like changing your behavior throughout our daily routine is that something that you can change your view, too. (one-year interview)

The limited feeling of empathy existed one year later. As with her previous responses, Chloe qualified her response by acknowledging that she could not fully identify. Furthermore, this limited ability to assume the feelings of those impacted by CEI are what categorized her responses as moderate.

**Kelly.** Kelly brought prior experiences with CEI to the course; however, she stated that she never felt the repercussions of CEI, which contributed to her rating of low empathetic concern.

… my father, he farms additionally to other stuff he does. I know that I hear a lot of the time how hard it is farming and stuff…He doesn’t talk about what is going on. One time he had a really bad corn crop and they had to help him and stuff. And so I would say that would be the only extent I would physically be involved with. (pre-course, interview)

Kelly’s feelings of not being impacted by CEI resonated throughout her pre-course data, as she frequently stated she could not relate to individuals impacted by CEI because she was not familiar with the issues.

After completing the course, Kelly was better able to empathize with stakeholders, which resulted in a high rating. For example, she said,

Listening to that person, seeing their facial expression, their body expressions and listening to them talking about the issues made me more invested and made me kind of imagine what it would be like. When Hillary was talking about finding a dead calf. I was
playing in my mind this image of her coming up on this calf and me thinking well you know this is more money I have lost. What do I need to do? It made me think more in my mind what that image looked like. It made me embrace her story a little more, than if I just read about the experience. I was sitting right in front of her listening to her talk.

(post-course interview)

The course provided Kelly with authentic experiences to which she could relate. As a result, she became aware of the impact CEI have on stakeholders.

Kelly’s empathetic concern dropped to a moderate rating during the one-year period, but remained above her pre-departure rating. Her responses continued to refer to the experience talking with the ranchers about the impact of wolf predation on their farms. For example, she said,

…I remember sitting there, before the trip I had this strong opinion, people who kill wolves there is a reason and I was very open arms about it. I didn’t have any reason other than that’s just what felt right. Interview the ranchers helped me feel more empathy towards them because they could give us first-hand stories of the impact of wolf attacks. (one-year interview).

Kelly acknowledged her ability to empathize with the ranchers despite not living or working on a ranch. She was able to internalize the feelings of the ranchers and understand why they might not like the wolves.

Changes in Feelings of Responsibility. Students’ feelings of personal impact on CEI varied considerably over the course of the study. Table 11 summarizes students’ feelings of responsibility. The trend was that students felt a greater sense of responsibility post-course and one-year later than they did pre-departure.
Table 11 Students' Feelings of Responsibility Ratings

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<th>Feelings of responsibility</th>
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Hillary. Hillary provided one example related to her feelings of responsibility when in her pre-departure interview she stated, “…the water behind my house is not only part of the value of my home, but is also my family’s business. We all have to protect it,” (pre-departure interview). The fact that this was her only response related to feelings of responsibility, coupled with the self-serving nature of the response led to Hillary’s rating being low. During the post-course data collection, Hillary offered the following,

I was very much aware of the impact it (tourism) had on the bay and then the ocean…I have cut the plastic rings around soda cans, picked up litter, and avoided the use of plastic to preserve the resources that I could see every day, but am now much more aware of the other resources we impact every day. I realize the we must be good stewards of our environment and do what we can to give back. We take from our resources and simply expect them to remain convenient for us. (post-course interview)

Hillary was able to provide more detailed explanations of what actions she took to resolve CEI and also how those actions fit into the global level of resolving CEI. While her pre-departure
response implied the environment needed to be protected because of its monetary value to her family, Hillary’s post-course responses reflected a deeper understanding for the value of the environment beyond profiting from it.

During the one-year data collection period, Hillary’s responses took on a more direct approach to her feelings of responsibility. In the previous two collection periods she claimed to feel very responsible for CEI, but offered limited examples of how she felt responsible. The one-year data provides a different view of Hillary’s feelings of responsibility,

I have always loved and appreciated nature, but before the trip I was unaware of our direct effect on our surroundings, and in turn on others in the environment. I am much more aware of my use of disposable materials, engaged with the idea of sustainability, and interested in sharing my learning experiences with others. Since the trip, I have implemented a recycling system for myself and neighbors and friends, and have been a vegetarian ever since the trip. (one-year interview)

The one-year data supports the feelings of responsibility claims and also provides specific examples of what she has done to address those feelings. Additionally, elsewhere in her one-year data, Hillary discussed actions she has taken to reduce human impact on the environment; specifically, she set up and maintains a disposal station for people who smoke behind the neighboring hospital as well as collecting trash and recyclables from campsites and disposing of these items properly. Like her post-course comments, Hillary’s one year comments reflect a deeper understanding of the importance of the environment to all people. There does not appear to be an emphasis on protecting the environment simply so she and her family can continue their business. It should also be noted that the level of effort associated with Hillary’s feelings of responsibility increased over the course of the study.
**Chloe.** Chloe’s pre-departure responses indicated that she felt moderately responsible for resolving CEI. She provided two responses regarding her feelings of responsibility. First she stated, “I realize that everyone can make a difference and so doing one small action that may be an inconvenience to me could really impact resolving social issues regarding natural resources management,” (pre-departure SEEDS). Additionally, she offered, “I feel guilty because I say we should (engage in pro-environmental behaviors), but then I guess it’s an inconvenience to me, so I don’t. I think it’s important for us to do that, but I guess I have never been,” (pre-departure interview). Chloe was rated as feeling low responsibility because she was not able to identify any actions she took to resolve CEI and also because she expressed guilt at not doing anything because it was an inconvenience to her.

During the post-course data collection period, Chloe demonstrated moderate feelings of responsibility. Her SEEDS responses stated,

I do feel responsible for causing social issues regarding the environment because every inconvenience I choose to let get the best of me has a negative impact on those issues. For example, if I choose not to recycle, then I am contributing to the social issues related to the environment. I am trying to overcome those inconveniences though! I think the small things count, so even just recycling when you can makes a huge difference! (post-course SEEDS)

This comment demonstrates moderate feelings of responsibility because she acknowledges her prior behavior and claims to want to fix it. There is also ownership of her behavior, whereas in the pre-departure there was a willingness to place responsibility on society as a whole. However, unlike those rated high, Chloe only speaks in a hypothetical context, there is no specific example of how she feels responsible.
Chloe also demonstrated moderate feelings of responsibility during the one-year data collection period. Her comments were consistent with those she gave during the previous two data collection periods. During an interview she stated,

I realize how much of an impact it actually has on the environment whereas before I didn’t necessarily realize what one person can actually do in just making the little inconvenient life changes and I don’t know, it’s not inconvenient anymore. It’s just part of my daily routine. You can save a little water, recycling things, doing things like that, making sure you don’t litter. Those kinds of things, I mean, I always knew about but going to the Yellowstone trip really opened my eyes and really take, even if it’s a little bit more inconvenient to walk over to the recycling bin. (one-year interview)

As with her post-course responses, Chloe continued to focused on common-place environmental actions and overcoming the minor inconveniences of such behaviors. Notably, Chloe demonstrated personal responsibility for these actions and did not displace that responsibility to others.

**Kelly.** Kelly began the course feeling little responsibility for resolving CEI pre-departure. Kelly provided the following comment during the pre-departure interview, “…I specifically never felt affected by it (CEI); so I have the mindset, along with many other people in the world, if it doesn’t affect me I don’t need to do something for that.” Her response indicates an “out of sight, out of mind” approach to feeling responsible and an ignorance to the impact her daily decisions play in both local and global CEI.

The post-course data indicates Kelly began to feel more responsible for resolving CEI. She stated,

I think that I feel responsible for some of the hunting issues. I come from a southern
family who hunts and things like that. I remember thinking when they were talking about how they couldn’t shoot the bears and stuff that were taking their cows. I remember thinking about if something was in my backyard and it could potentially harm me or my family and I wasn’t able to shoot it… what that would be like? And I remember being like wow that would be really tough. I feel a little more responsible for that, I have that option. They don’t have that option. I think that I have to think a little more how I can make an impact on things like that. (post-course interview)

The experiences in the course helped Kelly make connections to existing issues in her local community, which resulted in her feeling more responsible for resolving these issues. Compared to her pre-departure responses, Kelly was able to expand her understanding of CEI and realize they exist in her local community and not just on a global scale.

Kelly’s one-year responses also indicate moderate feelings of responsibility. For example, “Coming from a southern family where shooting something in the backyard because it’s messing with the garden isn’t unheard of, it never occurred to me that there were implications for those actions beyond saving the garden” and “I felt that my experience in Yellowstone helped me become more empathetic and helped me realize that I could make a difference, even through the smallest actions.” Both of these exemplars demonstrate Kelly’s increased understanding of her connection to resolving CEI relative to her pre-departure responses, as well as her responsibility for resolving CEI by acknowledging CEI in her daily life and expressing a willingness to modify her behaviors in order to mitigate these issues.

**Changes in Willingness to Act.** Willingness to act addresses students’ personal conviction to actively address and resolve contentious issues (Herman, Newton, & Zeidler, 2015). All students entered the course with either a low willingness to act or a moderately
willing to act to resolve CEI. During the post-course data collection, Kelly remained in the low ranking, Emily demonstrated a high willingness to act, and the remaining five students were moderately willing. Several changes occurred at the one-year collection period and are summarized in Table 12. The students reporting low willingness to act identified mitigating factors that prevented them from acting to resolve CEI.

Table 12 Summary of Students’ Willingness to Act Ratings

<table>
<thead>
<tr>
<th>Willingness to Act</th>
<th>Pre-departure</th>
<th>Post-course</th>
<th>One-year</th>
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<tbody>
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<td>Low</td>
<td>Chloe, Emily, Hillary, Kelly, Lisa, Naomi</td>
<td>Kelly</td>
<td>Lisa, Kelly</td>
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<tr>
<td>Moderate</td>
<td>Susan</td>
<td>Chloe, Hillary, Lisa, Naomi, Susan</td>
<td>Chloe, Naomi</td>
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<tr>
<td>High</td>
<td>Emily</td>
<td>Emily, Hillary, Susan</td>
<td>Emily, Hillary, Susan</td>
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**Hillary.** Hillary began the course with a low willingness to act to resolve CEI. She was only able to offer a single example of her willingness to act during the pre-departure data collection. She stated, “Being so young, I don’t think anyone would ever listen to me, but my family always tries to explain the situation to others when they are mistaken,” (pre-departure interview). She was unable to provide any qualitative responses on the SEEDS because she was unable to think of any specific examples where she was willing to act toward resolving CEI.
Post-course there was little change in Hillary’s willingness to act. The following quote demonstrates her moderate willingness to act.

I am unsure how much of an impact I can have on larger social issues surrounding natural resource management, but I intend to change my own actions, hoping to impact others. I would be willing to get involved in other actions to resolve these issues, but I am unsure where to start. (post-course SEEDS)

Hillary still doubted her impact on influencing others, but was willing to participate in resolving issues despite not having figured out how to do so. Key changes however, were Hillary’s recognition that she could change her own actions to influence others and a willingness to participate in other actions. This was interpreted as an increase compared to her pre-departure statement, which indicated that she could not do much because she was too young.

