A "RIGHT" WAY TO TEACH ABOUT ENDANGERED SPECIES? AN ANALYSIS AND COMPARISON OF TWO ENVIRONMENTAL EDUCATION APPROACHES USING NORTH ATLANTIC RIGHT WHALES AS A CASE STUDY.

by

JESSICA MARIE HARDY

(Under the Direction of Michael Tarrant)

ABSTRACT

Environmental education and behavior change theories suggest that environmental educational materials targeting specific conservation behaviors (conservation-action approach) are more likely to influence behavioral change than programs focusing on broad environmental attitudes or issues (general-knowledge approach). However, the capacities of these two contextual approaches to promote environmental literacy have not been experimentally compared. This study evaluated whether materials developed with these contextual approaches differentially affected preservice science educators' environmental literacy related to conserving the critically endangered North Atlantic right whale. Results suggest that lessons designed with the conservation-action approach have a greater capacity to promote students' environmental literacy because their objectives are better aligned with the goals of environmental education and, because teachers perceive these goals as important and are thus more inclined to implement materials they perceive as effective at promoting their students' environmental literacy.

INDEX WORDS: Environmental education materials; Environmental literacy; Preservice teachers; Endangered species; North Atlantic right whale

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TABLE OF CONTENTS

Page

LIST OF TABLES

Page

LIST OF FIGURES

Page

GLOSSARY OF TERMS & ABBREVIATIONS

Terms

Conservation-Action Approach: The contextual approach in which the environmental education materials' learning objectives and content directly pertain to the conservation of the materials' target.

Contextual Approach (of environmental education materials): The perspective from which environmental education materials' objectives and content are developed to achieve the materials' environmental literacy goals.

Environmental Education: An educational "process aimed at developing a world population that is aware and concerned about the total environment and its associated problems, and has the attitudes, motivations, knowledge, commitment and skills to work individually and collectively towards solutions of current problems and the prevention of new ones" (Stapp, 1969, p. 36).

Environmental Literacy: "the capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems" (Roth, 1992, p. 17).

Flagship Species: "popular, charismatic species that serve as symbols and rallying points to associations conservation awareness and action" (Heywood, 1995, p. 491).

Formal Education: "institutionalized, chronologically graded and hierarchically structured educational system, spanning lower primary school and the upper reaches of the university" (Belle, 1982, p. 162).

General-Knowledge Approach: The contextual approach in which the environmental education materials' learning objectives and content do not directly pertain to the conservation of the materials' target.

Non-formal Education: "Any organized, systematic, educational activity carried on outside the framework of the formal system to provide selected types of learning to particular subgroups in the population, adults as well as children" (Belle, 1982, pp. 161-162)

SEIT E&O Committee: A committee of the Southeastern Implementation Team which is responsible for the public outreach and education efforts the North Atlantic Right Whale Recovery Plan in the southeastern U.S.

Abbreviations

E&O Committee	Education and Outreach Committee (of the SEIT)
EE	Environmental Education
NAAEE	North American Association of Environmental Educators
NARW	North Atlantic right whale
SEIT	Southeastern Implementation Team (for the North Atlantic Right Whale Recovery Plan)

CHAPTER 1

INTRODUCTION

The effective conservation of endangered species often requires a multifaceted approach, including biological research (Savage, Guillen, Lamilla, & Soto, 2010), direct protection and management, legal and policy reform, incentives, and environmental education (Salafsky, Margoluis, Redford, & Robinson, 2002). Some contend that environmental education may be particularly important to the long-term success of conservation initiatives (Jacobson & McDuff, 1998) because of its capacity to influence responsible environmental attitudes and behavior (Zelezny, 1999). Despite the general acceptance of environmental education as an important conservation tool, little research has been done to empirically test whether specific features of environmental education materials' content influence the effectiveness of those materials at cultivating responsible environmental behavior and other components of environmental literacy (knowledge, affect, and skills). The findings of such research could be instrumental to ensuring that environmental education materials on endangered species are as effective as possible at promoting environmental literacy about those species and their conservation.

Background on the Case Study: North Atlantic Right Whale Conservation Education

The North Atlantic right whale was chosen as the case study for this research because of its potential as an animal ambassador for the development of a best-practices framework describing the aspects of environmental education educational materials' content (i.e. what is taught) that are the most effective at catering to the education and outreach needs of endangered species conservation efforts. First, the North Atlantic right whale (*Eubalaena glacialis*) is one of

the most endangered whale species on Earth (Clapham, Young, & Brownell, 1999). The populations is estimated is contain only about 350-400 individuals (NMFS, 2005). Thus, the need to conserve this species is very urgent.

As one of the great whale species, the North Atlantic right whale can be categorized as a member of the 'charismatic megafauna,' large vertebrates that appeal to people's emotions and sympathies (Barney, Mintzes, & Chiung-Fen, 2005; Wallmo & Lew, 2011). Research has shown that these animals make effective 'flagship species' for larger conservation issues such as habitat conservation and the establishment of protected areas (Home, Keller, Nagel, Bauer, & Hunziker, 2009; Walpole & Leader-Williams, 2002). The very nature of these charismatic species attracts and directs the public's attention to the conservation issues they represent (Barney, et al., 2005). This provides conservationists with a venue for engaging and educating the public about these issues, thereby raising their awareness and support (Bowen-Jones & Entwistle, 2002; Walpole & Leader-Williams, 2002).

The North Atlantic right whale is also a locally relevant species to every state on U.S. eastern coastline, but is particularly relevant to the state of Georgia. The only known calving area of the North Atlantic right whale is in coastal waters of Georgia and northern Florida (Kraus & Rolland, 2007). In 1985, a year after the discovery of the calving area, the species was designated as Georgia's official state marine mammal (Georgia General Assembly). Locally relevant species, as long as they are positively perceived, are thought to make effective flagship species because they appeal to the place-attachment of the local citizenry and are more likely to be linked to people's cultural identity (Bowen-Jones & Entwistle, 2002; Home, et al., 2009).

Lastly, the need for education about this species in the state of Georgia is great. Despite its critical population status, charismatic appeal, local relevance surprisingly few Georgia

citizens are knowledgeable about the plight of the North Atlantic right whale and its associated conservation efforts (Kristina Summers, personal communication, 2009). The lack of environmental literacy on North Atlantic right whale issues is likely due to a combination of factors. One potential factor is spatial removal of most Georgia citizens from coastal issues. Another is the fact that the right whale has little exposure to the public eye. Conservation regulations prohibit anyone without a special permit from approaching within 500 yards of a right whale (NMFS, 2005). This prevents the species from playing any role in the state's economy through tourism ventures such as whale-watching tours and also limits its exposure in visual media such as nature documentaries. The highly political nature of North Atlantic right whale conservation is another factor. Mitigation of the primary threats to North Atlantic right whale survival (vessel strikes and entanglement in commercial fishing gear) is controlled at the state and national levels by government and industry (Kraus & Rolland, 2007). The majority of Georgia citizens have few practical actions they can take to directly contribute to threat mitigation. Thus, action by the general public has not been widely targeted by conservationists.

North Atlantic right whale conservationists' education and outreach efforts have historically been targeted at the specific audiences who most directly impact the species' survival. These primarily include members of the maritime and fishing industries, and recreational watercraft users. However, in order to cultivate broad public support for endangered species conservation, education efforts need to reach a larger population. In the interest of broadening public support, the Education and Outreach (E&O) Committee of the Southeastern Implementation Team for the North Atlantic Right Whale Recovery Plan (SEIT) is interested in increasing school-based, youth-centered environmental education efforts, including the development of an updated North Atlantic right whale curriculum. The results of this study

should inform the SEIT E&O Committee on the approach it should use in developing future North Atlantic right whale environmental education materials and may have implications for any initiatives seeking to educate youth about an endangered species.

Study Rationale

Increasing the environmental literacy and, more specifically, the active involvement of people with the capacity to help mitigate threats to species' survival is particularly important in endangered species conservation due to the imminent possibility of extinction. Numerous studies have shown that environmental education initiatives have influenced increases in knowledge about an endangered species and its conservation, positive attitudes towards an endangered species, action to conserve an endangered species, and increased species survival (Curti & Valdez, 2009; Dimopoulos, Paraskevopoulos, & Pantis, 2008; Engels & Jacobson, 2007; Fernández-Juricic, 1999; Kuhar, Bettinger, Lehnhardt, Tracy, & Cox, 2010; Marker, Mills, & Macdonald, 2003; Savage, et al., 2010; Trewhella et al., 2005). However, despite the demonstrated capacity of environmental education to influence the success of conservation initiatives, it is argued that the results of environmental education efforts, particularly those based in the formal education system, too often fall short of desired environmental literacy outcomes (Blumstein & Saylan, 2007).

Rationale: Contextual Approach.

One prominent contention is that these shortcomings result from "a pronounced discrepancy between the problem-solving and action-oriented goals associated with the contemporary philosophy of environmental education and an emphasis on the acquisition of environmental knowledge and awareness in school programs" (Stevenson, 2007, p. 139). Stevenson argues that this discrepancy is evident in the design of many environmental education

curriculum materials, and that, subsequently, these materials fail to achieve the goals of environmental education. This study refers to the two philosophies of curriculum content design discussed by Stevenson (2007) as *contextual approaches* of environmental education materials: the perspectives from which environmental education materials' objectives and content are developed to achieve the materials' environmental literacy goals.

The two North Atlantic right whale lessons analyzed in this study both endeavor to increase environmental literacy about North Atlantic right whales in ways that will promote threat mitigation efforts, but they do so using two different contextual approaches. The first lesson, adapted from an existing North Atlantic right whale education curriculum, teaches students about aspects of the species' natural history; it does not directly address the conservation of the species. The second was developed by the researcher in partnership with the SEIT E&O Committee and teaches specifically about the predominant threat to North Atlantic right whale recovery. The contextual approach of the first lesson is referred to as the general-knowledge approach, and that of the second lesson is referred to as the conservation-action approach. This study focuses on determining the contextual approach that is most effective at promoting the environmental literacy about North Atlantic right whales.

Rationale: Audience of the Education Materials.