One-year later, Hillary’s willingness to act increased. She responded to interview questions regarding willingness to act with the following response,

In order for change to happen, ways that businesses operate will have to change and through that change, economical stress will occur. Especially since many businesses are unwilling to change, even hiring lobbyists to sway law makers in their favor…Businesses make it known when they are supporting environmentally sustainable products, and the prices reflect that. I often go out of my way to support these businesses myself. (one-year interview)

The responses above indicate not only a conviction to resolve the issues, but also her actively participating to resolve them. The first quote demonstrates Hillary’s personal conviction to reducing the littering near her home. The second quote exemplifies Hillary’s willingness to
actively address sustainability on a more global level. She was enduring personal sacrifice by spending more money to influence the behaviors of large companies.

**Chloe.** Chloe began the course with a low willingness to act rating. She was only able to offer a single response during the pre-departure data collection period. She stated,

> I am not recycling and it’s something so easy. I guess when it comes down to it, I feel like if somebody needed somebody to back them, I would definitely stand up for nature and natural resources and stuff. (pre-departure interview)

Her response exhibits a low level of commitment. First, there is no specific example(s) provided of situations where she was willing to act to resolve natural resource issues. There is no initiative displayed to take charge of the situation, rather, Chloe was only willing to act in a supportive role.

At the post-course data collection point, Chloe demonstrated a more moderate willingness to act. She responded to the willingness to act question during the interview as follows,

> I feel that everyone counts in trying to resolve certain social issues; however, I don’t see necessarily believe that global cooperation will help the specific issues in the United States. For example, beyond the U.S., how could other countries contribute to resolving the wolf issue in Yellowstone? This is a domestic affair, not an international one. However, I believe some issues are so large that global cooperation is necessary to resolve. (post-course interview)

Chloe’s response still lacks any specific task that she is willing to act upon, but she was able to consider the impact that action could have on a global level.
One-year after the course was completed, Chloe still provided a moderate willingness to act. She responded,

…now I realize how much of an impact it actually has on the environment, whereas before I didn’t really necessarily realize what one person can actually do in just making the little inconvenient life changes. It’s not inconvenient anymore to me. It’s just part of the daily routine. (one-year interview)

Chloe was able to reference her own potential actions at this time, versus previous collection periods. However, her comments indicate a willingness to act only when it requires minimal effort on her part.

Kelly. Kelly demonstrated a low willingness to act at all three data collection points in the study. During the pre-departure collection period, she stated,

…I don’t have much information on that sort of thing. I guess my policy on doing stuff like that is if I don’t have enough information on it, I will not take a stand on it. I am not completely aware of that decision. (pre-departure interview)

Additionally, Kelly was unable to provide any examples of her willingness to act on the pre-departure SEEDS. Kelly’s response during the pre-departure indicated her lack of willingness to inform herself on CEI and thus, she could not act.

Kelly provided a similar response as her pre-course response during her post-course data collection. During her post-course interview she stated, “I want to be well-informed about any issues that I would work on solving, which may not mean I always initiate such efforts.” As with her pre-course response, it appears her justification for not acting is because she wants to be well informed. The lack of knowledge appears to be a justification for not leading efforts to resolve
It should be noted that Kelly did not refer to trying to become more informed, it appears as if her ignorance on the issues is her justification for not acting to resolve them.

One-year after completing the course, Kelly offered the following response during her interview,

…it’s not that I don’t think about those things because they are present in my mind. It’s just my laziness overcomes that and then says, well you know it’s okay this one time and then one time turns into 20 times and then it’s a habit. So, I’m just lazy. (one-year interview)

Kelly’s quote captures the overarching theme of the interview. Namely, her lack of desire to engage in behaviors intended to resolve CEI. During the one-year data collection, Kelly did not claim that her lack of knowledge impeded her from acting, rather, she contributes it to her lack of desire. She also used her lack of experience dealing with CEI as a reason to not act. For example, she states, “I have never personally been affected by these issues, so it is hard for me to see how I can contribute to resolving this issue,” (one-year SEEDS). Kelly’s justification for not acting to resolve CEI because they don’t affect her is similar to her reasoning for her lack of feelings of responsibility.

The Impact of Authentic Experience on CEI Engagement

Students consistently referenced the role direct experience played in negotiating CEI. Every student in this study mentioned the epiphanic moments generated by interactions with stakeholders, which lead to a more nuanced understanding of GYA environmental issues. It is important to keep in mind that students’ prior experiences should also be considered. Two exemplar quotes appear below. First, Hillary said,

I felt that at the start of this trip I would have my mind set on certain issues, and not
understand how anyone could have a different opinion than my own. But then hearing from various stakeholders and how issues such as wolf reintroduction had an effect on so many individuals for different reasons, I realized how many standpoints must be taken into consideration before making huge changes within a population. Looking at issues from an economic, social, ethical, and environmental standpoint made me realize what all must be considered before making changes to our ecosystem in even the smallest ways. And even after slight alterations are made, changes must be recorded and analyzed in order to identify negative trends that can be addressed in the future (one-year interview).

Kelly also described the impact of direct experience in her one-year interview when she stated,

I remember sitting in the grass and listening to Vern and Hilary talk and I remember,
I have this very strong visual image of sitting in the grass and listening to them talk and just feeling like this was like what the experience was about. Being here and hearing these different people's perspectives like being in an actual, like be an active researcher in an actual place rather than sitting back in Virginia, because I could have called these people theoretically and been like hey, can I interview you?

In both cases the students pointed to the interactions with individuals in the GYA that could not have occurred in a traditional classroom. The individuals Naomi referenced not only included the speakers arranged for the course, but also citizens of the communities with whom the students engaged at dinner or the hotel. Additionally, Kelly described the influence of being physically present in the GYA compared to engaging stakeholders from a distance. Elsewhere in her one-year interview, Kelly acknowledged the impact of seeing the people she interviewed and being able to see the emotion in their faces as they described their opinions on various CEI.
SSI Dimensions and Environmental Behaviors

A close inspection of Tables 8 and 9 reveals that certain SSI dimensions appear more closely associated with environmental behaviors than others are. For example, empathetic concern seemed to be the least associated with environmental behaviors, followed by perspective taking, feelings of responsibility. The most closely associated SSI dimension was willingness to act.

Empathetic Concern. Empathetic concern was the SSI dimension least associated with changes in environmental behaviors with only two of 14 data collection points in agreement. There was no trend noticeable between the two variables. For example, Hillary was rated high empathic concern during pre-departure with low environmental behaviors, but one year after the course, she still maintained a high empathic concern score with high environmental behaviors. Chloe was rated moderately empathetic with low environmental behaviors pre-departure and moderate in both empathetic concern and environmental behaviors one year later. Finally, Kelly showed moderate empathy and low environmental behaviors at both collection periods.

Perspective Taking. Perspective taking showed a closer association with environmental behaviors. In 10 out of 14 collection points, perspective taking ratings matched environmental behavior ratings. During the pre-departure period, Hillary was rated as low in both perspective taking and in environmental behaviors and at the one-year collection point, she was rated as high in both variables. Chloe was moderately able to consider multiple perspectives, but demonstrated low environmental behaviors. One-year later, Chloe was rated moderate in perspective taking and in environmental behaviors. Finally, Kelly was rated low in perspective taking and environmental behaviors at pre-departure. One-year after the course, she was moderately able to consider multiple perspectives, but rated low for environmental behaviors.
Feelings of Responsibility. Twelve of 14 collection points demonstrated an association between feelings of responsibility and environmental behaviors. These results are very close to the willingness to act results discussed below, which is understandable because both variables are couched under Socioscientific Accountability on the SEEDS instrument and the CVGCA instrument (Lee et al., 2013). Examination of the three cases shows that only Kelly’s one-year ratings, moderate feelings of responsibility/low environmental behaviors, is the only collection point where the two variables are not in associated with one another.

Willingness to Act. In all 14 data points, students’ willingness to act ratings mirrored their environment behaviors ratings. Again, to ensure that willingness to act and environmental behaviors were not the same construct, the researcher independently coded and rated each student and a science education faculty member triangulated the coding and ratings. Tables 14-16 provide a side-by-side representation of the three cases’ willingness to act and environmental behaviors responses. The students’ responses indicate the difference between the two variables is that willingness to act addresses feelings about resolving CEI, while environmental behaviors addresses actions taken by the individual to resolve CEI. For example, Hillary expressed a low willingness to act during her pre-departure interview. She discounted her impact on CEI resolution and does not express any personal feelings about resolving CEI. However, one-year later, Hillary expressed much stronger feelings about her personal feelings about CEI resolution and reported high environmental behaviors. Chloe demonstrated low willingness to act and environmental behaviors in a very similar manner to Hillary. One-year later, Chloe claimed to be more willing to act, but only if someone else took the lead and her environmental behaviors demonstrated a moderate level of personal effort or inconvenience. Finally, Kelly demonstrated a lack of feelings toward CEI in both her pre-departure and one-year data. Likewise, she
demonstrated behaviors that either required minimal effort or she did not engage in any environmental behaviors.

**Summary of Findings for Research Question 2**

Research Question 2 asked, “How do postsecondary students’ conceptualizations of CEI shift one-year after participating in an experiential environmental education course with embedded SSI instruction and to what extent are the shifts in CEI conceptualization associated with changes in environmental behaviors?” The findings for Research Question 2 indicate an association between students’ conceptualizations of CEI and their environmental behaviors, specifically students’ willingness to act towards resolving CEI. Tables 7 and 8 show that students’ environmental behaviors reflect their CEI conceptions and align with their willingness to act. In all cases students’ environmental behaviors mirrors the willingness to act dimension. The use of multiple sources of data for each student, along with independent reviews triangulates the data to ensure that students changes were associated with aspects of the course.