The North Atlantic right whale lessons used in this study to compare the two contextual approaches were designed for use in the formal education setting at a middle-school learning level. Lessons designed for this target audience were chosen for use in this study due to their significant potential to aid in the creation of an environmentally literate citizenry. Environmental education efforts directly targeting youth have the potential to significantly increase the environmental literacy of a larger population than efforts directed at adults. Barriers such as

adults' lack of time, limit opportunities for environmental educators to actively engage a captive adult audience and directly influence their environmental literacy (Duvall & Zint, 2007). However, since the majority of American youth attend school, formal education provides a vast, captive potential audience for environmental education efforts. Also, studies have shown that, since youth often share what they have learned with their adult family members, environmental education efforts directed at youth can serve to educate an audience much greater than that of the immediate participants through intergenerational and intercommunity learning (Duvall & Zint, 2007; Vaughan, Gack, Solorazano, & Ray, 2003). A review of studies on the topic determined that environmental education initiatives that allowed for in-depth exploration of local environmental issues and which included hands-on, action-oriented activities were more likely than other types of activities to stimulate intergenerational learning (Duvall & Zint, 2007). Both of these characteristics are features of the conservation-action North Atlantic right whale lesson used in this study.

Environmental education materials designed for use in the formal education setting at a middle-school learning level are also highly adaptable for implementation with additional audiences. According educators on the SEIT E&O committee, it is much simpler to decrease or increase the depth of lessons designed for a middle-school audience to make them appropriate elementary or high school students than it would be to adapt an activity designed for high school students into one that could be implemented effectively at the elementary school level. Also, due to the emphasis formal education places on state and national education standards, lessons designed for the formal education setting can more easily be adapted for the non-formal setting than vice versa, due to the more rigid requirements and structure of formal education. This is important because, even though far fewer students participate in non-formal education programs

than attend institutions of formal education, non-formal environmental education programs have consistently shown great capacity for increasing learners' environmental literacy (Winther, Sadler, & Saunders, 2010). The adaptability of middle-school, formal education-targeted environmental education materials greatly expands the potential audiences of these materials, increasing their potential to influence the environmental literacy of a still larger population. It is because of the potential for middle-school, formal education-targeted environmental education materials to help create a citizenry literate in the North Atlantic right whale conservation that the SEIT E&O Committee chose to develop lessons for this target audience.

Rationale: Audience of the Research Study.

Even though the ultimate audience of the analyzed environmental education materials is the students, the sample chosen for this study was pre-service science educators. This sample was selected for several reasons. Teachers were chosen instead of students as participants because they could lend valuable insight into the effectiveness of the lessons as related to their use in the classroom. This is particularly important because even the most well designed, student-oriented classroom environmental education materials cannot be fully effective unless they are implemented by teachers. Also, it was presumed that, since the material taught in the lessons would be novel to the majority of the participants, they could also provide valuable insight into how the lessons influenced their environmental literacy on the topics explored. This could help to guide future research into how the lessons could influence the environmental literacy of the lessons' student target audience.

Preservice teachers were chosen instead of in-service teachers because they were both a more convenient and equally viable sample. They were easier to access in assemblages large enough to comprise adequately-sized sampling groups than in-service teachers. Also, despite

their inexperience in the classroom, it was deemed that preservice teachers would possess enough of the knowledge of in-service teachers to adequately respond to the questions posed during the study. Many in the field also believe that preparing preservice teachers to effectively implement environmental education is one of the most effective means for broad-scale infusion of environmental education into formal education practice (McDonald & Dominguez, 2010). Similar to the reasons stated earlier for focusing on formal education, integrating environmental education into the curriculum of preservice teachers can also provide the potential to capitalize on the multiplier effect: "Where one teacher has the potential to impact the number of students taught throughout a career, a methods course [for preservice teachers] has the potential to impact many future teachers and, ultimately, a far greater number of students" (Powers, 2004, p. 3).

Integrating environmental education into preservice teaching curricula serves two main functions. First, it functions to reduce the barriers preservice teachers will perceive once they enter their profession. It is argued that instruction in environmental education at the preservice level is so effective because it exposes preservice teachers to the best professional practices of the field early in their career, equipping them with "resources ready for curriculum planning, development, and use" (McDonald & Dominguez, 2010, p. 20). In addition to these resources, preservice teachers acquire the knowledge and skills needed to both efficaciously implement environmental education with their students and integrate environmental education into their teaching practices, the lack of which propagates—at least in-part—many of the barriers inservice teachers identify as preventing their implementation of environmental education. These barriers include: lack of training, lack of content and pedagogical knowledge, discomfort with environmental education teaching approaches, lack of perceived preparation time, lack of adequate resources, difficulty of integrating environmental education into overcrowded,

standards-based curricula, and lack of relevance to established curricula (Ernst, 2009; Grace & Sharp, 2000; McDonald & Dominguez, 2010).

The second purpose of integrating environmental education into preservice teaching curricula is to increase the environmental literacy of preservice teachers. One of the conclusions McDonald and Dominguez (2010) reach at the end of their review of the professional preparation of environmental educators is that "preservice teachers must… develop their own environmental awareness and an attitude toward environmental responsibility and stewardship to be effective environmental educators" (p. 27). This alone should help to mitigate the effects of barriers such as lack of motivation or commitment to teaching environmental education and lack of value placed on the goal of environmental education (Ernst, 2009; Grace & Sharp, 2000; McDonald & Dominguez, 2010). It is believed that this heightened level of environmental literacy functions to motivate teachers to overcome barriers that arise in their future careers which their preservice training did not or could not prepare them for, such as lack of funding or other resources and lack of support from their administration, peers, or students' parents (Ernst, 2009; Shuman & Ham, 1997). Thus, for both logistical and theoretical reasons it was deemed that preservice teachers would be an appropriate audience when comparing the effectiveness of the contextual approaches of the North Atlantic right whale education materials.

Research Objectives

This study seeks to compare the effectiveness of the two North Atlantic right whale lessons and their distinct contextual approaches in promoting environmental literacy and to determine whether the degree to which the lessons promote environmental literacy makes a significant contribution to predicting preservice teachers' intentions to implement those materials. The research objectives of this study are as follows:

Objective 1: Describe the study sample (participants).

Objective 2: Describe whether the lessons of contrasting contextual approaches differentially affect preservice teachers' environmental literacy

Objective 3: Describe whether the lessons of contrasting contextual approaches differ in preservice teachers' perceptions of their effectiveness at promoting environmental literacy

Objective 4: Describe whether the lessons of contrasting contextual approaches differentially affect factors likely to predict preservice teachers' behavioral intentions

Objective 5: Describe whether the lessons of contrasting contextual approaches differ in preservice teachers' intentions to implement them in their future classes.

Objective 6: Describe whether the degree to which the lessons promote environmental literacy makes a significant contribution to predicting preservice teachers' intentions to implement an environmental education lesson.

CHAPTER 2

LITERATURE REVIEW

This chapter endeavors to explain the study's research objectives in light of previously published literature on related topics. The goals and standards of environmental education are explained in order to shed light onto whether the contextual approach of environmental education materials affects the materials' ability to promote learners' environmental literacy. This is explained along with literature on behavioral prediction to help elucidate whether the contextual approach of environmental education materials affects preservice teachers' intentions to implement specific environmental education materials. The chapter concludes enumerating the hypotheses developed based on the research discussed herein that predict the outcomes of research objectives 2 through 6.

Environmental Literacy and Environmental Education

The primary goal of environmental education is to increase people's environmental literacy, "the capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those systems" (Roth, 1992, p. 17). Environmental literacy can be divided into four different competencies, called strands. These strands are knowledge, affect, skills, and behavior (Roth, 1992). The purpose of environmental education is to develop competency in these strands by promoting knowledge acquisition and raising awareness of the environment and conservation issues; encouraging the development of attitudes and values that motivate people to conserve, protect, and improve the environment; facilitating skills building that allows people to identify and solve environmental

problems; and promoting active participation in solving environmental problems (UNESCO-UNEP, 1978).

Environmental literacy, in contrast to other commonly referenced forms of literacy that are concerned primarily with various sets of cognitive skills, is characterized by the strong emphasis it places on behavior (Monroe, 2003; Roth, 1992). Environmental literacy does emphasize particular ways of thinking and valuing, but as the 'means to an end' for choosing to act in an environmentally appropriate manner. The importance of behavior in the concept of environmental literacy stems from the fact that environmental conservation results from appropriate environmental behavior, regardless of whether it is achieved directly or indirectly, or at the individual or societal level, or is defined by the maintenance, restoration, or improvement of environmental systems. Environmental literacy's emphasis on behavior is echoed in Stevenson's (2007) description of effective environmental education curriculum and pedagogical practices, in which the "development of knowledge, skills and values is not only directed towards action, but emerges in the context of preparing for… and taking action" (p. 146).

Standards of environmental education: promoting environmental literacy

In accordance with the goal of achieving environmental literacy through environmental education, the North American Association for Environmental Education (NAAEE), the premier environmental education organization in North America, developed its five *Guidelines for Excellence* documents describing the elements that define high quality environmental education initiatives. The process of developing the guidelines assimilated the input of over one thousand environmental education practitioners and scholars from a variety of backgrounds and organizational affiliations (NAAEE, 1996). In the field of environmental education, these guidelines are recognized as the prevailing standards in the development of formal and informal

environmental education initiatives (Zint, 2001). One of the documents, *Environmental Education Materials: Guidelines for Excellence*, outlines the following key characteristics of environmental education materials: fairness and accuracy, depth, emphasis on skills building, action orientation, instructional soundness, and usability (NAAEE, 1996). Four of these key characteristics (fairness and accuracy, depth, instructional soundness, and usability) pertain to ethics and mechanics of learning and teaching, which are beyond the scope of this study, but the remaining two hold great relevance to this study.

Both 'emphasis on skills building' and 'action orientation' relate directly to the capacity of environmental education materials to promote environmental literacy. 'Emphasis on skills building' refers to the capacity of environmental education materials to "build lifelong skills that enable learners to address environmental issues" (NAAEE, 1996, p. 9). This includes developing critical and creative thinking skills, action skills (such as interpersonal and communication skills, citizenship skills, and basic laboratory and field skills), and the ability of learners to apply their knowledge and skills to environmental issues. 'Action orientation' refers to whether environmental education materials endeavor to "promote civic responsibility, [and encourage] learners to use their knowledge, personal skills, and assessments of environmental problems and issues as a basis for environmental problem solving and action" (NAAEE, 1996, p. 12). This includes promoting learners' sense of personal stake and responsibility, as well as increasing their perceived self-efficacy.