**Research Question 3: How is SSI instruction embedded in an experiential environmental education course associated with postsecondary students’ socioscientific reasoning (SSR) one year after completing the course?**

SSR is a complex construct, which is difficult to observe entirely within one individual regarding a single event. As such, for this question, the unit of analysis will be the entire group of students. Examples of three components of SSR: skepticism, complexity, and socioscientific perspective taking were visible during the post-course and one-year data collection periods. The data was coded using the description of SSR located in Table 2. Statements that included the characteristics identified in Table 2 were considered to demonstrate that dimension. Absence of the traits resulted in the statement not be coded for a dimension of SSR.
<table>
<thead>
<tr>
<th>Collection Period</th>
<th>Willingness to Act</th>
<th>Environmental Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-departure</td>
<td>Being so young, I don’t think anyone would ever listen to me, but my family always tries to explain the situation to others when they are mistaken.</td>
<td>I recycle things that aren’t renewable like metal and my family is always careful of what lawn care products we use and clean out the storm drains as these can directly impact our waterways.</td>
</tr>
<tr>
<td>One-year</td>
<td>I have always loved and appreciated nature, but before the LUYNP trip I was unaware of our direct effect on our surroundings, and in turn on others in the environment. I am much more aware of my use of disposable materials, engaged with the idea of sustainability, and interested in sharing my learning experiences with others. (Since the trip, I have implemented a recycling system for myself and neighbors and friends, and have been a vegetarian ever since my first LUYNP trip.)</td>
<td>Businesses make it known when they are supporting environmentally sustainable products, and the prices reflect that. I often go out of my way to support these businesses myself.</td>
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<td></td>
<td>I definitely feel more in charge of or more responsible for recycling now. So definitely after Yellowstone, I’m more aware and I’ve done more research on what can and cannot be recycled and how it can be recyclable.</td>
<td>I live right by a hospital and there was no place for employees to smoke which is very healthy anyway but I put up a place for them to at least put their trash in so they weren’t just throwing their butts into the grass. Because that really bothered me with the disposal of their cigarette butts so I did that after I came back from Yellowstone.</td>
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<td></td>
<td>Mr. Fraser was really huge and he’s kind of what he opened my eyes to the with the Wi-Fi and the cellular interference with the bees. I had no idea that that was a thing. So I did a research on it after he said something and it’s really interesting.</td>
<td>I’ve started recently I did recycling within my own home and I’ve tried to do my family and friends, help them to do it.</td>
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<td></td>
<td>I’ve always been concerned about it, but now even when we go away for the weekend, I’ll keep a bag of recycling to bring it home since there was only a dumpster, there was no recycling. So I collected aluminum cans at our campsite and then I brought it home especially for the girls. I brought it home to recycle.</td>
</tr>
<tr>
<td>Collection Period</td>
<td>Willingness to Act</td>
<td>Environmental Behaviors</td>
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<tr>
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</tr>
<tr>
<td>Pre-departure</td>
<td>I am not recycling and it’s something so easy. I guess when it comes down to it I feel like if somebody needed somebody to back them… I would definitely. Stand up for nature and natural resources and stuff</td>
<td>I don’t recycle, so I guess personally I feel guilty. Taking the survey online saying yes I think we should go out of our way to take care of nature and provide I guess me not recycling</td>
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<td></td>
<td></td>
<td>I don’t go as far as recycling as much as I should. If a bin is available, I do recycle</td>
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<td></td>
<td></td>
<td>I don’t litter, I don’t do anything like that. I make a point to pick up after other people who can’t walk a piece of trash to a trash can.</td>
</tr>
<tr>
<td>One-year</td>
<td>Those kinds of things I mean obviously I always knew about but going to the Yellowstone trip really helped me to open my eyes and really take, even if it’s a little bit more inconvenient to work over to the recycling bin.</td>
<td>I’m all about it like I recycle. You know if I’m going to do a little laundry, it’s going to be a full load so I don’t use as much water. Little things like that I do but unfortunately I haven’t really taken a stance in the actual issue as much as I probably could</td>
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<td></td>
<td>Now it’s not to say that the opportunity presented itself that I wouldn’t be behind those groups of people or organization, anything like that. I guess I haven’t taken an action yet.</td>
<td>Now that’s not to say I don’t carpool because I do carpool. So I try and cut down on other ways. I guess I’m just wanting to-if I have my neighbor, we carpool. Our schedule, we are all in the same graduate classes. It just seems really to us dumb to us both drive, both waste gas money, both have the fumes messing up the environment and all of those things when we can just limit it to just one vehicle. We’re both getting to where we need to go and it’s just not as wasteful. It just makes more sense for us. So you can save a little water, recycling things, doing things like that, making sure you don’t litter. Those kinds of things I mean obviously I always knew about but going to the Yellowstone trip really helped me to open my eyes and really take, even if it’s a little bit more inconvenient to work over to the recycling bin.</td>
</tr>
<tr>
<td></td>
<td>Doing that, now I realize how much of an impact it actually has on the environment whereas before I didn’t really necessarily realize what one person can actually do in just making the little inconvenient life changes and I don’t know. It’s not inconvenient anymore to me. It’s just part of the daily routine.</td>
<td>Something as simple as throwing my gum out of the car window strikes me as absurd behavior now because I worry about the potential animals who may wonder into the road in order to eat the gum. Also, while brushing my teeth, I no longer let the faucet run water the entire time I brush, rather, I only use it as needed. Small choices like these can make a huge difference in conservation and I may not have realized this had I not participated in the course.</td>
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</table>
Table 15 Kelly's Willingness to Act and Environmental Behaviors Responses

<table>
<thead>
<tr>
<th>Collection Period</th>
<th>Willingness to Act</th>
<th>Environmental Behaviors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-departure</td>
<td>I am not really… I do not have much info on that sort of thing. I guess my policy on doing anything on stuff like that. If I do not have info on it I will not take a stand on it. I am not completely aware of that decision.</td>
<td>I know that this is so funny but my roommate really like recycling and so I hate recycling. It drives me nuts. For the other ones I specifically never felt affected by it. So I have the mindset along with many other people in the world. If it doesn’t affect me I don’t need to do something for that. My family doesn’t recycle and so in some ways I guess I am really skeptical.</td>
</tr>
<tr>
<td>One-year</td>
<td>I have never personally been affected by these issues, so it is hard for me to see how I can contribute to resolving this issue I guess that earlier, it's not that I don't think about those things because they are present in my mind. It's just my laziness overcomes that and then says, well you know like it's okay this one time and then this one time turns into 20 times and then it's a habit. So I'm just lazy.</td>
<td>I'm always willing to recycle but when someone doesn't force me to do that, I'm not necessarily doing it Probably the only thing I would partake in is recycling. It is one of the easier things for me to do Before LU@YNP, I think I would have just indistinctly thrown these items away, even if the recycle bin was sitting there. And especially because the recycle bin doesn’t get emptied; we have to do that. Additionally, my roommate recently bought a Brita pitcher in order to cut back on the waste of water bottle, and I have taken to using refillable glasses…not only because it’s cheaper and I’m a broke grad student, but also because there isn’t as much waste. I would like to think that I would be open arms and I’d love to do things. I'm thinking about the recycling thing again but I’m just really lazy and that's really, really bad but it's not that I don't think about them. It's just that I think I prioritize things. So it's like the recycling if I were going to take that out on my drive to school, that means that I have to leave probably of extra five minutes early which means that I wouldn't have extra five minutes to sleep. That's a really horrible but honest answer and I think that it's not that I don't think about them. I'm just too lazy maybe to do anything about it I'm lazy. That's really sad. But it's true.</td>
</tr>
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</table>
Pre-Departure

Little qualitative evidence was reported indicating any on the dimensions of SSR, as seen in the summary of SSR occurrences in Table 16 below. Emily provided a response indicating a level of skepticism when asked about the role of scientific evidence in mitigating CEI when she stated, “Evidence should only be used when unbiased” (pre-departure SEEDS). Her quote suggested Emily had at least some idea that stakeholders may have biases, which could influence the evidence used to support a given perspective.

Table 16 SSR Occurrences during Pre-Departure

<table>
<thead>
<tr>
<th>SSR dimension</th>
<th>Exemplar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skepticism</td>
<td>Evidence should only be used when unbiased (Emily, pre-departure SEEDS)</td>
</tr>
<tr>
<td>Socioscientific Perspective Taking</td>
<td></td>
</tr>
<tr>
<td>Complexity</td>
<td></td>
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</table>

Post-Course

Student responses point to increases in SSR, however; these changes did not occur uniformly across all students. Table 17 summarizes the frequency each dimension exhibited during the post-course data collection period.

Table 17 SSR Exemplars Post-Course

<table>
<thead>
<tr>
<th>SSR Dimension</th>
<th>Exemplar</th>
</tr>
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<tbody>
<tr>
<td>Skepticism</td>
<td>I have learned about the scientific bias they have. Who is publishing it? Is it the whole research or just the part they want everyone to see? Who is doing the research?...I would look further into it to see if there is a different story (Lisa, post-course interview).</td>
</tr>
<tr>
<td>Socioscientific Perspective Taking</td>
<td>I remember thinking when they were talking about how they couldn’t shoot the bears and stuff that were taking their cows. I remember thinking about if something was in my backyard and it could potentially harm me or my family and I wasn’t able to shoot it, what would that be like? And I remember being like, wow, that would be really tough. I feel a little more responsible for that, I have that option. They don’t have that option. I think I have to think a little more how I can make an impact on things like that (Kelly, post-course interview).</td>
</tr>
</tbody>
</table>
Table 17 SSR Exemplars Post-Course (cont’d)

<table>
<thead>
<tr>
<th>SSR Dimension</th>
<th>Exemplar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complexity</td>
<td>We need to consider the other consumers, stakeholders, and community members including animals, plants, and water resources (Hillary, post-course SEEDS)</td>
</tr>
</tbody>
</table>

**Skepticism.** Students provided examples of skepticism more than the other two dimensions. Throughout the post-course data collection period evidence emerged indicating students recognized stakeholders may have biases, which influences what information is presented and/or how the information is presented. For example, Hillary stated,

> Because humans live in or around the environments being managed, they are going to have personal connections or opinions. As we saw with the wolf controversy, hearsay becomes fact and fact is manipulated to meet the demands of the people (post-course interview).

Hillary’s experience with stakeholders regarding the wolf management issue in the GYA have elevated her awareness of the subjectivity associated with contentious issues. Hillary also commented on the need for unbiased scientific information to resolve CEI elsewhere in her interview. Susan echoed these sentiments in her post-course interview,

> Everybody has bias. If you spent 10 years researching wolves, you will obviously have personal connections with the wolves. Emotions cloud everybody’s judgement sometimes. If you are a good scientist about it, you are trying to be as unbiased as possible.

While Hillary’s comments acknowledge the bias laypersons bring to CEI, her comment implies scientists may be immune to such biases. Susan’s statement, however, extends to the biases professional scientists bring to their work. Lisa also commented on her awareness of potential
bias in scientists, especially as it pertained to funding scientists. All of this speaks to an increased level of skepticism not visible in the pre-departure data.

**Socioscientific Perspective Taking.** No examples of socioscientific perspective taking (SSPT) were observed pre-departure; instead, what was observed was simply an acknowledgment of other viewpoints and the need to tolerate others’ perspectives. However, an increase in socioscientific perspective taking (SSPT) was observed post-course. This is evident in the following comment,

> I come from a southern family who hunts and things like that. I remember thinking when we were talking about how they couldn’t shoot the bears and stuff that were taking their cows. I remember thinking about if something was in my backyard and it could potentially harm me or my family and I wasn’t able to shoot it, what would that be like? And I remember being like, wow, that would be really tough. I feel a little more responsible for that, I have that option. They don’t have that option. I think that I have to think a little more how I can make an impact on things like that. (Kelly, post-course interview)

Kelly’s comment captures all aspects of SSPT. First, she engaged with people in the GYA who must manage predation on their land, while also abiding by governmental regulations. Kelly also uses her own experiences to empathize with the stakeholders, which allows her to shift her perspective from an outsider to an insider. Finally, Kelly reflected on the difficulty of refraining from shooting predators and demonstrated reflexive judgment by considering how her actions might be influencing natural resources at her home and her need to reconsider her actions.
Complexity. Students acknowledged the multitude of factors involved in CEI, as well as implementing the non-linear thinking required to understand the nuances of the situation. For example,

I think that science is a good basis and starting point. Without science it might be hard to come up with a solid number that works and keeps a balance in nature. I also think considering the public is also important…like Ben and Ally said, take science as your framework and build off that and off the public’s opinion and moral and ethics and values and stuff. You can come up with a good balance of numbers where the humans are benefitting and where the wildlife isn’t suffering (Chloe, post-course interview).

Chloe is referring to an interaction the students had with two wildlife biologists who managed the winter elk herd. The discussion focused on determining the optimal number of elk allowed on the winter range. Chloe alluded to the need to consider more than the science, in this case, carrying capacity, but also consider the members of the community impacted by the presences of thousands of elk.

One-Year

As with other aspects of this study, the dimensions of SSR were less observable one-year after the course was completed and in the case of complexity, returned to pre-departure levels.

Table 19 summarizes the occurrences of each dimension in the qualitative data.

Skepticism. Students expressed less skepticism regarding CEI than immediately after the course concluded. The references to biases were directed exclusively toward scientific data, both in the subjectivity of the scientist conducting research, as well, as how the data is used to support arguments. Chloe spoke of critically analyzing data sources with the statement, “wait a second, where did that statistic come from,” instead of accepting the information and “jumping to
conclusions as quickly,” (one-year interview). Additionally, Emily stated, “(the course) taught me to consider any bias scientific sources may have. Sometimes people use scientific evidence out of context to support their own opinions or beliefs,” (one-year interview).

Table 18 SSR Occurrences During One-Year

<table>
<thead>
<tr>
<th>SSR dimension</th>
<th>Exemplar</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skepticism</td>
<td>…taking away from Yellowstone, bringing all of those experiences back to the east coast and being able to apply …not jumping to conclusions as quickly and reading about something and the deciding if the statistic is fair now…Just keep questioning things and thinking about things more so than I did prior to the Yellowstone trip (Chloe, one-year interview).</td>
</tr>
<tr>
<td>Socioscientific Perspective Taking</td>
<td>… once we talked to Vern and Hillary, I just remember thinking, okay, maybe what I thought isn’t wrong. I still think we shouldn’t kill the wolves but I have a different understanding of that and I had more sympathy for them and I think a better perspective on these laws and things and on these people who had to deal with these natural science issues all the time, rather than someone like me…I don’t have to worry about if there is a deer in my backyard and we’re feeding something, my dad is probably going to shoot at it. But in Yellowstone, you can’t just shoot at a wolf and scare it off…</td>
</tr>
<tr>
<td>Complexity</td>
<td>When consuming scientific evidence, one must remember the other factors involved. Even though scientific research is meant to be clear and definitive, we can easily take it out of context. For scientific evidence to be meaningful, we must fully understand the question being answered and the other factors, or lenses, affecting the same topic (Hillary, one-year interview).</td>
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</table>

**Socioscientific Perspective Taking.** The frequency of SSPT dropped considerably one-year after the course was completed. Kelly provided the only response, which contained the aspects of SSPT. Many other comments were missing components of SSPT, but were more advanced than simple perspective taking. For example, Emily eluded to an emic/etic shift when she mentioned, “putting myself in that person’s shoes.” This statement moves beyond simply tolerating diverse opinions, but falls short of generating any reflective or reflexive judgement.

**Complexity.** The occurrence of statements reflecting complexity decreased during the one-year collection period. Hillary provided the only example of complexity, which is in Table 18. The responses, generally, lacked specificity when discussing CEI.
Summary of Findings for Research Question 3

Research Question 3 asked, “How is SSI instruction embedded in an experiential environmental education course associated with postsecondary students’ socioscientific reasoning (SSR) one year after completing the course?” Socioscientific reasoning (SSR) is a complex construct and difficult to observe in an individual for a single experience. Thus, the group of students was considered the unit of analysis for this question. The findings indicate the group was not able to apply three dimensions of SSR pre-departure, but could do so more frequently post-course and to a lesser extent, one-year after the course.

Summary

The data produced in this study supports the claim that experiential environmental education courses infused with SSI instruction are associated with changes in CEI conceptualization and residual environmental behaviors in post-secondary students. All seven students demonstrated change in at least one dimension of conceptualization of CEI from pre-departure to one-year post-course. It appears that there was an association between how students conceptualized CEI and their environmental behaviors. What is less clear is if one particular dimension could be specifically associated with behavior changes. In 12 of the 14 cases (seven pre-departure and seven one-year) students’ willingness to act rating matched their environmental behaviors. It appears that the willingness to act dimension seemed to mirror the changes seen in environmental behaviors.

However, three cases do not demonstrate environmental behaviors mirroring the willingness to act. For example, Emily’s pre-departure data indicated low ratings in all of the dimensions studied for Research Question 1. Despite these ratings, Emily was moderately engaged in environmental behaviors. In this case it is possible that Emily’s environmental
behaviors rating was inflated because self-reported data was considered as part of the overall rating and research has shown self-reported data is often unreliable (Corral-Verdugo, 1997; Donaldson & Grant-Vallone, 2002). Naomi’s one-year data might offer a second possibility. Naomi had two low ratings, two moderate ratings and a moderate environmental behaviors rating in her one-year data. Her ratings indicate that there could be a complex interaction between the dimensions.

Finally, socioscientific reasoning changes were not visible in all students individually, but when the unit of analysis was broadened to include all seven students there were changes that maintained one-year after the course was completed.
Chapter Five: Discussion

Introduction

The purpose of this study was to examine the extent to which an experiential environmental education experience embedded within a socioscientific issues (SSI) Framework is associated with students’ conceptualization of contentious environmental issues (CEI) and residual changes in environmental behaviors. Qualitative data was collected via questionnaires and semi-structured interviews. Likert-style items designed to address the same dimensions as the qualitative data were administered and used to triangulate the data.

The findings in this study have both theoretical and practical implications. First, this study extends the theoretical discussion on using case-based issues as an entry point of the Socioscientific Issues Framework (Zeidler & Keefer, 2003) to include authentic experiences. Previous case-based SSI studies have indicated, among other things, students demonstrate various forms of informal reasoning (Sadler, 2004; Sadler & Zeidler, 2005), while becoming more sensitive and compassionate to the impacts of science and technology on various individuals associated with contentious issues (Lee, Yoo, Choi, Kim, Krajcik, Herman, & Zeidler, 2013). A criticism of the framework questions whether case-based SSI actually create situations similar to those students will experience outside of the science classroom and if the SSI framework motivates students to take action to resolve SSI (Levinson, 2006; 2013).

To this point, little research has considered the role authentic experiences play in how students conceptualize SSI or if there is any association between an authentic SSI experience and
students’ behaviors towards SSI resolution. What research exists indicates that elementary-age students developed critical thinking skills necessary for resolving environmental issues (Burek & Zeidler, 2015). The present study further extends SSI research into informal settings. Unlike Burek and Zeidler’s work, which focused on elementary on a one-day trip to a science center, the present study immersed post-secondary students in the actual location where the contentious issues were taking place.

This study offers practical applications to science teaching, as well by offering an alternative to environmental education which moves beyond knowledge acquisition and develops the skills necessary to become contributing members of society capable of resolving environmental dilemmas (Hart, 2010; Marcinkowski, 2009). Implementing the SSI Framework within Kolb’s (1984) experiential model allowed students to engage both their cognitive and affective domains, which led to an association between the course and environmental behaviors.

**Conceptualizing Contentious Environmental Issues through Experiential SSI Instruction**

The findings in this study indicate experiential SSI instruction can be successful at accomplishing the same outcomes as SSI instruction in traditional classroom settings. Experiential SSI is associated with the way students conceptualize contentious environmental issues, both immediately after the course and one year after completing the course. This adds support to the notion that authentic SSI investigations promote moral growth, critical thinking skills and content knowledge through an engaging curriculum. After engaging with stakeholders, some students in the study were able to improve their perspective taking, often described as seeing the other side of the argument, and began to empathize with the individuals and understand the CEI from an insider’s perspective. The shift in perspective allowed students to think reflectively and reflexively on the issue, while using informal reasoning to resolve various
CEI. Additionally, students felt more responsible for resolving CEI after the course and one year later.

**Perspective Taking, Empathetic Concern, and Feelings of Responsibility.** The current study informs the literature because it demonstrates effective SSI instruction implemented in experiential settings and that the changes observed immediately after the completion of the course are visible longitudinally. The data presented in Chapter 4 shows students who participated in the course exhibited changes in their informal reasoning patterns and moral and ethical development similar to students in previous studies in traditional classrooms (Zeidler, Applebaum, & Sadler, 2011). Furthermore, the current study adds to the extant literature by identifying specific pedagogical decisions that resonated with students to be associated with long-term changes in perspective taking, empathetic concern, and feelings of responsibility.

The findings in Chapter 4 show that, unlike other issues-based approaches to EE (e.g., STSE and IIAT), an experiential SSI approach developed the informal reasoning skills necessary to resolve CEI. Students’ ability to consider the cognitive and affective dimensions of CEI is not seen in studies on issues-based curriculum. When the results from this study are viewed through a Neo-Kohlbergian framework for moral development, it appears students are demonstrating shifts in moral schema toward a more Postconventional schema (Rest et al., 1999).

In examining the changes in how students conceptualize CEI, there was evidence that students were more apt to apply what Rest et al. refers to as *shareable ideals*. Students began to consider how resolutions could be justifiable to all parties involved. This stemmed from the students’ ability to take others’ perspectives and empathize with those stakeholders. Furthermore, students began to demonstrate *full reciprocity*, where the latent biases associated with CEI policies were questioned. For example, students often noted the number of perspectives
they had failed to consider before traveling to the GYA. Hillary captured this sentiment in her one-year interview when she said, “Mr. Frazer (Native American) was really huge and he’s what kind of what, he opened my eyes…” Hillary was referencing policies that affected the rights of Native Americans on traditional tribal lands. On the surface, the prior laws seemed to be an adequate compromise between environmentalist and those who owned the land surrounding the park. However, the Native American perspective was not considered, which prevented them from practices they had carried on for centuries. As discussed in Chapter 2, the dissonance created when students compared new information from the course with their prior knowledge caused more nuanced moral schema are developed.

Likewise, the results from this study support the idea that moral development is not exclusively a cognitive process (Thøgersen, 2006). Repeatedly, students demonstrated using affective dimensions to resolve CEI, which aligns with Hoffman’s moral socialization theory (2000). The impact that the direct experiences student had with stakeholders is consistent with Hoffman’s idea that people develop pro-social norms by empathizing with individuals who are harmed by specific behaviors. In the context of this study, students were able to witness the repercussions of CEI on stakeholders throughout the GYA. Kelly’s comment during her one-year interview captures this,

Being here and hearing these different people’s perspectives in an actual place, rather than sitting back in Virginia. I could have called these people, theoretically, and been like ‘Hey, can I ask you a question?’ But being in an actual space, I felt, made it more real for me and that is something I value very much…once we got to Yellowstone and we talked to a lot of people, I remember thinking, okay, maybe what I thought wasn’t wrong. I still don’t think we should kill wolves, but I have a different understanding of
that and I had more sympathy for them and I think I had a better perspective on these
laws and things and on these people who had to deal with these natural science
issues…(one-year interview)

It is clear from her comments that Kelly was influenced by her empathy for the people who live
in the GYA and are impacted by CEI. This is an example of what Hoffman (2000) calls induced
empathy and demonstrates the complex connection between humans and the environment. The
results also support Hoffman’s claim that affective dimensions, like empathy, can be engaged
when students are directly in contact with those directly impacted by environmental issues.

The current study is supported but previous SSI studies, which determined that students
are more empathetic towards stakeholders immediately after participating in SSI instruction. Lee
et al. (2013) found high school biology students were more empathetic after examining genetic
modifications through the SSI framework than their peers who experienced traditional
instruction. The existing research does not examine the longitudinal success of SSI instruction.
The current study supports the pre-course/post-course findings in the research base and adds to it
by demonstrating residual changes one-year after the course was completed. Lee et al.’s group
also found students felt slightly more responsible for resolving issues stemming from a SSI.