Clear parallels can be drawn between environmental education materials that are action-oriented and place an emphasis on skills building, and the curriculum and pedagogical practices Stevenson (2007) describes as "[focusing] on learners working individually and collectively towards the resolution of current environmental problems... [through a process] of inquiry into

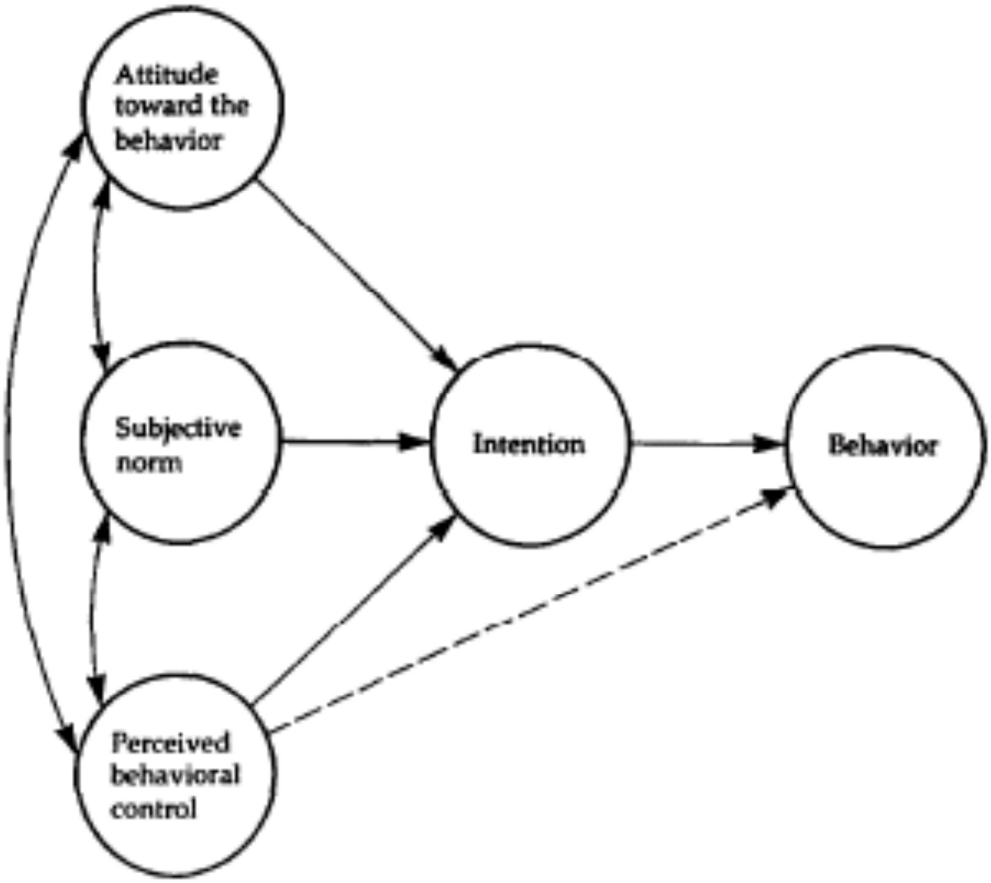
and action on real environmental issues[, which] demands that students actively engage in critical or complex thinking about real problems" (2007, p. 146). Stevenson claims that these practices, which are grounded in the philosophy of environmental education, are necessary in order to achieve the stated goals of environmental education. Similarly, materials that fail to achieve the goals of environmental education, which Stevenson describes as deviating from the rhetoric of environmental education philosophy, placing their emphasis instead on "the mastery of many fragmented facts, concepts, and simple generalizations" about the environment (2007, p. 146), can be likened the materials which fail to promote the key characteristics of 'emphasis on skills building' and 'action orientation'. Thus, the effectiveness of Stevenson's two philosophies of curriculum content design (referred to in this study as contextual approaches) at promoting the goals of environmental education can be described by their effectiveness at promoting 'emphasis on skills building' and 'action orientation'. For this reason, this study uses these two key characteristics of environmental education materials as the standards by which preservice teachers evaluate the effectiveness of the two North Atlantic right whale lessons (with their contrasting contextual approaches) at promoting environmental literacy.

Theoretical Framework: Theory of Planned Behavior

The Theory of Planned Behavior (Ajzen, 1985) and the Model of Responsible Behavior (Hines, Hungerford, & Tomera, 1986-87) offers potentially important insight into the contextual approach of environmental education materials that would best promote the goals of endangered species-focused environmental education efforts. The Theory of Planned Behavior (Figure 1) describes the manner in which peoples' behavioral intentions and, in turn, their behavior can be predicted by their attitudes toward the behavior, the subjective norms they perceive in relation to the behavior, and the level of control they perceive in being able to complete the behavior

(Ajzen, 1991). Since the measure of actual behavior is beyond the scope of this study, behavior intention is used as a proxy for actual behavior. As is stated by the Theory of Planned Behavior and affirmed by numerous empirical studies, behavioral intention accounts for a considerable amount of the variance in actual behavior so long as the behavior is under the person's volitional control (Ajzen, 1991). Both behavior and behavioral intentions are operationalized using four elements: the action, the target, the context, and the time.

Figure 1: *The Theory of Planned Behavior* (from Ajzen, 1991, p 182)



Promoting environmental literacy and the Theory of Planned Behavior.

One of the implications of this theory that the most effective way to change peoples' intentions to undertake a specific behavior is to change their attitudes, perceived behavioral

control, and/or their perceptions of norms that are directly associated with that behavior in terms of its action, target, context, and time (Fishbein & Manfredo, 1992). Furthermore, it implies that educational interventions that focus on broad attitudes and issues are less likely to influence people's behavior than interventions that focus on the attitudes, subjective norms, and/or perceived behavioral control directly corresponding to the behaviors the interventions seek to change. The implied emphasis on the importance of specificity in environmental education is also validated in a separate, but related behavior theory, the Model of Responsible Environmental Behavior (Hines, et al., 1986-87). This model states that having knowledge of the environmental issues pertinent to a particular environmental behavior, knowledge of specific action strategies that could be used to address those issues, and the specific action skills needed to perform one of those action strategies are powerful predictors of whether a person will engage in environmentally responsible behavior.

The specificity with which the North Atlantic right whale lessons promote various aspects of species-specific environmental literacy is believed to be the fundamental difference between the contextual approaches of the two lessons used in this study. The Baleen & Blubber lesson was developed from the perspective that raising students' awareness about right whales and teaching them interesting facts about the species' natural history will incline students to take action promoting North Atlantic right whale conservation. Conversely, the Vessel Strikes lesson was developed from the perspective that in order to inspire students to take meaningful action to promote the mitigation of threats to North Atlantic right whale recovery, such as political or community activism, students need to be taught about specific threats and the conservation measures that function to mitigate those threats.

Specifically, the goal of the Vessel Strikes lesson is to promote political activism in relation to renewing the Right Whale Ship Strike Reduction Rule, a piece of protective legislation that was enacted to mitigate the threat of whale-ship collisions, after it expires in 2013. The lesson teaches students about the threat posed by collisions with maritime vessels, how Ship Strike Reduction Rule works to reduce the threat of vessel strikes, why mandatory speed restrictions are necessary, and controversy the legislation raises because of its economic impact on shipping-related industries. Thus, the lesson teaches about a specific conservation issue and promotes positive attitudes toward a specific conservation solution for that issue, but—in congruence with environmental education best practices—leaves the final judgment of that solution up to the students' discretion. The researcher believes that this conservation-action approach is more in line with the implications of the Theory of Planned Behavior than the general-knowledge approach and thus is more likely to influence participants' environmental literacy in terms of their attitudes and behavioral intentions regarding North Atlantic right whale conservation.

Teachers' Intentions and the Theory of Planned Behavior.

Though this study does focus on the effects of the lessons' different contextual approaches on the effectiveness with which they promote environmental literacy, the behavioral intention measured in this study is that of preservice teachers' intentions to implement the North Atlantic right whale lessons in their future classes. It is intuitive to judge the effectiveness of environmental education materials based on their capacity to promote learners' environmental literacy. However, in the case of materials designed for use in the formal education system, it is also prudent that they be evaluated in terms of whether they are in fact implemented by educators. Even the most well designed materials can have little influence on their conservation

goals or students' environmental literacy if teachers do not choose to implement them. Though it is believed that the Vessel Strikes lesson (conservation-action approach) should theoretically be more effective than the Baleen & Blubber lesson (general-knowledge approach) at promoting environmental literacy, it also remains to be seen how teachers will respond to lessons of the differing contextual approaches. The researcher believes that the Theory of Planned Behavior can again be applied, this time to help predict how the contextual approach of environmental education materials will affect teachers' intentions to use those materials. Below are sections describing each of Theory of Planned Behavior's three predictors of behavioral intention: attitudes, subjective norms, and perceived behavioral control.

Attitudes.

Ajzen (1991) defines attitudes as "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (p. 188). In the context of the Theory of Planned Behavior, attitudes are discussed in reference to the specific, operationalized behavioral intention being predicted, not to classes of behavior or to goals associated with the behavior in question (Fishbein & Manfredo, 1992). This helps to explain, for example, why little correlation exists between attitudes toward climate change and driving behavior; the attitude and behavior are not immediately related (Kollmuss & Agyeman, 2002). However, this is not to say (for the sake of example) that peoples' beliefs about climate change cannot to some extent affect their attitudes toward driving. In the Theory of Planned Behavior, peoples' attitudes are said to arise from the beliefs they hold about the object of the attitude (Ajzen, 1991). These beliefs are formed based on the association of certain attributes with the attitude object, such as characteristics, events, or other attitude objects. These attributes can be viewed either positively or negatively and thus lead to the favorable or unfavorable attitudes toward the behavior and its

consequences. Numerous salient beliefs can contribute the formation of a single attitude. The influence of any one salient belief on the overall attitude is determined by the strength of that belief and the evaluation of the attribute(s) associated with that belief.