SSI Framework, Authentic Experiences, and Environmental Behaviors

SSI Framework and Authentic Experiences. The goal of any environmental education
(EE) course is to foster positive change in the ways students engage with the environment
programs in place-based settings may have the most positive impact on EE programs’ outcomes.
The only study cited in the meta-analysis identified as both experiential and issues based
implemented the Investigating and Evaluating Environmental Issues and Actions (IEEIA)
framework; which, like the *Science, Technology, Society, and Environment* (STSE) framework point out potential conflicts but do not capitalize on the opportunity to intentionally develop moral and ethical reasoning of the students. The IEEIA and STSE research demonstrate linear, deficit models of instruction that have not been shown to have any association with changes in environmental behavior. Furthermore, these approaches fall short in adequately addressing the goals set out by UNESCO (1978) and environmental education scholars who call for approaches that consider the affective dimensions of decision making (Hart 2010; Marcincowksi, 2009). As a result, these studies do not demonstrate any changes in students’ behavior toward the environment.

As an alternative approach, SSI studies have indicated, among other things, that students demonstrate various forms of informal reasoning (Sadler, 2004; Sadler & Zeidler, 2005), while becoming more sensitive and compassionate to the impact of science and technology on various individuals associated with contentious issues (Lee, Yoo, Choi, Kim, Krajcik, Herman, & Zeidler, 2013).

This study leveraged the authentic experiences related to CEI to develop the cognitive and affective dimensions of the student to promote functional environmental literacy where individuals apply their knowledge, values, attitudes, and skills towards a resolution (UNESCO, 1978). The findings from this study demonstrate an association between experiential SSI and residual behavior changes. These findings have theoretical implications. First, this study successfully implemented the Socioscientific Issues Framework beyond the brick and mortar classroom. The SSI Framework was infused with Kolb’s (1984) Experiential Learning Theory to promote change in how students mitigate CEI.
Figure 1 summarizes the implementation of SSI instruction within the ELT framework. The figure describes individual experiences that occurred throughout the course and is not intended to represent the entire experience as one linear experience. For example, the instructors deliberately exposed students to stakeholders with a multitude of perspectives on the issue of wolf reintroduction and management. Students were then guided through the debriefing process by the instructors who asked questions designed to challenge students’ existing beliefs, as well as prompt the students to critically analyze the information gained through their interactions with stakeholders. However, because students also engaged with stakeholders who were not scheduled by the faculty, new concrete experiences occurred as the students gained new information about wolf reintroduction and management. At some point, the students had to reflect on their experiences with the stakeholders and consider how the student’s ideas, beliefs, and attitudes affected how they perceived the issue of wolf reintroduction. Students then engaged with other new stakeholders and students, applying their new conceptualization to the experience. This new experience starts the cycle over again.
SSI Framework and Environmental Behaviors. Early models attempting to explain environmental behaviors implemented a linear, deficit model, which posited that increased environmental knowledge led to an improved attitude towards the environment and resulted in increased environmental behaviors. However, later research suggests a more complex interaction involving internal factors like affective, knowledge, and values coupled with external factors (e.g., political, social, and cultural) (Kollmuss & Agyeman, 2002). Kollmuss and Agyeman’s model differed in that it does not assume a correlation between increased environmental knowledge and environmental behaviors. As such, the socioscientific dimensions in this study have been combined to form Kollmuss and Agyeman’s construct called environmental consciousness that subsumes willingness to act, feelings of responsibility, empathetic concern, and perspective taking to consider the internal factors thought to influence environmental
behaviors. The reasoning behind this decision is that socioscientific dimensions in this study also are influenced by the affect, knowledge, and values of an individual (Zeidler, Berkowitz, & Bennett, 2014).

A popular model used to explain pro-environmental behaviors is the Kollmuss and Agyeman’s (2002) Model of Pro-Environmental Behaviors. Students’ conceptualizations of CEI demonstrate the complexity associated with resolving such issues. Likewise, inspiring change in individuals’ behaviors is equally as complex. From a socio-cultural perspective, it may be difficult to arbitrarily separate internal from external factors, but Kollmuss and Agyeman’s (2002) model for pro-environmental behaviors considers both the myriad of internal factors of the individual, external pressures, and potential barriers for change. Looking specifically at the internal factors influencing environmental behaviors Kollmuss and Agyeman tacitly indicate that attitudes, knowledge, feelings, emotions, and values carry equal influence on pro-environmental behaviors. Over the course of the present study, the data indicates students demonstrated an increased understanding of the issues (knowledge), greater feelings of responsibility and empathy (feelings), and greater willingness to act (values/attitudes) and at the same time, many students also exhibited changes in their environmental behaviors.

What the data from this study indicates is that the internal factors identified by Kollmuss and Agyeman did not appear to change at the same level as the students’ environmental behaviors. In fact, the data indicates that environmental behaviors associate best with the willingness to act variable. These results indicate the need to reconsider the existing model to examine how willingness to act shapes environmental behaviors.

**Willingness to Act and Environmental Behaviors.** The results of this study indicate an association between students’ willingness to act and their environmental behaviors. It appears
that as the willingness to act changes, students’ environmental behaviors changes to the same degree. What is unclear is the extent to which willingness to act is associated with environmental behaviors. The questions raised from these findings are: (1) how do the variables in this study interact, and (2) why are some people more willing to act? To answer these questions, it is necessary to consider the research related to willingness to act toward the environment and how morals motivate individuals to behave.

Existing models support the claim that willingness to act influences environmental behaviors. For example, the Theory of Reasoned Action model (Ajzen & Fishbein, 1980) states that attitudes shape behavioral intentions, which shapes behaviors. However, the Model for Responsible Behavior (Hines, Hungerford, & Tomera, 1986), based on a meta-analysis of 128 pro-environmental behavior studies, identified a willingness to act as a weak variable influencing environmental behaviors.

Likewise, empirical studies have also examined the relationship between willingness to act and environmental behaviors, with varying results. For example, Berenguer (2007) exposed 60 college students to either a picture of a duck covered in oil or a fallen tree. Half of the students were asked to empathize with the object in the picture and half were asked to remain objective. Students who empathized with the object were more willing to support a fictitious organization on campus tasked with protecting the environment by recommending the university contribute funding to the organization. Furthermore, Berenguer (2010) found that when students experienced induced empathy using pictures of a human or a vulture they were able to provide a higher number of moral arguments related to specific environmental dilemmas. Additionally, Gigliotti (1992) found that college students who believed that technology would resolve CEI were less apt to participate in pro-environmental behaviors.
Unlike Berenguer (2007) who induced empathy in students and used hypothetical situations with little direct impact on the participants, this study examined actual situations and behaviors in which students were more directly invested, meaning the students gave their time, energy, or money. The results of this study do not indicate as strong an association between empathy, willingness to act, and environmental behaviors as Bergenguer’s findings. There is not a clear connection between empathetic concern and environmental behaviors in the present study. Additionally, the results of this study are not as definitive as Gigliotti’s (1992). In the present study, students’ perspective taking abilities were assessed and in several cases, students’ perspective taking ratings were different from their environmental behaviors rating.

The results from this study indicate that there is a need to reconsider the role of willingness to act, perspective taking, empathy, and feelings of responsibility in regards to individual’s environmental behaviors. Kollmuss and Aygeman (2002) synthesized several models of environmental behavior to create the Model for Pro-Environmental Behavior discussed in Chapter 4. In this model, knowledge, feelings, emotions, and values are all seen as equally influencing the individual’s environmental consciousness. However, in the context of this study, it does not appear that those variables are acting equally. For example, one year after completing the course, Kelly demonstrated moderate levels of perspective taking, empathetic concern, and feelings of responsibility while exhibiting only low willingness to act. She also demonstrated low environmental behaviors. According to Kollmuss and Aygeman’s model, this should not be the case, which raises the possibility that willingness to act may be moderating the association between the other variables and environmental behaviors.

A possible explanation may exist when considering how the students in this study developed the moral changes seen in the data. Thøgersen (2006) discusses the role moral norms
play in motivating environmental behaviors. Based on the moral development theories of both Kohlberg and Hoffman, Thøgersen developed a norm taxonomy that considers the motivations behind moral development. The study consisted of 1112 participants who responded to questions related to four environmentally relevant consumer behaviors, as well as a series of questions related to moral constructs. He argues that some morals are superficially internalized out of feelings of guilt or pride, while other morals are deeply internalized and incorporated into the person’s identity and do not require feelings of guilt or pride to motivate the individual. The findings in his study indicate that those morals that are deeply internalized are better motivators for environmental behaviors.

Kelly serves as an example of Thøgersen’s (2006) theory. On multiple occasions over the course of the study, she identifies an external pressure that causes her to engage in pro-environmental behaviors. In her pre-departure interview, she identifies her roommate as the reason she recycled. Likewise, one-year later, she stated, “I’m always willing to recycle, but when someone doesn’t force me to do that, I’m not necessarily doing it.” Furthermore, she said, …my roommate recently bought a Brita pitcher in order to cut back on the waste of water bottles and I have taken to using refillable glasses, not only because it’s cheaper, and I am a broke grad student, but also because there isn’t as much waste.

Clearly Kelly is engaging in environmentally responsible behaviors because she is concerned with pleasing her roommate and saving money. It does not appear that she has deeply internalized any of the empathy or feelings of responsibility that she demonstrated elsewhere in her data.

In comparison, during the one-year data collection, Hillary demonstrated more internalization of the variables studied. Her responses indicate that in addition to her prior
experiences the course played a role in Hillary’s deep internalization of the variables. For example, “I definitely feel more in charge of or more responsible for recycling now. So definitely after Yellowstone, I’m more aware and I’ve done more research on what can and cannot be recycled and how it can be recycled,” (one-year interview). Additionally, she stated, I have always loved and appreciated nature, but before the trip I was unaware of our direct effect on our surroundings and in turn, on others in the environment. I am much more aware of my use of disposable materials, engaged with the idea of sustainability, and interested in sharing my learning experiences with others. (one-year interview)

There is a noticeable absence of any guilt or sense of pride in Hillary’s comments. Instead, it seems that she has internalized her pro-environmental morals and as a result is willing to act and is engaging in pro-environmental behaviors.

**A New Model for Environmental Behavior**

Considering the findings in this study and considering Thøgersen’s (2006) norm taxonomy, a new model derived from the present research proposes an alternative to existing models of environmental behaviors. Figure 2 below captures the model. Instead of treating all variables as equal contributors, the new model removes willingness to act from the internal factors and sees it as a construct comprised of internal and external factors that influence moral development. The extent to which the individual internalizes the morals necessary to perform pro-environmental behaviors then influences the individual’s willingness to act, which leads to high or low environmental behaviors. The model proposed below is intended to serve as a heuristic model, serving as a guide to consider pro-environmental behaviors. Like, Kollmus and Agyeman’s (2002), the proposed model separates internal and external factors, but recognizes
that these interact with one another. Additionally, it is important to recognize that influencing factors vary with context.

Students’ morals are influenced by both internal and external factors. It is reasonable to infer that these factors are superficially internalized, meaning the individual accepts these norms with little reflective or reflexive thinking. Ultimately, the individual adheres to these morals out of a feeling of guilt or pride and in the absence of those two motivators there in no adherence to the moral. Other times, the internal and external factors may be deeply internalized, because the individual has thought reflectively and reflexively about the belief and as incorporated it into their self-concept. This deep internalization leads individuals to adhere to their morals without guilt or pride acting as a motivator and because of the deep internalization, the individual does is not motivated by guilt or pride. Referring to Kelly and Hillary’s statements from the previous section, Kelly was motivated by guilt and had a low willingness to act, while Hillary deeply internalized her morals and did not require guilt or pride as motivation to engage in pro-environmental behaviors.

**Authentic Experience and Socioscientific Reasoning**

The results from this study were inconclusive regarding the association between an experiential environmental course infused with SSI and socioscientific reasoning (SSR). As stated previously, SSR is a complex construct and may take multiple exposures to contentious issues to fully develop or observe in an individual. However, students collectively demonstrated several features of SSR after completing the course, which were not observed pre-departure. Most significantly, several students demonstrated examples of socioscientific perspective taking (SSPT), which had previously only been theorized (Kahn, 2015). Students demonstrated
reflective and reflexive thinking because of these experiences immediately after the course was completed and some maintained those beliefs one year later.

The results show that considering the cognitive and affective dimensions of moral development as described by neo-Kohlbergian and Social Moral Development theories is valuable when developing scientifically literate students (Hoffman, 2000; Rest et al., 1999). These results align with Park (2007), who identified the need to move away from “cold” conceptual change, which only considered the cognitive aspects of conceptual change.

**Limitations and Potential Solutions**

**Sample selection.** As with any research, this study is constrained by certain methodological choices. Participant selection is one of those constraints. The course contained 36 post-secondary students, of which 24 participated in all the pre- and post-course data collection, despite the fact that all surveys and interviews were part of the grade for the course. The investigator speculates the abundance of course work assigned within a relatively short period of time may have contributed to the lack of participation. In other words, students may have elected to complete assignments with a larger impact on their final grade. One year later, all students were contacted again to complete the surveys and interview, with 13 complying. The investigator then selected all of the students who had completed surveys and interviews for all data collection periods, which resulted in the seven students in the study. In addition to efforts to increase participation mentioned in chapter three, the investigator could have maintained more contact with the students in the year after the course finished. Additionally, the pre-departure surveys could have been sent to the students earlier; however, that would have conflicted with final exams.
Figure 2 Revised Pro-Environmental Behaviors Model
Furthermore, post-secondary students’ conceptualizations and behaviors were only examined in this study. Younger students should be studied in order to gain a more thorough understanding of the association between experiential SSI course environmental behaviors. This is especially important in light of the emphasis the *Next Generation Science Standards* (Achieve, 2013) place on the interdependence of organisms and the environment, along with the desire to promote argumentation.

**Instrumentation.** The items on the *Environmental Behaviors Instrument* (EBI) had been piloted with students like those in the study and were based on items from existing environmental behavior questionnaires; however, no student indicated participating in activities like demonstrations. Bennett (2008) cites the fact that many of today’s youth see demonstration and protests as historical relics and are more inclined to implement social media as a means of participating in social change. As such, the EBI should be modified to consider the use of social media in political activism. This change could also help to address Hodson’s (2010) criticism of the SSI Framework for not instilling enough socio-political action.

Additionally, phrasing on the open-ended responses of the SEEDS need to be reconsidered. During the pre-departure data collection, students sometimes left them blank because the prompt asked students to use specific examples they could think of to support their responses to the Likert items. When the investigator inquired about the blank responses students stated they did not have any specific examples from their life. Students seemed to interpret the statement to mean first-hand experiences and if they did not have first-hand experiences they did not respond. Perhaps the items need to be reworded in a manner allowing for a broader interpretation of specific examples.
**Collaboration with faculty.** The large number of faculty from various disciplines positively and negatively impacted the quality of this course. The diverse perspectives and knowledge each individual offered certainly offered a level of depth to the study of CEI which allowed the students to consider appreciate the complexity of the issues. Unfortunately, there were instances where content was given priority over pedagogy. For example, experiences intended to allow students to more deeply consider CEI were cut short or eliminated in order by other faculty to squeeze in more content, ultimately, these decisions were out of the researcher’s control in his role as a junior instructor. The issue of balancing content knowledge with pedagogical content knowledge has been a longstanding issue. While unintentional, the different emphasis placed on content knowledge, pedagogical knowledge, and pedagogical content knowledge by the faculty in this study impacted the direction of the course and, as a result, the outcomes of the course (Zeidler, 2002).

**Time.** One of the biggest challenges with a study of this type is maturation (Campbell & Stanley, 1963). Students were exposed to multiple variables that might have influenced their conceptualizations of CEI and/or their environmental behaviors. The researcher attempted to focus students’ thoughts back to their experiences in the course through the interview protocol. There is little the research can do to prevent students from maturing and engaging in new experiences, but it would have been beneficial to remain in contact with students over the course of the study. The researcher was concerned with over contacting students, which might have been frustrating to them and resulted in a lower number of participants willing to complete the one-year follow up interviews.
Theoretical Implications

The present study will further the research in SSI and EE. To this point, most of the SSI research has focused on traditional classroom settings with some exceptions (Burek & Zeidler, 2015; Greely, 2008). This study expands the SSI literature into the non-formal setting which is becoming more of an area of interest because individuals spend 97% of their time outside the traditional classroom experience (Ballantyne & Packer, 2005) and it is vital that more research is done to understand how to better use this time to develop environmentally literate citizens. The results from this study indicate many post-secondary students demonstrated residual changes in several key areas, namely perspective taking, empathetic concern, feelings of responsibility, and willingness to act, necessary to developing functionally scientific literate citizens.

While infusing an SSI approach can be met with resistance in the traditional school setting (Zeidler & Kahn, 2014), this research will help to guide the copious after school and outdoor programs to better meet the challenges of tomorrow’s environmental issues. Additionally, the findings in this study address the critique of the SSI approach. Students in this study engaged with authentic CEI, not activities under the control of a teacher or simulations with little relevance to life outside of school (Levinson, 2013). Furthermore, the findings support the notion that an SSI approach can be associated with student actions toward CEI resolution.

Implications for Practice

This study advances the notion that students should engage in authentic experiences, guided by teachers to facilitate cognitive and affective growth. Both environmental and science educators advocate developing scientifically literate citizens with the skills, knowledge, and values to rectify complex scientific dilemmas (Hart, 2009; Marcinkowski, 2010; Zeidler et al, 2005). The results of this study indicate authentic experiences can be associated with students’
longitudinal conceptualizations and behaviors related to natural resources management issues. According to the model proposed in this study, it is imperative that teachers develop curricula that promote deeply internalizing the morals required to promote environmental behaviors. There are a multitude of internal and external factors associated with the formation of environmental behaviors, but the results of this study suggest that implementing an SSI approach embedded within an experiential course fosters the type of moral development required for lasting behavior change.

Authentic experiences do not need to be two-week trips to distant locations. In fact, Noddings (2005) encourages teachers to begin by having students consider local issues before moving on to dilemmas that are more global. The close proximity of the issues provides relevance to the students and fosters the idea that contentious issue exists in the local community and minimizes the idea that issues only exist in other locales. It is not unthinkable for teachers to design experiences where students engage local stakeholders to consider community issues. The importance of experiential learning in the community is also supported in the science education literature, which argues that experiential science education allows students to engage with local issues, while contributing to the resolution of the issue (Roth & Lee, 2004). However, the results indicate that one prolonged experience is not enough to modify environmental behaviors is all cases. Authentic experiences should begin early in students’ schooling and occur frequently in order to overcome old behaviors.

This study also serves as an alternative design for environmental educators seeking to more successfully meet the goals established by the international community. Environmental education researchers have called for approaches focusing on developing more than content knowledge and developing the morals and ethics of future decision-makers. It would behoove
environmental educators to consider implementing the pedagogical decisions in this study as ways to develop the crucial skills, values, and attitudes identified by the United Nations over 30 years ago (UNESCO, 1978).

This study does provide new insight into the effectiveness of blending an issues-based approach emphasizing the moral and ethical development with experiential learning. Prior research in environmental education considering contentious issues focused heavily on scientific content knowledge acquisition and merely acknowledged the potential for ethical dilemmas. In this study, students were directly engaged with the participants and could see first-hand the impacts of CEI on the people and environment of the GYA, which has been identified as crucial to promote student involvement in the environmental humanities (Alagona & Simon, 2010). The engagements with stakeholders were deliberate and intended to provide the concrete experiences necessary to promote the dissonance and reflection necessary for cognitive and moral growth (Kolb, 1984, Hoffman 2000, Zeidler et al., 2005). However, students were not left to ponder the CEI on their own. The instructors debriefed with the students after every experience to promote reflective and reflexive thinking. Additionally, students were required to participate in a town hall-style debate where they implemented various forms of formal and informal reasoning to justify their assumed position related to wolf management in Montana. Again, while improbable that most teachers will be able to provide experiences to distance locations, they can provide thoughtful experiences where students have the opportunity to engage in authentic experiences with stakeholders and dissect these experiences in a way to promote cognitive, affective, and moral growth.
Future Research

Several avenues of research exist because of this study. The most significant future research is to further test the model proposed in this study. It is imperative that more cases are examined to determine the generalizability of the model. Research needs to determine the motivating factors behind environmental behaviors to support the claims in this paper.

Additionally, more research is necessary to determine the association between the variables in this study. The literature is unclear on the role of willingness to act and research must clarify whether willingness to act acts a moderating variable or contributes equally toward environmental behaviors. The data from this study indicates the need to explore the role that other variables play in developing environmental behaviors. For example, there is an indication that feelings of responsibility and perspective taking should be examined more closely. A potential future research question might ask, “To what extent are feelings of responsibility associated with students’ willingness to act to resolve contentious environmental behaviors?”

Furthermore, the investigator has already begun to participate in research specifically focused on developing empathy because of this experience. Empathy serves as a vital component of moral and ethical development through the development of socioscientific perspective taking. Additionally, future research should consider the association between local experiential courses and CEI resolution. The authentic setting for the current study is most likely not highly reproducible in many academic settings. Therefore, research must focus on the replication of the finding in more local contexts. A potential research question addressing this line of research may be, “To what extent are authentic experiences in the local community associated with students’ conceptualizations of CEI engagement?”
Furthermore, the results from this study indicate that developing SSR in individuals requires more than one prolonged field experience and it is necessary to determine how several experiences can be associated with student’s conceptions of CEI. A potential opportunity exists with the course used in this study. Teaching assistants travel with the class every year and are often selected from students who have participated in the course as students. It would be valuable to examine the effects of multiple exposures to CEI in the GYA on individuals’ SSR and the conceptualization of CEI.

Finally, researchers should consider the association between experiential SSI and socio-political action related to social media. Hodson’s (2010) call for socio-political action seems to only consider actions taken by previous generations and gives little weight to the types of digital actions students can take. Bennett (2008) discusses students’ attitudes towards traditional methods of calls for change (e.g., protests, marches) as antiqued and are unlikely to engage in such activities. It is imperative that science educators consider the role that different media forms play in how students voice their concerns and displeasures. Some authors have argued that students’ reliance on technology have led to a reduction in the ability to deeply contemplate complex situations and nuanced arguments (Zeidler, Herman, Clough, Olson, Kahn, Newton, 2016). If this is the case, it is vital that science educators understand the role various media play in the internalization of morals necessary to promote behavior change.