A study conducted about teachers' views on thirty-six theorist-advocated components of environmental education may help to elucidate teachers' beliefs about various aspects of environmental education materials. One of the major objectives of this study, conducted by Grace and Sharp (2000), was to determine how teachers would rate the importance of various expert-espoused components of environmental education if the barriers to implementing those initiatives were removed. These components were divided into two categories: 'content' and 'approach' components. The four most highly rated 'content' components included: (a) personal responsibility for the environment, (b) respect and caring for the environment, (c) global environmental issues), and (d) local environmental issues. The four 'approach' components included (a) exposure to positive attitudes, (b) links to personal lives, (c) environmental problem solving, and (d) informed decision making. Understanding attitudes, and the beliefs through which they arise, is especially important because statistical evidence on behavioral predictive using the three Theory of Planned Behavior variables suggests that personal attitudes can even tend to overshadow the influence of perceived subjective norms (Ajzen, 1991).

Subjective norms.

Ajzen (1991) defines subjective norms as "the perceived social pressure to perform or not to perform [a] behavior" (p. 188). According to the Theory of Planned Behavior, the subjective norms people perceive arise from normative beliefs about specific referent individuals or groups. The power of these normative beliefs in shaping someone's perceived subjective norm is a factor of the strength of each belief and their motivation to comply with the given referent. Subjective

norms are typically measured by asking about the level of approval or disapproval that respondents believe "important others" would feel in regard to the respondent performing a particular behavior. For teachers, the individual referents that make up this group of "important others" include teachers' students, administration, peers (i.e. fellow teachers), and students' parents (Danter, 2005).

Subject norms are the only norms included in the model of the Theory of Planned Behavior. However, Ajzen (1991) found that in certain contexts when the performance or nonperformance of a behavior is linked with moral or ethical issues, the measurement of social pressures might be insufficient in predicting behavior. In these contexts, adding measurements of personal norms, such as feelings of moral obligation and personal responsibility, add to the predictive power of the Theory of Planned Behavior model. The importance of feelings of personal responsibility in predicting environmentally responsible behavior is also validated in the Model of Responsible Environmental Behavior (Hines, et al., 1986-87). In the Model of Responsible Environmental Behavior, personal responsibility, attitudes, and locus of control make up the personality factors that, in addition to knowledge and skills, influence a person's intentions to perform a particular environmentally responsible behavior. Personal responsibility is also one of six major areas of environmental literacy (Roth, 1992): environmental sensitivity, knowledge, skills, attitudes and values, *personal investment and responsibility*, and active involvement. People who exhibit a high level of environmental literacy are expected to possess strong feelings of personal responsibility toward making choices to reduce their own negative impacts on the environment or to make choices that may help to resolve particular environmental issues (NAAEE, 1996; Roth, 1992).

Perceived behavioral control.

Perceived behavioral control is defined as "the perceived ease or difficulty of performing [a] behavior" (Ajzen, 1991, p. 188). These perceptions stem from beliefs about the presence or absence of resources, opportunities, impediments, and/or obstacles. Control beliefs are believed to primarily be based on past experience or second-hand information about the behavior. The salience of a control belief is determined by its strength and power (Ajzen, 2002). The strength of a control belief refers to a person's perceptions on how likely it is that a given control factor will be present. The power of a control belief refers to the power a person believes a given control factor has in facilitating or impeding their behavior in the event of its presence.

Perceived behavioral control is sometimes described in terms of peoples' self-efficacy. The accuracy of description depends on whether self-efficacy is referred to in terms of "beliefs in one's capabilities to organize and execute the courses of action required to produce given levels of attainments" (Bandura, 1998, p. 624) or "people's beliefs about their capabilities to exercise control over their own level of functioning and over events that affect their lives" (Bandura, 1991, p. 257). The first definition is compatible with the definition of perceived behavioral control because it focuses on control over the performance of the behavior itself. However, the second definition, which focuses on control over outcomes or events, is too broad to be compatible with the perceived behavioral control (Ajzen, 2002). The latter definition is in fact a description of beliefs associated with peoples' locus of control. Ajzen (1991) reports that locus of control, as a broad behavioral disposition, fails to predict specific behavior in a variety of different contexts. However, studies pertaining to the prediction of environmentally responsible behaviors suggest that locus of control is a significant predictor of behavior in this context (Hines, et al., 1986-87; Hwang, Kim, & Jeng, 2000). A strong internal locus of control, in which

people strongly believe that their actions have the capacity to influence desired outcomes, is also a characteristic of people with a high level environmental literacy (Roth, 1992).

In relation to beliefs concerning one's performance of a behavior, empirical research has shown that perceived self-efficacy explains a significant amount of variance in behavioral intention not accounted for by attitudes or subjective norms (Ajzen, 2002). It also accounts for a significant portion of the variance in actual behavior not accounted for by behavioral intention. This contrasts to findings in which perceived behavioral control was measured using controllability, the extent to which people believe the performance of the behavior in question is up to them. While controllability did significantly add to the prediction of behavior, it did not significantly improve the prediction of behavioral intentions.

It is also believed that perceived self-efficacy is an appropriate construct by which to measure teachers' perceived behavioral control in implementing environmental education with their students. In an empirical study of barriers to teachers' use of environmental education, a major difference existed between the indirectly expressed self-efficacy of teachers who did and did not use environmental education in their classes (Ernst, 2009). This difference was apparent through teachers' ratings of potential barriers related to their efficacy in implementing environmental education: lack of training, lack of environment content knowledge, and lack of pedagogical content knowledge. A separate study that reviewed inservice and preservice teachers' perceived barriers to implementing environmental education curricula found that teacher comfort and confidence with science background knowledge was the most prevalent barrier to implementing environmental education, cited in 15 of the 16 reviewed studies (Shumacher & Fuhrman).

Other influential factors.

In addition to the three factors from the Theory of Planned Behavior (attitudes, subjective norms, perceived behavioral control), literature on environmental education cites other factors with the power to influence whether teachers implement environmental education materials. Two of these factors that are particularly pertinent to the objectives of this study include barriers and motivations. The barriers and motivations teachers perceive in relation to environmental education implementation are intimately linked and can be seen as precursors to the factors measured in the Theory of Planned Behavior.

Barriers.

In relation to teachers' use of environmental education, barriers can be considered as specific reasons why teachers do not implement environmental education in their classes (Ernst, 2009). Barriers can act in reference to any of the three intention predictors described by the Theory of Planned Behavior. Barriers in relation to perceived behavior control includes factors such as lack of time, lack of funding, lack of adherence to standards emphasized in state testing, lack of training, lack of knowledge, or discomfort implementing various teaching approaches. Subject-norms related barriers may include factors such as lack of support from significant others (such as teachers' administration, peers, students, or students' parents) or perceptions that teaching environmental education is counter to their school's culture. Lastly, attitude-related barriers might include factors such as low opinions concerning the importance of the goals of environmental education, low opinions of environmental education's relevance, lack of motivation to implement environmental education, or inhibitions to teach about controversial environmental subjects or to promote positive environmental attitudes or pro-environmental behaviors with their students (Cotton, 2006a; Ernst, 2009; Grace & Sharp, 2000).

Motivations.

In the context of teachers' use of environmental education, motivations can be considered factors that positively influence teachers' decisions, essentially functioning in the opposite manner from barriers. According to the Theory of Commitment to Environmental Education Teaching (Shuman & Ham, 1997), these impelling influences that arise from significant life experiences help to explain why some teachers implement environmental education despite the existence of barriers that prevent other teachers from doing the same. The strength of these various influences was a focus of a pair of particularly thorough studies comparing factors influencing the implementation of two instructional approaches to environmental education. Ernst (2007, 2009) compared the perceived influences of various impelling factors on decisions of teachers who utilized environmental education in the form of stand-alone activities, units, or courses versus teachers who used a very intensive form of environmental education called environment-based education (EBE), in which "the local environment serves as a context for integrating multiple disciplines or core subject areas and as a source of real-world learning experience" (Ernst, 2007, p. 19). The second, larger-scale study analyzed the factors that teachers reported as having strongly influenced their decisions to use environmental education a part of their teaching and found that teachers in both groups reported the following factors as having a 'strong' to 'very strong' influence: positive environmental attitudes, environmental sensitivity, receptiveness to EBE teaching practices, teaching context, and environmental literacy knowledge and skills.

All but one of these factors can be considered motivations to teachers' implementing environmental education. Teaching context, the only non-motivation factor, refers to factors such as the grade level and subjects taught, school setting (urban suburban, or rural), and school

type (public, private, charter, etc.) (Ernst, 2007). Positive environmental attitudes was reported at the most influential motivator by both groups of teachers, and was the only one of the listed motivations that did not differ significantly between the two groups of teachers (Ernst, 2009). Teachers using the more intensive EBE approach to environmental education responded that all of these motivations had greater influence on their implementation decisions than did teachers using environmental education as a stand-alone component of their curriculum. This can be interpreted to imply that the more teachers' motivations influence their environmental education practices, the more likely they are to adopt a more intensive approach to teaching environmental education. Interestingly, several of the motivational factors described above as having a strong influence on teachers' decisions to implement environmental education (positive environmental attitudes, environmental sensitivity, and environmental literacy knowledge and skills) deal with factors pertaining to environmental literacy.

Hypotheses

Based on the literature cited herein, the following set of hypotheses was developed:

Hypothesis 1: Preservice teachers who experience the Vessel Strikes lesson (conservation-action approach) will exhibit greater environmental literacy pertaining to North Atlantic right whales than those who experience the Baleen & Blubber lesson (general-knowledge approach).

Hypothesis 2: Preservice teachers will perceive the Vessel Strikes lesson (conservation-action approach) as more effective at promoting environmental literacy than the Baleen & Blubber lesson (general-knowledge approach).

Hypothesis 3: Preservice teachers who experience the Vessel Strikes lesson (conservation-action approach) in comparison with those who experience the Baleen & Blubber lesson

(general-knowledge approach) will (a) exhibit more positive attitudes towards implementing the education materials in their future classes, (b) perceive more negative subjective norms, (c) show no significant difference in terms of self-efficacy, and (d) perceive more barriers in relation to implementing the education materials in their future classes.

Hypothesis 4: Preservice teachers will express higher levels of intention to implement the Vessel Strikes lesson (conservation-action approach) than the Baleen & Blubber lesson (general-knowledge approach).

Hypothesis 5: The contextual approach of environmental education materials' content makes a significant contribution to predicting preservice teachers' intentions to implement an environmental education lesson.

CHAPTER 3

METHODS

This study seeks to compare the effectiveness of the two North Atlantic right whale lessons and their distinct contextual approaches in promoting environmental literacy and to determine whether the degree to which the lessons promote environmental literacy makes a significant contribution to predicting preservice teachers' intentions to implement those materials. The research objectives of this study are as follows:

Objective 1: Describe the study sample (participants).

Objective 2: Describe whether the lessons of contrasting contextual approaches differentially affect preservice teachers' environmental literacy

Objective 3: Describe whether the lessons of contrasting contextual approaches differ in preservice teachers' perceptions of their effectiveness at promoting environmental literacy

Objective 4: Describe whether the lessons of contrasting contextual approaches differentially affect factors likely to predict preservice teachers' behavioral intentions

Objective 5: Describe whether the lessons of contrasting contextual approaches differ in preservice teachers' intentions to implement them in their future classes.

Objective 6: Describe whether the degree to which the lessons promote environmental literacy makes a significant contribution to predicting preservice teachers' intentions to implement an environmental education lesson.

Methods Overview

The two North Atlantic right whale lessons are compared both indirectly and directly in their capacity to increase learners' environmental literacy about North Atlantic right whales. This capacity of the lessons is indirectly measured by assessing the preservice teachers' comparative ratings of the lessons' effectiveness at promoting environmental literacy. Teachers rated the effectiveness of the materials based on the 'Skills Building' and 'Action Orientation' key characteristics of the NAAEE *Guidelines for Excellence* in developing and selecting environmental education materials.

Direct exhibitions of the participating preservice teachers' environmental literacy were measured in terms of three of the four strands of environmental literacy: knowledge, affect, and behavior. Knowledge was measured with a short quiz over topics taught in the lessons. Affect was measured in in three ways: (a) participants' attitudes towards North Atlantic right whale conservation, (b) their perceived ability to "make a difference" in North Atlantic right whale conservation through personal action (i.e. locus of control), and (c) their feelings of personal responsibility for taking action to promote North Atlantic right whale conservation. Behavior was measured using the proxy of participants' behavioral intentions to implement the two North Atlantic right whale lessons. It was not deemed appropriate to directly measure changes in environmental literacy in terms of participants' skills because of the nature of the activities and the limited contact time with participants during which skills could be taught.

In addition to comparing the effectiveness of the two lessons at promoting environmental literacy, the study also seeks to determine whether the degree to which the lessons promote environmental literacy helps to positively predict preservice teachers' intentions to use the North Atlantic right whale education materials. This was done by integrating the variables used to

compare the capacity of the lessons to increase learners' environmental literacy into the framework of the Theory of Planned Behavior and analyzing whether they made any additional significant contribution to predicting teachers' intentions to implement the lessons. These analyses were done with the purpose of describing the aspects environmental education educational materials' content that are the most effective at catering to the education and outreach needs of North Atlantic right whale conservation efforts.

Data was collected during an in-class professional development workshop with two classes of pre-service science education students, which defined the treatment groups. Participants experienced both the Baleen & Blubber (general-knowledge approach) and Vessel Strikes (conservation-action) lessons, the order of which depended on the treatment group. Three questionnaires were used to collect the data and are hereafter referred to as the pre-, mid-, and post-workshop questionnaires. The pre-workshop questionnaire was completed at the beginning of the workshop, and the mid-workshop questionnaire was completed after participants partook in their first lesson. Participants completed the post-workshop questionnaire after participating in their second lesson. Data analysis was completed to check the reliability of the questionnaire constructs and then to fulfill each of the objectives. Procedures varied by objective, but consisted of analysis of frequencies, crosstabulations, both independent- and paired-samples t-tests, and multiple regression analysis.

Materials Selection and Development

This study compares the effectiveness of two environmental education lessons, embodying the general-knowledge and conservation-action approaches, in promoting environmental literacy about the critically endangered North Atlantic right whale. The general-knowledge lesson was adapted from existing educational material about the North Atlantic right

whale, while the conservation-action activity was created specifically for this research project with input from the SEIT E&O Committee. The general-knowledge lesson focused on teaching about aspects of North Atlantic right whale natural history, and the conservation-action lesson teaches about the whale's most significant threat and the policy in place to mitigate that threat.

The general-knowledge lesson consisted of two short natural history-based activities adapted from a book of right whale lesson plans, *North Atlantic Whales in the New Millennium: Right Whale Lesson Plans* (Harr, 2009). The first activity of the lesson, "Incredible Insulators," teaches students about blubber. Its objective is for students to "learn the function of blubber and the effectiveness with which fat helps a body hold in its heat" (p. 58). The adaption of the lesson used in this research study begins with a brief interest approach to get students to start thinking about how North Atlantic right whales can stay warm enough in to survive while living in water that is much too cold for humans to swim in without protection for extended periods. The students then perform a small experiment in which they cover one hand in a layer of vegetable shortening, put both hands in an ice water bath, and measure how long it takes before the cold temperature becomes uncomfortable. After the activity, the students discuss the outcome of their experiment and are given a brief presentation about the structure and function of blubber and its significance to the historical threat from whaling. Teachers are told that this lesson can be used to tie in subjects such as thermodynamics, the properties of water and lipids, endothermy/exothermy, evolution, and the scientific method (particularly making and testing hypotheses).

The second activity, "Baleen Strains," teaches about baleen and North Atlantic right whale feeding ecology. Its objectives are for students to learn the structure and function of baleen and "how the largest animals on the planet, baleen whales, are adapted to eat [some of]

the smallest animals on the planet, plankton" (p. 52). The adaption of the lesson used in this research study begins with a brief interest approach to get students to start thinking about what and how much North Atlantic right whales eat, and what the equivalence of that might be in terms of a human diet. The interest approach is followed by a short presentation about the North Atlantic right whales' diet, the structure and function of baleen, and its feeding behavior. For the activity the students receive a cup of water, sprinkles, and a pocket comb. The students then perform a small experiment in which they add sprinkles to the water, sip the water, and then use their teeth or either side of the comb (with teeth different widths apart) to keep the sprinkles in their mouths while filtering out the water. The lesson ends with a discussion of the most effective experimental feeding method and how right whales and humans are adapted for different diets and feeding strategies. Teachers were told that this lesson can be used to tie in subjects such as food chains/webs, comparative anatomy, evolution, and the scientific method (particularly making and testing hypotheses).

The conservation-action lesson consisted of a single activity, "Slow Down… Whale Crossing". In this lesson, participants learn why vessel strikes are a threat to North Atlantic right whale survival and how two existing conservation measures, the Early Warning System and the Right Whale Ship Strike Reduction Rule, work to mitigate the impacts of this threat. The lesson begins with a brief interest approach in which students are asked reflect on their experiences with and feelings toward animals that have been hit by vehicles on the road. They are then shown a picture of a North Atlantic right whale that has been hit by a ship and discuss what killed the whale. This is followed by a presentation about how vessel strikes impact individuals and the population, why North Atlantic right whales are particularly vulnerable to vessel strikes due to certain natural history traits and their population dynamics, the Early Warning System, and the

Ship Strike Reduction Rule and justifications for its regulations. The activity that follows consists of three simulations in which groups of students representing vessels of different sizes make 'shipping runs' through a space representing a critical habitat area where 'right whale' students are dispersed. The three simulations represent scenarios in which 1) no conservation measures are in place, 2) the Early Warning System in place, and 3) the mandatory speed restrictions of the Ship Strike Reduction Rule are enforced. The lesson concludes with the analysis and discussion of the data gathered during the activity by the 'right whale' students on how many times they were hit by the vessels of different sizes and a discussion of the students' experiences during the simulations. Teachers are told that this activity can be used to tie in subjects such as the political rule-making process, political and/or community advocacy, population dynamics of endangered species, hydrodynamics, and the scientific method (particularly data analysis, interpretation, and graphic representation).

The conservation-action lesson was developed specifically for this research project and in partnership with the SEIT E&O Committee. The activity portion of the lesson was field tested twice; first with the UGA Ecology Club in May of 2010 and later in June of 2011 at the Georgia Vocational Agricultural Teachers Association conference. Feedback on possible improvements to the activity was gathered informally from field test participants. Changes were made to the activity in accordance the feedback received. The final conservation-action activity and two existing general-knowledge right whale activities were used in the lessons presented during the in-class workshops for pre-service teachers where data was collected.

Sample Description

Study participants consisted of 44 pre-service teachers from two science education courses at the University of Georgia. One class (hereafter referred to as the Blue Group)

consisted of 20 students, and the other class (hereafter referred to as the Red Group) consisted of 24 students. The classes were recruited by contacting the instructors and setting aside class periods during which experimentation could occur. The blue group's course met for fifty-five minutes, three times a week, and the red group's course met for three hours, once a week. Experimentation with the blue group started at the beginning of class on Monday, September 12, 2011 and continued on the 14th and 16th. Experimentation with the red group occurred within the block of a single three hour class on Monday, September 19, 2011.

The Blue Group consisted of undergraduate pre-service teachers completing the junior year of their Middle School Education (grades 5-8) licensure program. The Red Group consisted of a mixture of undergraduate and graduate pre-service teachers in the Secondary Education (grades 6-12) licensure program. According to the students' professors, the participants in both groups had not yet started the student teaching portion of their licensure program and had no previous formal experience teaching in formal education. Even though the licensure programs of the groups were different, it was decided that both could be justifiably included in the sample because the activities, which were designed for middle school target audiences and easily adaptable for high school audiences, would be relevant to the pre-service teachers in both licensure programs.

These two classes defined this study's two experimental groups. The Blue Group experienced the general-knowledge lesson before taking the mid-workshop evaluation and then experienced the conservation-action lesson. The Red Group experienced the activities in the reversed order. The assignment of the treatments to the groups was not random, but was made to best accommodate the time needs of the lessons/research project and the time constraints of the classes. Since the conservation-action lesson was longer than the general-knowledge activities,

the opposite assignment of the treatments would have resulted in the Blue Group having to end class in the middle of the conservation-action lesson. It was decided that this would result in greater measurement error than not randomly assigning the treatments.

Instrumentation

The instrument constructed for use in this study consisted of three questionnaires (the pre-, mid-, and post-workshop questionnaires), which were used to evaluate the relative effectiveness of the Vessel Strikes (conservation-action approach) and Baleen & Blubber (general-knowledge approach) lessons (see Appendix II). The variables measured in each of these questionnaires are displayed in Table 1.