Summary

This study sought to understand the association between an experiential environmental education course with SSI instruction and students’ conceptualizations and behaviors one year after completing the course. Students demonstrated increased feelings of responsibility, empathetic concern, and perspective taking one year after the course. Despite these changes, not
all students demonstrated changes in environmental behaviors, primarily because of economic limitations or difficulties modifying existing behaviors. The results emphasize the need to include authentic experiences in the science curriculum and make deliberate pedagogical decisions intended to develop the affective domain. Limitations of this study should be considered in future research in order to develop a fuller understanding of the association between experiential SSI and student behavior. Specifically, the instruments should be modified to encourage students to provide more detailed qualitative responses and environmental behaviors should be included that are more relevant to students in the 21st century. Additionally, students of other ages should be studied in the context of experiential SSI and courses should be studied with teachers more in tune with the educational literature and research-based educational practices.
References


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Appendix A. Interview Protocol

Participant’s Name: __________________________________

Ask each question on the list. Vary the order you ask the questions between participants. You are allowed to ask participants to expand on an answer if you feel the answer provided is too broad or lacks sufficient detail. If you are running out of time, feel free to circle the questions left to ask and have the participant provide written responses.

In what ways do you think human impact and technological development can disrupt the balance of nature?

To what extent do you think natural resources can be managed in a sustainable manner that benefits nature and humans?

Do you think work done in the natural sciences needs to be responsive to social, moral and ethical issues? Explain.

How much do you attempt to consider other’s viewpoints and opinions regarding natural resources issues?

To what extent can you personally identify with those who feel the impacts from natural resources decisions and policies?

What examples can you provide where you have felt responsible for natural resources issues and been willing to endure personal inconvenience for their resolution?

To what extent would you be willing to take actions that would resolve social issues stemming from natural resources management?

What role does scientific evidence play in the understanding and proposing solutions to social, moral and ethical issues stemming from natural resources management?

Do you engage in any pro-environmental behaviors (e.g. recycling, reading about environmental issues, campaigning or demonstrating)?

   **If yes:** Why do you engage in these behaviors?

   **If no:** Why don’t you engage in any of these behaviors? (as an alternative, What prevents you from engaging in these behaviors?)
Appendix B. Socioscientific and Environmental Engagement Dimensions Survey

Please indicate the extent that you agree with the following statements by circling the number associated with the following descriptions.

1= never, 2 = seldom/rarely, 3 = sometimes, 4 = often/frequently, 5 = always

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<th>Ecological Worldview</th>
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<tr>
<td><strong>Interconnectedness (I)</strong></td>
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<td>1. I believe scientific and technological development probably will not disrupt the balance in nature. 1 2 3 4 5</td>
</tr>
<tr>
<td>2. I believe human impact on nature such as agriculture; stream modification and wildlife management will have long-term consequences. 1 2 3 4 5</td>
</tr>
<tr>
<td>3. If human beings manipulate and change nature for their benefit, it might cause devastating results. 1 2 3 4 5</td>
</tr>
</tbody>
</table>

*With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did.*

<table>
<thead>
<tr>
<th>Sustainable Development (S)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. I believe human beings should follow the laws of nature as they are an integral part of it. 1 2 3 4 5</td>
</tr>
<tr>
<td>5. I believe we have to manage natural resources within the scope of not tempering with natural ecosystems. 1 2 3 4 5</td>
</tr>
<tr>
<td>6. I believe it is possible to seek development mutually beneficial both for us (human beings) and nature. 1 2 3 4 5</td>
</tr>
</tbody>
</table>

*With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did.*
Social and Moral Compassion

Moral and Ethical Sensitivity (M)

7. I believe social issues (ex: water quality, stream modification, disease in wildlife populations, use of agricultural lands and natural parks) in natural resources management can raise ethical concerns and conflicts. 1 2 3 4 5
8. I can predict the social, ethical and moral impacts that the work in the natural sciences might cause. 1 2 3 4 5
With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did.

Perspective-taking (P)

9. I try to consider the diverse opinions and perspectives of those involved, when deciding which sides to take on natural resources management issues caused by work done in the natural sciences. 1 2 3 4 5
10. I try to think in others’ perspectives to imagine, “What if I were in their situation?” before criticizing different opinions on natural resources management issues caused by work done in the natural sciences. 1 2 3 4 5
With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did.

Empathetic Concerns (E)

11. I genuinely feel sorry for those who suffer (ex: from loss of livestock, agricultural resources and finances) from the results of natural resources management issues. 1 2 3 4 5
12. I am unable to feel like it is my own experience when I see those who are suffering (ex: from loss of livestock, agricultural resources and finances) from the impacts of natural resources management issues. 1 2 3 4 5
13. I believe we have to take care of (e.g. provide financial compensation, cultural preservation) those who suffer (e.g. from loss of livestock, agriculture and finances) because of managing natural resources issues. 1 2 3 4 5
With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did.
# Socioscientific Accountability

## Feeling of Responsibility (R)

14. I do not feel responsible for causing social issues related to natural resources management and the environment.
15. I believe small actions I take can contribute to resolving social issues regarding natural resources management and the environment.
16. I am willing to endure personal inconveniences in order to resolve social issues caused by natural resources management because I feel responsible for those issues.

_With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did._

## Willingness to Act (W)

17. I believe cooperation and supports from members of community I live in are required to solve social issues related to natural resources management (ex: water quality, stream modification, disease in wildlife populations, use of agricultural lands and natural parks).
18. I will participate in supporting the resolution of social issues related to natural resources management at national and global levels (e.g. through inter-country cooperation and international convention).
19. I will make efforts to initiate community movements and communicate with community members to resolve social issues related to natural resources management.
20. I do not believe global cooperation and support from various nations are required to solve social issues related to natural resources management.

_With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did._

## Examining Scientific Evidence
When it comes to controversial natural resources issues, I think scientific evidence could be used to justify any position or solution. Everything is up in the air!

Scientific evidence regarding natural resources issues can account for what is really going on in nature and should be used to propose the best solutions for those issues.

I believe natural resources issues are much too complex and uncontrollable for scientists to gather reliable evidence about and understand.

I think that continuous research and considering scientific evidence will result in effective natural resources issues resolution.

With actual examples you are familiar with, please explain in depth why you responded to the previous items the way you did.
Appendix C. Environmental Behaviors Questionnaire

The intention of this survey is to gain an understanding of your environmental behaviors. This instrument is not scored on accuracy. The responses will be reviewed and returned to students who do not provide sufficient responses.

Your responses are valuable for multiple reasons. First, they will help improve the quality of your experience in the Greater Yellowstone Ecosystem. Second, your responses will help shape future versions of this course.

Please complete this survey by Saturday, May 3 at 11:59 pm.

**Directions: For each item, indicate the frequency with which you participate in the behavior in the last month.**

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last month, how often have you recycled cans, bottles, or paper?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>In the last month, how often have you used reusable bags for store purchases to reduce the amount of plastic consumed?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>In the last month, how often did you adjust the heat or air conditioning to limit energy use?</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td>When available, how often did you purchase products made of</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
<td>○</td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>Always</td>
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</tr>
<tr>
<td>recycled materials in the last month?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last month, how often have you watched television programs, movies, or internet videos about environmental issues?</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>In the last month, how often have you read any newsletter, magazines, web blogs, or other publications about environmental issues?</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>In the last month, how often do you wait until you have a full load to use the washing machine or dish washer?</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>In the last month, how often have you used public transportation to reduce the consumption of fossil fuels and/or reduce the emission of greenhouse gases?</td>
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<tr>
<td>In the last month, how often have you bought organically grown products?</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last month, how often have you purchased</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Never</td>
<td>Rarely</td>
<td>Sometimes</td>
<td>Often</td>
<td>Always</td>
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</tr>
<tr>
<td>cleaning products such as detergents or cleaning solutions that are environmentally friendly?</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Directions:** For each item, indicate the frequency with which you participate in the behavior in the *six months*.

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>Rarely</th>
<th>Sometimes</th>
<th>Often</th>
<th>Always</th>
</tr>
</thead>
<tbody>
<tr>
<td>In the last six months, how often did you contribute money to a pro-environmental organization?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last six months, how often have you donated your time to a pro-environmental organization?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last six months, how often have you contacted a politician about an environmental behavior?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In the last six months, how often have you talked to others about environmental issues?</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>In the last six months, how often have you written to a newspaper, magazine, blog, or social media about environmental issues?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix D. Semi-structured Interview Protocol for Cases

Interview Protocol for Case Study

1. To what extent did your experiences in the LU@YNP course relate to the way you engage in natural resource issues after the course was completed?

2. In what ways did your experiences in the LU@YNP course influence how you consider scientific evidence regarding natural resource issues?

3. To what extent did your experiences in the LU@YNP course relate to your attempt to consider multiple perspectives regarding natural resources after the course was completed?

4. In what ways did the LU@YNP course influence how you view the relationship between humans and the environment?
Appendix E. IRB for the University of South Florida

3/31/2014

Benjamin Herman, Ph.D.
Secondary Education
EDU 105, University of South Florida
4204 East Fowler Avenue
Tampa, FL 33620

RE: Expedited Approval for Initial Review
IRB#: Pro00016081
Title: Impact of Experiential Field-Based Socioscientific Issues Pedagogy on Post-Secondary Students' Conceptions of Environmental Issues in the Greater Yellowstone Ecosystem

Study Approval Period: 3/31/2014 to 3/31/2015

Dear Dr. Herman:

On 3/31/2014, the Institutional Review Board (IRB) reviewed and APPROVED the above application and all documents outlined below.

Approved Item(s):
Protocol Document(s):
Experiential Environmental SSI Instruction on Conceptions of Environmental Issues Study Protocol

Consent/Assent Document(s) *:
Adult IC minimal risk (1).docx.pdf

* Please use only the official IRB stamped informed consent/assent document(s) found under the "Attachments" tab. Please note, these consent/assent document(s) are only valid during the approval period indicated at the top of the form(s).

It was the determination of the IRB that your study qualified for expedited review which includes activities that (1) present no more than minimal risk to human subjects, and (2) involve only procedures listed in one or more of the categories outlined below. The IRB may review research through the expedited review procedure authorized by 45 CFR 46.110 and 21 CFR 56.110. The research proposed in this study is categorized under the following expedited review
category.

(7) Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

As the principal investigator of this study, it is your responsibility to conduct this study in accordance with IRB policies and procedures and as approved by the IRB. Any changes to the approved research must be submitted to the IRB for review and approval by an amendment.

We appreciate your dedication to the ethical conduct of human subject research at the University of South Florida and your continued commitment to human research protections. If you have any questions regarding this matter, please call 813-974-5638.