Table 1: *Study Variables*

Questionnaire	Variable	Items	Related Objectives	Variable Type (IV or DV)
n/a	Treatment group	n/a	all	all: IV
Pre-workshop Questionnaire	Involvement in environmental education and learning about environmental topics	1–4	1 , 6	1: DV 6: IV
	Engagement in environmentally responsible behaviors in the past 6 mo.	5–9	1 , 6	1: DV 6: IV
	Prior knowledge of and engagement with North Atlantic right whale topics	10–13	1 , 6	1: DV 6: IV
	Initial interest in implementing workshop material	14	1 , 6	1: DV 6: IV
	Attitudes toward the mitigation of threats to North Atlantic right whale survival (Pre)	15–20	1 , 6	1: DV 6: IV
	Demographic variables	21–28	1 , 6	1: DV 6: IV
Mid-workshop Questionnaire	Knowledge gained about the North Atlantic right whales	1–6	2 , 6	2: DV 6: IV
	Attitudes toward North Atlantic right whale conservation	7–18	2 , 6	2: DV 6: IV
	Attitudes toward the mitigation of threats to North Atlantic right whale survival (Mid)	13–18	2	2: DV
	Locus of control	19–22	2 , 6	2: DV 6: IV

	Sense of personal responsibility	23–26	2 , 6	2: DV 6: IV
	Subjective norms related to implementing the lesson in future classes	27–30	4 , 6	4: DV 6: IV
	Attitudes toward implementing the lesson in future classes	31–36	4 , 6	4: DV 6: IV
	Confidence in implementing the lesson in future classes	37–39	4 , 6	4: DV 6: IV
	Influence of barriers in preventing implementation of lesson in future classes	40–55	4 , 6	4: DV 6: IV
Post-workshop Questionnaire	Effectiveness of lessons at increasing learner knowledge	1	3 , 6	3: DV 6: IV
	Effectiveness of lessons at promoting positive attitudes	2	3 , 6	3: DV 6: IV
	'Skills Building' rating of the lessons	3–12	3 , 6	3: DV 6: IV
	'Action Orientation' rating of the lessons	13–21	3 , 6	3: DV 6: IV
	Intention to implement the lessons	22–24	5 , 6	all: DV

The questionnaires were developed using both original questionnaire items and items adapted from instruments published in environmental education masters theses and doctoral dissertations. Items adapted from established instruments were used whenever possible because they were already field tested for reliability and validity. Thus using portions of those questionnaires helped to bolster this study's internal and external validity. To the see how items from other questionnaires were adapted into the instrument used in this study, see Appendix III. Original items were developed whenever established items could not be found to measure needed constructs. Internal consistency (reliability) and validity within all questionnaire constructs, both original and adapted, was confirmed following data collection.

The following sections provide descriptions of the types of data that were collected to fulfill the first five research objectives. All three questionnaires focused on collecting data to fulfill the study's research objectives. The pre-workshop questionnaire was used to collect the data needed to fulfill this study's first research objective. The data needed to fulfill objectives 2

and 3 was collected in the mid-workshop questionnaire. Since the mid-workshop questionnaire was administered after subjects participated in their first lesson and before they participated in their second lesson, the lesson to which the data from this instrument pertains differs by group. Data collected from the Blue Group pertains to the Baleen and Blubber lesson, and data collected from the Red Group pertains to the Vessel Strikes lesson. The post-workshop questionnaire was used to collect data to fulfill objectives 4 and 5. All three questionnaires in combination collected the data needed to fulfill objective 6.

Objective 1: Describe the study sample (participants).

The pre-workshop questionnaire collected data that allowed the researcher to describe the study's sample in terms of participants' individual characteristics that could act as confounding variables on the dependent variable of intention to implement the North Atlantic right whale lessons. These characteristics included participants':

- involvement in environmental education and learning about environmental topics (Pre, Section 1),
- engagement in environmentally responsible behaviors in the past six months (Pre, Section 2),
- prior knowledge of and engagement with North Atlantic right whale topics (Pre, Section 3, items 10-13),
- initial interest in implementing material from the workshop with their future classes (Pre, Section 3, item 14),

- attitudes toward the mitigation of threats to North Atlantic right whale survival (Pre, Section 4), and
- demographic variables (age, gender, level of degree, graduation date, teaching licensure program, subject specialization, and likelihood of pursuing careers in formal and/or non-formal education; Pre, Section 5).

Many of the items in the pre-workshop questionnaire were adapted from other sources. In Section 1, items 1 and 3, measuring the number of college level environmental science or conservation course taken and attendance at environmental education professional development opportunities, were adapted from a study on preservice economics teachers intentions to teach economics (Kang, 2007). Item 2, measuring participants certifications in environmental education programs, was adapted from a study on how teachers react to a required environmental education program (Cheng, 2008). Item 4, an original item, was added to measure participants' levels of experience in teaching environmental education. A 4-point unidirectional Likert-type response scale (ranging from "Not Experienced" to "Very Experienced") was used for this item instead of a 7-point Likert scale because, though details on participant's positive responses (ex. level of experience) were thought to be useful, it was not thought that details of negative responses (i.e. degrees of inexperience) were pertinent for the purposes of this study.

Section 2 consisted of 5 original items measuring participants' engagement in environmentally responsible behaviors in the past six months. Each of the items described a common avenue for engaging in environmentally responsible behavior. A dichotomous yes/no scale was used to measure these items because further detail was not deemed pertinent for the purpose of this study.

In section 3, the idea for using picture identification of a species to measure knowledge (item 10) was taken from a study investigating public perception of mammals and mammal conservation issues (Wong, 2009). The other measures of prior knowledge of and engagement with North Atlantic right whale topics (items 11-13) were adapted from two studies, one on impacts of environmental education programs on participants' environmental behaviors (Sheehan, 2008) and the other on teachers' intention to implement material learned in a professional development workshop (Danter, 2005). The measure of initial interest in implementing the workshop material was also adapted from the aforementioned study on teachers' implementation intentions. Variations of a 4-point Likert scale were used for items 11, 12, and 14 for the same reason as it was used for item 4. Item 14 also included "Don't Know" as a response because it was thought that some participants may have felt that they could not give a more accurate answer considering their limited level of knowledge about the workshop material.

Participant's attitudes toward the mitigation of threats to North Atlantic right whale survival was measured in two constructs, attitudes towards regulating the shipping industry to mitigate the threat of vessel strikes (Section 4, items 15-17) and attitudes towards measures used to mitigate the threat of entanglement posed by the fishing industry Section 4, items 18-20). Items 15, 17, 18, and 19 were adapted from the instrument used in the nationwide study *American Perceptions of Marine Mammals and their Management* (Kellert, 1999), commissioned by the Humane Society of the Unites States. An original item, constructed using similar verbiage to adapted questions, was added to each of these attitude constructs to give each of the constructs three items. These and all subsequent attitude scales use a 7-point Likert 'Agreement' response scale ranging from "Strongly Disagree" to "Strongly Agree". This scale

was chosen for the level of detail it provided, with three degrees of both positive and negative responses on either side of a neutral response.

The majority of the demographics items, as well as the items measuring the likelihood of pursuing a career in formal and non-formal education, are original to this study. The only demographic item adapted from an existing questionnaire was the one reporting participants' licensure program. It was adapted from two studies on preservice teacher attitudes (Alexander, 2011; Jones, 2009). All of the demographic items were phrased in first-person because this gives the items a more conversational tone, which is considered a characteristic of well-developed questionnaires (Dillman, 2000). In general, first-person was used whenever possible in the phrasing of both original and adapted items unless doing so made the phrasing of the items seem awkward.

Objective 2: Describe whether the lessons of contrasting contextual frameworks differentially affect preservice teachers' environmental literacy

Variables related to environmental literacy were measured in the mid-workshop questionnaire. These variables included participants':

- knowledge gained about the North Atlantic right whales (Mid, Section 1),
- attitudes toward North Atlantic right whale conservation (Mid, Section 2),
- locus of control (Mid, Section 3, items 19-22), and
- feelings of personal responsibility to promote North Atlantic right whale conservation (Mid, Section 3, items 23-26).

The knowledge participants gained about North Atlantic right whales was measured by four multiple choice and two short-answer quiz questions. These were all original questions, though format of item 1 (identical to pre-workshop questionnaire item 10) was inspired by an

item from an existing instrument (Wong, 2009). Participant's attitudes toward North Atlantic right whale conservation were measured using three sub-constructs:

- attitudes related to conserving the North Atlantic right whale and it being critically endangered species (Section 2, items 7-10),
- attitudes towards regulating the shipping industry to mitigate the threat of vessel strikes (Section 2, items 11-15, including two questions not in the matching pre-workshop questionnaire construct), and
- attitudes towards measures used to mitigate the threat of entanglement posed by the fishing industry (Section 2, items 16-18).

The latter two of these sub-constructs matched items in the pre-workshop questionnaire, which allowed for the measurement of participants' changes in attitudes after experiencing the initial lesson. Locus of control and feelings of personal responsibility were each measured with a single construct. All of the items measuring environmental literacy variables, with the exception of the knowledge quiz items, were phrased in first person and used the 7-point Likert 'Agreement' response scale. Except for items 13, 14, 16, and 17 (identical to pre-workshop questionnaire items 15, 17, 18, and 19), all of the items used to measure participants' attitudes toward North Atlantic right whale conservation, locus of control, and feelings of personal responsibility to promote North Atlantic right whale conservation were original to this study.

Objective 3: Describe whether the lessons of contrasting contextual frameworks differ in preservice teachers' perceptions of their effectiveness at promoting environmental literacy

Section 1 of the post-workshop questionnaire comparatively measured participants' opinions of the effectiveness of the lessons in promoting environmental literacy. These items

were all original items, all but two of which were rooted in the NAAEE *Guidelines for Excellence in Materials* (NAAEE, 1996). The effectiveness of the lessons in promoting environmental literacy was measured in two constructs. The items for these constructs were adapted from relevant descriptive elements of two of the *Guideline*'s Key Characteristics, Emphasis on Skills Building and Action Orientation. The Emphasis on Skills Building construct (Post, Section 1, items 3-12) measured whether the lessons functioned effectively to "build lifelong skills that enable learners to address environmental issues" (NAAEE, 1996, p. 9). The Action Orientation construct (Post, Section 1, items 13-21) measured whether the lessons functioned effectively to "promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental problems and issues as a basis for environmental problem solving and action" (NAAEE, 1996, p. 12). Items 1 and 2 measured how well participants thought the lessons increased learners' knowledge about an environmental topic or issue and promoted learners' positive attitudes towards an environmental topic or issue.