Sincerely,

[Signature]

John Schinka, Ph.D., Chairperson
USF Institutional Review Board
Appendix F. Letter of Support from Longwood University

LONGWOOD UNIVERSITY
201 High Street
Farmville, Virginia 23909
tel: 434.395.2000
fax: 434.395.2596
toll-free: 711

February 18, 2014

Dr. Benjamin Herman
Department of Secondary Education
College of Education
University of South Florida
Tampa, Florida

Dear Dr. Herman:

It is my pleasure to provide this letter of support to accompany your proposal to the University of South Florida’s Institutional Review Board. In submitting this letter, I aim to provide a bit of context for the proposed project, both in regards to our institution and the academic program itself, and affirm Longwood University’s commitment to facilitating the work.

Longwood is a comprehensive university in central Virginia, classified by the Carnegie Foundation as “arts and sciences plus professions” with “some graduate coexistence” and a “very high undergraduate” enrollment profile. Longwood is one of the 15 senior institutions in the Commonwealth of Virginia’s public higher education system. There are approximately 4,300 undergraduates enrolled this academic year, the vast majority of whom are of traditional college age and reside in campus-managed housing for their college careers. The 225 full-time faculty members on campus may be best described as teachers-scholars, each with a deep commitment to teaching as the heart of our academic work but with research, especially that which engages students, as a vital component of professional life. Innovative teaching and interdisciplinary collaborations are valued and strongly supported by Longwood, and the Longwood@Yellowstone National Park (LU@YNP) program is one example of that.

The focus of the proposed research is the LU@YNP program, an effort affiliated with the American Democracy Project (http://www.aascu.org/programs/ADP/) and its Stewardship of Public Lands initiative. LU@YNP also is deeply rooted in the campus’ decade-long SENCER effort (Science Education for New Civic Engagements and Responsibilities; www.sencer.net). Longwood started work on a Yellowstone-focused project in 2005, and we first took students to Yellowstone in 2006. Since then, Longwood students have traveled to Yellowstone seven more times, with 200+ students from more than a dozen academic majors having participated in the project. Faculty participation has captured the diversity of the liberal arts and sciences foundation at Longwood, with contributions from visual arts, sociology, biology, geography, mathematics, earth sciences, and rhetoric. Faculty teach and students participate in one of several associated courses, to wit:

- BIOL/ENSC 295 – Socioscientific Approaches to Complex Challenges
- GNED 261 – Exploring Science in our World
- GNED 400 – Exploring Public Issues through Writing
The LU@YNP project unfolds over six weeks in the first part of the summer. Faculty and students meet together on campus in the week immediately following spring semester final exams for work focused on preparing for the field experience. In addition to the usual start-of-course activities (e.g., overview of assignments, expectations, etc.), students participate in collaborative work designed to prepare them for work on the ground in Yellowstone and to introduce them to the key stewardship issues of our first national park. Students then return to their homes for a few days before flying out West for a nine-day immersion experience. Students arrive at the Jackson Hole airport, which is situated inside Grand Teton National Park and at the feet of the Teton. With that striking image as their first impression, students are off and running in an intense experience in the Greater Yellowstone Ecosystem. Through structured explorations of local communities, meetings with stakeholders, and first-hand experiences in the landscapes, students consider the complex challenges associated with stewardship of our public lands. On the ninth day, students return home and commence a four-week segment of the course that is completed in a distance model. In that time, students work with faculty to complete a series of assignments that vary among the courses, but all of which build on their personal experiences out West.

In the work proposed by you and your colleagues, students in the GNED 400 and BIOL/ENSC 295 courses will complete surveys and interviews both at the opening and close of the six-week academic project. Students in the long-running GNED 400 course will serve as a 'control' group, and they will have the same experience as students in recent years of the LU@YNP project. Students in the BIOL/ENSC course will participate in a modified curriculum that explicitly emphasizes the socioscientific issues pedagogical approach. All students will be informed of the USF research. While some will experience a different pedagogical approach for some parts of the course, none will be disadvantaged in any way. The faculty team for this year's LU@YNP project is fully aware of your plans, and all are not just supportive but also eager to facilitate the work. Dr. Alix Fink, Dean of our Honors College and project leader for LU@YNP, has worked with your doctoral student, Mr. Mark Newton, for 5 years, and she will do what is necessary to ensure that your team has what it needs to accomplish its work. I too am prepared to assist in any way appropriate. Please note too that, in parallel to your submission to the USF IRB, our LU IRB also is evaluating the proposed work.

In closing, the LU@YNP project is very important to the faculty team that invests significant personal time in it year after year. This opportunity to collaborate with you and your USF colleagues is exciting, and we welcome this careful examination of the students' experiences and their learning outcomes. We stand ready to assist, and we are eager to do so. If I may provide any additional information, please let me know.

Sincerely,

Kenneth B. Perkins, Ph.D.
Provost and Vice President for Academic Affairs
I. Informed Consent to Participate in Research Information to Consider Before Taking Part in this Research Study

IRB Study # Pro00016081

You are being asked to take part in a research study. Research studies include only people who choose to take part. This document is called an informed consent form. Please read this information carefully and take your time making your decision. Ask the researcher or study staff to discuss this consent form with you, please ask him/her to explain any words or information you do not clearly understand. We encourage you to talk with your family and friends before you decide to take part in this research study. The nature of the study, risks, inconveniences, discomforts, and other important information about the study are listed below.

The study will examine participants’ experiences as part of the Longwood University at Yellowstone National Park (LU@YNP) courses. Minimal risk is associated with this study. Electing not to participate will have no impact on any student’s grade in the course.

Please tell the study staff if you are taking part in another research study.

We are asking you to take part in a research study called: Socioscientific Issues Pedagogy and Students’ Conceptions of Environmental Issues. The person who is in charge of this research study is Dr. Benjamin C. Herman. This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge. These staff include: Dr. Dana Zeidler, and Mr. Mark Newton.

The research will be conducted at various locations in Jackson, Wyoming and Gardiner, Montana. In addition, phone conversations may occur once participants return to their homes.
II. **Purpose of the study**
The purpose of this study is to:

- examine the extent to which experiences in the LU@YNP courses play a role in participants’ decision-making on complex issues.

III. **Study Procedures**
If you take part in this study, you will be asked to:

- Complete all course work and attend all course meetings. At various times over the duration of the course, participants will complete individual interviews with a member of the study team. Participants will also engage in focus group discussions. Participants will also be contacted after the completion of the course to complete surveys and conduct a phone interview.
- Each individual interview will require 30 minutes to complete. Focus groups will require one hour to complete. Surveys will require 30 minutes to complete.
- Surveys and interviews will be completed prior to, immediately after, and five to six months after the course. Focus groups will take place during the second and third week of the course.
- Audio recordings will be made of interviews and focus groups. Research staff members will be the only individuals with access to these recordings. The purpose of the recordings is to accurately capture participants’ responses and then transcribe those responses. All audio files and other data sources will be stored in a locked file cabinet and/or on a password secured computer for a maximum of ten years.

IV. **Total Number of Participants**
About 40 individuals will take part in this study.

V. **Alternatives**
You do not have to participate in this research study.

VI. **Benefits**
Benefits to the participants may include satisfaction for contributing to the study’s success and increased levels of reflection about LU@YNP course themes.

VII. **Risks or Discomfort**
This research is considered to be minimal risk. That means that the risks associated with this study are the same as what you face every day. There are no known additional risks to those who take part in this study.

VIII. **Compensation**
You will receive no payment or other compensation for taking part in this study.

IX. **Cost**
There will be no additional costs to you as a result of being in this study.
X. Privacy and Confidentiality

We will keep your study records private and confidential. Certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are:

- The research team, including the Principal Investigator, study coordinator, and all other research staff.
- Certain government and university people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. This is done to make sure that we are doing the study in the right way. They also need to make sure that we are protecting your rights and your safety.
- Any agency of the federal, state, or local government that regulates this research. This may include the Food and Drug Administration (FDA), Florida Department of Health, and the Department of Health and Human Services (DHHS) and the Office for Human Research Protection (OHRP).
- The USF Institutional Review Board (IRB) and its related staff who have oversight responsibilities for this study, staff in the USF Office of Research and Innovation, USF Division of Research Integrity and Compliance, and other USF offices who oversee this research.

We may publish what we learn from this study. If we do, we will not include your name. We will not publish anything that would let people know who you are.

XI. Voluntary Participation / Withdrawal

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study. You are free to participate in this research or withdraw at any time. There will be no penalty if you stop taking part in this study. The decision to participate or not to participate will not affect your student status (e.g., course grade).

XII. New information about the study

During the course of this study, we may find more information that could be important to you. This includes information that, once learned, might cause you to change your mind about being in the study. We will notify you as soon as possible if such information becomes available.

You can get the answers to your questions, concerns, or complaints

If you have questions about your rights as a participant in this study, general questions, or have complaints, concerns or issues you want to discuss with someone outside the research, call the USF IRB at (813) 974-5638.
XIII. Consent to Take Part in this Research Study

It is your choice whether you want to take part in this study. If you willingly volunteer to participate in this study, please sign the form, if the following statements are true.

I freely give my consent to take part in this study and authorize that my information as agreed above, be collected/disclosed in this study. I understand that by signing this form I am agreeing to take part in research. I have received a copy of this form to take with me.

______________________________________________
Signature of Person Taking Part in Study          Date

______________________________________________
Printed Name of Person Taking Part in Study

XIV.

XV. Statement of Person Obtaining Informed Consent

I have carefully explained to the person taking part in the study what he or she can expect from their participation. I hereby certify that when this person signs this form, to the best of my knowledge, he/ she understands:

- What the study is about;
- What procedures/interventions/investigational devices will be used;
- What the potential benefits might be; and
- What the known risks might be.

I can confirm that this research subject speaks the language that was used to explain this research and is receiving an informed consent form in the appropriate language. Additionally, this subject reads well enough to understand this document or, if not, this person is able to hear and understand when the form is read to him or her. This subject does not have a medical/psychological problem that would compromise comprehension and therefore makes it hard to understand what is being explained and can, therefore, give legally effective informed consent. This subject is not under any type of anesthesia or analgesic that may cloud their judgment or make it hard to understand what is being explained and, therefore, can be considered competent to give informed consent.

______________________________________________
Signature of Person Obtaining Informed Consent / Research Authorization          Date

______________________________________________
Printed Name of Person Obtaining Informed Consent / Research Authorization
Appendix H. Longwood University Informed Consent Form

Longwood University
Consent for Participation in Social and Behavioral Research

I consent to participate in the research project entitled:

Socioscientific Issues Pedagogy and Students’ Conceptions of Environmental Issues

being conducted in the Department of Biological and Environmental Sciences by

Alix D. Fink, Mark H. Newton, Benjamin C. Herman, Dana L. Zeidler

- I understand that my participation in this research is voluntary, and that I am free to withdraw my consent at any time and to discontinue participation in this project without penalty.

- I acknowledge that the general purpose of this study, the procedures to be followed, and the expected duration of my participation have been explained to me.

- I acknowledge that I have the opportunity to obtain information regarding this research project, and that any questions I have will be answered to my full satisfaction.

- I understand that no information will be presented which will identify me as the subject of this study unless I give my permission in writing.

- I acknowledge that I have read and fully understand this consent form. I sign it freely and voluntarily. A copy of this form will be given to me.

Name (Print): ________________________________________

Date: ________________       Signed: ______________________

I understand that if I have concerns or complaints about my treatment in this study, I am encouraged to contact the Office of Academic Affairs at Longwood University at (434) 395-2010.