Objective 4: Describe whether the lessons of contrasting contextual frameworks differentially affect factors likely to predict preservice teachers' behavioral intentions

Variables from the Theory of Planned Behavior (Ajzen, 1985) were measured in the mid-workshop questionnaire. These variables included:

- the subjective norms perceived by participants in regard to implementing the first lesson they experienced in their future classes (Mid, Section 4),
- participants' attitudes toward implementing the lesson in future classes (Mid, Section 5.1),

- participants' level of perceived behavioral control in implementing the lesson in future classes (Mid, Sections 5.2), and
- barriers participants believed would prevent them from implementing the lesson (Mid, Section 6).

Items measuring subjective norms (with the exception of item 30) and attitudes towards implementing workshop material all were adapted from existing instruments using the Theory of Planned behavior as their theoretical framework (Danter, 2005; Sheehan, 2008). Perceived behavioral control was measured using all original items. Since the pre-service teachers participating in this study are not already in a school environment about which typical perceived behavior control are asked, this construct measured participants' confidence in implementing various aspects of the lesson in different situations. A 7-point Likert-type 'confidence' scale ranging from "Very Unconfident" to "Very Confident" was used to measure this construct. Participants' perceptions of the level of influence potential barriers would have in preventing them from implementing their lesson were measured using a 7-point Likert-type 'level of influence' scale ranging from "No Influence" to "Extreme Influence." Most of the potential barriers measured in this study are described in a literature review of barriers to implementing environmental education (Shumacher & Fuhrman). A few other more specific barriers added to reflect specific aspects of the lessons presented in this study.

Objective 5: Describe whether preservice teachers report a higher level of intention to implement either of the different lesson types.

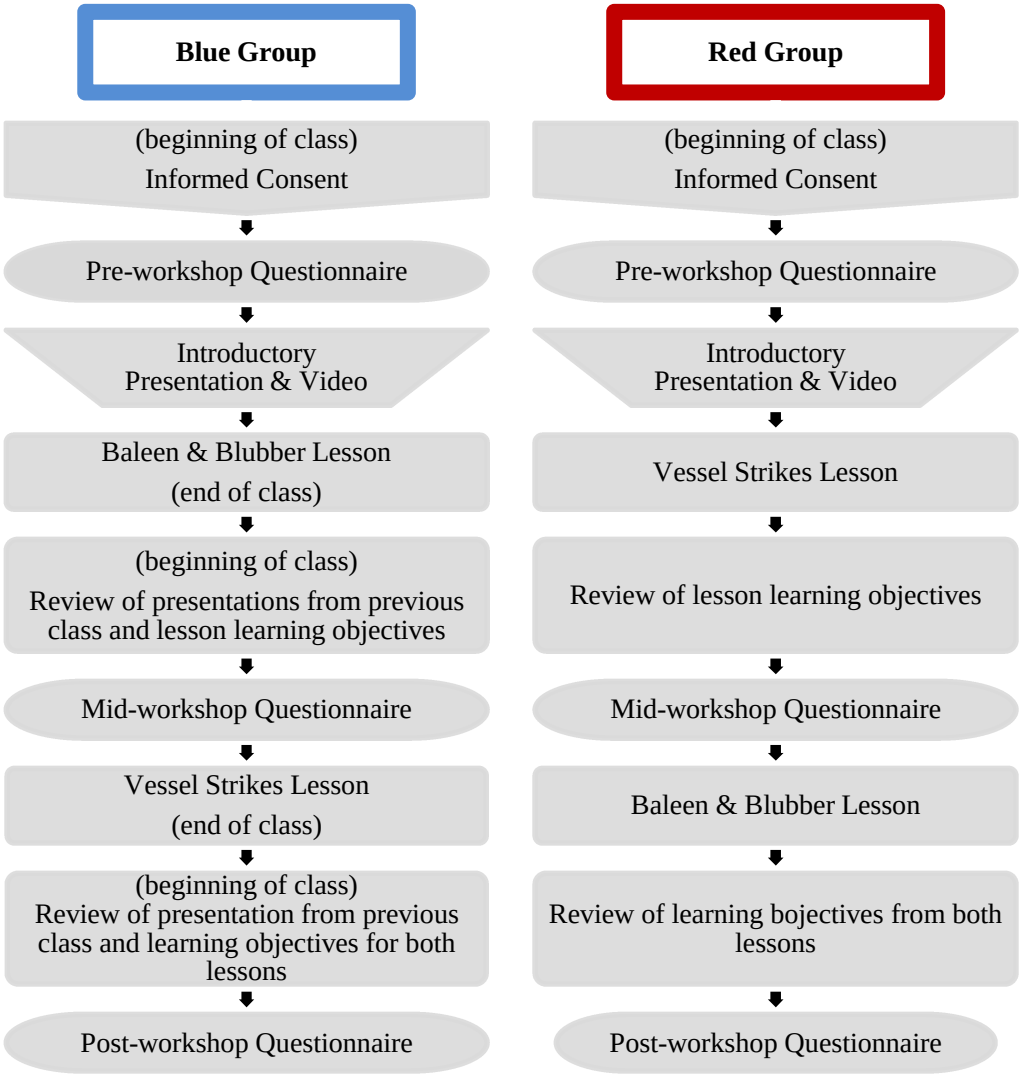
Section 2 of the post-workshop questionnaire comparatively measured participants' intentions to implement each of the lessons. The intention questions were adapted from a doctoral dissertation (Danter, 2005). Participants were asked about their intentions to implement

each the lessons at three different times: during their student teaching, during their first year of teaching, and after their first year of teaching. This format was used because literature on the Theory of Planned Behavior states that the more specifically people's intentions to perform a specific behavior are measured in terms of time and context, the more accurate their responses are in predicting their actual behavior (Fishbein & Manfredo, 1992). Responses consisted of a 7-point Likert-type scale ranging from "Very Unlikely" to "Very Likely" with an eighth "Don't Know" option.

Data Collection

This study was conducted in the context of an in-class professional development workshop on teaching about North Atlantic right whales (see Figure 2 for a schematic of the workshop schedule for both treatment groups). At the beginning of the workshop, participants were given the informed consent materials to review and sign if they agreed to participate in the research study portion of the workshop (see Appendix I for IRB documentation and approval). Consenting participants filled out the pre-workshop questionnaire. Participants were allowed 10 minutes to complete the pre-workshop questionnaire. After completing the pre-workshop questionnaire, the researcher gave a brief presentation introducing North Atlantic right whales, their conservation, and the research project. Participants then watched a 20-minute documentary on North Atlantic right whales, *From Whaling to Watching*. The video's purpose was to ensure that every workshop participant received the same basic level of knowledge about North Atlantic right whale natural history and conservation before participating in the workshop lesson. After completing the video, the researchers gave the participants a short presentation about the Ship Strike Reduction Rule so that all participants knew of the protective legislation that has been enacted since the video was produced nearly a decade ago.

Figure 2: *Treatment Groups' Workshop Schedules*



Following the introductory presentations and video, each class participated in their first lesson (the Blue Group in the general-knowledge lesson and the red group in the conservation-action lesson). For the Blue Group, the first lesson concluded the first day of testing (Monday). Testing was resumed at the beginning of the next class (Wednesday) with a brief review of theworkshop's and first lesson's introductory presentations to refresh participants' memories. The Red Group, whose testing occurred during a single 3 hour block, did not receive the review

presentation. For both groups, however, the researcher reviewed the first lesson's learning objectives and allowed the participants to briefly discuss their experience and whether the objectives were met before administering the mid-workshop evaluation. Participants then completed the mid-workshop questionnaire, which they were allowed 15 minutes to complete.

Each class then participated in the second lesson. For the blue group, the second lesson concluded the second day on testing. As before, testing resumed at the beginning of the next class (Friday) with a brief review of the second lesson's introductory presentation. Both groups reviewed and briefly discussed the second lesson's learning objectives and then also briefly discussed the learning objectives of their first lesson. Participants then completed the post-workshop evaluation, which they were allowed 15 minutes to complete.

The variables in the post-workshop questionnaire were strategically measured after all subjects had participated in both lessons, making it possible for participants to answer the same questions in regard to both the Vessel Strikes lesson and the Baleen & Blubber lesson. This allowed for participants to make direct comparisons between lessons for themselves. It was determined measuring the lessons' effectiveness and the participants' intentions to implement the lessons by direct comparison would be more valid than relying on the comparison of overall group means for the same variables measured after subjects participated in only a single lesson. It was for this reason that both groups experienced both lessons and data was collected in three stages (pre-, mid-, and post-workshop questionnaires) instead of the groups experiencing only one of the two lessons and data being collected in a simpler pre/post format.

Data Analysis and Interpretation

Analysis of the data collected by the questionnaires was conducted primarily using SPSS. First, the reliability of each questionnaire construct was checked using Cronbach's α. For the

purpose of this study, a construct consisted of no fewer than three items. No items were removed from scales where Cronbach's α was greater than .8 unless removing an item increased α by at least .01. For the matching pre- and mid-workshop questionnaire scales, items were only removed if removing the items increased Cronbach's α by at least .01 in both the pre- and mid-workshop questionnaire scales. For scales in the post-workshop evaluation, items were only removed if removing the items increased Cronbach's α by at least .01 for both the Vessel Strikes lesson and Baleen and Blubber lesson scales. In preparation for constructing summated scale scores, missing values within for scale variables were replaced with the participants' group's means for that variable. This was done instead of excluding the participants' data for the scales with the missing values in order to preserve as many cases as possible for analysis. Summated scale scores of every construct were then calculated for each subject. These summated scale scores formed the basis of all further statistical analyses for the variables included in the scores.

Scales were also constructed to create summary measures for participants' involvement with environmental education-related topics (Pre-workshop questionnaire items 1 – 4), previous engagement in environmentally responsible behavior (Pre-workshop questionnaire items 5 – 9), knowledge and engagement with NARW topics (Pre-workshop questionnaire items 11 – 14; item 10 was excluded from this scale because only 1 participant who answered correctly indicated that she was not guessing), and knowledge quiz scores (Mid-workshop questionnaire items 1 – 6). In order to construct the first three scales from the pre-workshop questionnaire, the variables were recoded so that any response indicating some level of involvement with environmental education-related topics, knowledge or engagement with NARW topics, or environmentally responsible behavior equaled 1. Any response indicating a lack of the aforementioned was recoded as a 0. To construct the knowledge quiz score scale from the mid-workshop

questionnaire, all participants' responses to the quiz questions were graded as correct or incorrect. Incorrect responses were coded as 0, correct multiple-choice and fully correct short-answer responses were coded as 1, and partially correct short-answer responses were coded as .5. These summary scales formed the basis of all further statistical analyses for the variables included in the scores.

Objective 1: Describe the study sample (participants).

In order to fulfill objective 1, analyses were done to describe the sample as a whole, describe the groups individually, and to describe any possibly confounding differences between the test groups. Frequencies were run on the categorical demographic variables (gender, level of degree, graduation date, subject specialization) as well as likelihood of pursuing a career in formal education, likelihood of pursuing a career in non-formal education, initial interest in implementing material from the workshop with their future classes, and initial North Atlantic right whale identification. Data collected on participants' teaching licensure program was not analyzed because it was known from the participants' professors that all of the preservice teachers in the Blue Group were enrolled in the Middle School Education licensure program and all of those in the Red Group were enrolled in the Secondary Education licensure program. Frequencies of participants' subject specializations were conducted, but the variable was excluded from any addition analyses because it contained too many categories that contained too few participants and could not be combined. Means and standard deviations were calculated for birth year, likelihood of pursuing a career in formal education, likelihood of pursuing a career in non-formal education, involvement in environmental education and learning about environmental topics, engagement in environmentally responsible behaviors in the past six months, prior knowledge of and engagement with North Atlantic right whale topics, initial

interest in implementing material from the workshop with their future classes, and attitudes toward the mitigation of threats to North Atlantic right whale survival. The aforementioned analyses were conducted both for the entire combined sample and individually for both groups.

Possibly confounding differences between the test groups were analyzed using either crosstabulations or independent samples t-tests. For all tests of significance, alpha was set a priori at 0.05. Crosstabulations were used to compare differences between the Blue and Red groups in terms of categorical demographic variables: gender, level of degree, and graduation date. The X^2-test of significance was used compare differences between categorical variables and when the distribution of responses was non-normal (non-parametric). Effect size was calculated using Cramer's V. Independent samples t-test were used to compare the groups in terms of continuous variables: birth year, likelihood of pursuing a career in formal education, likelihood of pursuing a career in non-formal education, initial interest in implementing material from the workshop with their future classes, involvement in environmental education and learning about environmental topics, engagement in environmentally responsible behaviors in the past six months, prior knowledge of and engagement with North Atlantic right whale topics, and attitudes toward the mitigation of threats to North Atlantic right whale survival. Levene's Test for equal variances was performed as part of the analyses to determine the appropriate degrees of freedom and associated t- and p-values. In this study, results are considered statistically significant if $p \leq .05$. However, due to the exploratory nature of this study, results significant at the level of $p \leq .1$ are also noted. Effect size for these and all other t-tests conducted in this study were calculated using Cohen's *d*. Effect size threshold were defined as follows: small ($d = .2$), medium ($d = .5$), and large ($d = .8$).

Objective 2: Describe whether the lessons of contrasting contextual frameworks differentially affect preservice teachers' environmental literacy

To fulfill objective 2, the groups were compared in terms of environmental literacy variables. First, paired samples t-tests were used to compare participants' attitudes toward the mitigation of threats to North Atlantic right whale survival between the mid- and pre-workshop questionnaires for both groups and the combined sample. Next, independent samples t-tests were used to compare the groups' knowledge scores, change in attitudes toward the mitigation of threats to North Atlantic right whale survival between the mid- and pre-workshop questionnaires, attitudes towards North Atlantic right whale conservation, locus of control, and feelings of personal responsibility. Effect sizes were used to determine the practical significance of results.

Objective 3: Describe whether the lessons of contrasting contextual frameworks differ in preservice teachers' perceptions of their effectiveness at promoting environmental literacy

In order to fulfill objective 3, analyses were done to describe how participants comparatively rated the effectiveness of the Vessel Strikes and Baleen & Blubber lessons and describe the differences between groups in terms of how they rated the effectiveness of the two lessons. To determine how participants comparatively rated the lessons, paired samples t-tests were run comparing the participants' ratings of the lessons' effectiveness at increasing learner knowledge about an environmental topic or issue, promoting positive attitudes toward an environmental topic or issue, and at promoting the NAAEE Key Concepts of Skills Building and Action Orientation. This was done to determine if, overall, participants rated one or the other of the lessons as more effective in promoting learners' environmental literacy. Analyses were done both for the individual groups and the combined sample. To determine whether the groups

differed in their ratings of the variables, independent samples t-test were run to compare the groups' effectiveness ratings for increasing learner knowledge, promoting positive attitudes, Skills Building, and Action Orientation for both the Vessel Strikes and Baleen & Blubber lessons. Effect sizes were used to determine the practical significance of results.

Objective 4: Describe whether the lessons of contrasting contextual frameworks differentially affect factors likely to predict preservice teachers' behavioral intentions

To fulfill objective 4, the groups were compared in terms of variable in the Theory of Planned Behavior. Independent samples t-tests were used to compare the groups in terms of attitudes towards implementing the material they experienced before the mid-workshop questionnaire (referred to as 'implementation attitudes' from here forward), subjective norms, perceived behavioral control, and barriers to implementing the experienced material. Though intention is part of the Theory of Planned Behavior, the analysis of participants' intentions to implement material from the workshop is described later under objective 5. Effect sizes were used to determine the practical significance of results.

Objective 5: Describe whether preservice teachers report a higher level of intention to implement either of the different lesson types.

In order to fulfill objective 5, analyses were done to comparatively describe participants' intentions to implement the Vessel Strikes and Baleen & Blubber lessons and to describe differences in the groups' intentions to implement the lessons. Paired samples t-tests were used to conduct a comparative analysis of participants' intentions to implement the two lessons. This was done to determine if, overall, participants expressed greater intentions to use one or the other of the two lessons. Differences in the intentions of the two groups were analyzed using

independent samples t-tests. Effect sizes were calculated to determine the practical significance of the results.

Objective 6: Describe whether the degree to which the lessons promote environmental literacy makes a significant contribution to predicting preservice teachers' intentions to implement an environmental education lesson.

Objective 6 was fulfilled through linear regression analysis. The analyses were done with the purpose of establishing a single equation that could be used to predict intention to implement a North Atlantic right whale lesson. Thus, before attempting to create an overall model for the study using multiple-regression, the variables measured in the post workshop questionnaire were consolidated to contain only the data pertinent to the initial lesson participants experienced. For example, instead of separately analyzing participants' intention scores for the Baleen & Blubber and Vessel Strikes lessons, a single intention variable was constructed which contained the Blue Group members' intentions to implement the Baleen & Blubber lesson and the Red Group members' intentions to implement the Vessel Strikes lesson. Next, each of the independent variables was regressed against the dependent variable of intention to determine which variables were significantly associated with the dependent variable of intention. Assumptions of linear regression were checked, and analyses showed that all assumptions were met for each of the variables. All variables that did not regress significantly were interpreted as not being predictive of intention and were not included in the final multiple-regression analysis.

Next, correlations were run on the significantly regressing variables to check for problems of colinearity. Variables were discarded in stages based on the number of other independent variables with which they correlated. Variables that correlated with the highest number of other independent variables were the first ones to be removed. Variables were

removed until no variables correlated any more than one other variable. These variables were the ones selected for use in the multiple regression analysis.

For the final multiple-regression analysis, a single predictive equation was calculated. The variables selected in the previous step (which happened to all be continuous) were regressed against participants' intentions to implement their initial North Atlantic right whale lesson. This was done using backwards regression. The final significant equation was selected when all βs of the independent variables were significant.

CHAPTER 4

RESULTS

The research presented in this study was guided by six research objectives. Findings relevant to each of these objectives are described below. The results of the reliability analyses are discussed prior to the objective-related results.

Reliability Analysis

Before calculating summated scale scores of the variables measured in the questionnaires, the reliability of the variable constructs were calculated using Cronbach's α. Table 2 shows the reliability of the variable constructs, as well as descriptions of the questionnaire in which each construct was measured, the number and list of specific items included in each final construct, the mean summed score and standard deviation of each of the final constructs, and the range and midpoint of possible scores of each construct. The reliability threshold for Cronbach's α chosen for this study was .7 (Davis, 1971). All but one of the variable constructs produced a Cronbach's α above the reliability threshold of .7. The variable 'Subjective Norms' produced a Cronbach's α of .684. It was deemed that the variable was reliable enough to include in further analyses due to the fact that the reliability was very close to .7, the construct contained only three items, and the sample size of this study was relatively small (n = 44).

Table 2: *Reliability of Variable Constructs*

Variable Name	# of Items	Test	Items	α	Mean Summed Score (S.D.)	Min - Max (Midpoint) Scale Scores
Pretest Threat Mitigation Attitudes	5	Pre	15,16,18,19,20	.880	23.85 (5.410)	5 - 35 (20)
Midtest Threat Mitigation Attitudes	5	Mid	13,15,16,17,18	.901	24.68 (4.879)	5 - 35 (20)

Conservation Attitudes	11	Mid	7,8,9RC,10RC,11, 12,13,15,16,17,18	.905	56.86 (9.184)	11 - 77 (44)
Locus of Control	4	Mid	19RC,20RC,21,22	.867	20.14 (4.095)	4 - 28 (16)
Personal Responsibility	4	Mid	23RC,24,25,26	.895	18.37 (4.265)	4 - 28 (16)
Subjective Norms	3	Mid	27,28,29	.684	10.91 (2.860)	3 - 21 (12)
Implementation Attitudes	5	Mid	31,33,34,35,36	.875	27.26 (4.240)	5 - 35 (20)
Confidence/PBC	3	Mid	37,38,39	.851	14.61 (3.519)	3 - 21 (12)
Barriers	15	Mid	40-54	.840	60.11(13.415)	15-105 (60)
VS Skills Building	10	Post	3-12	.851	55.60 (7.169)	10 - 70 (40)
BB Skills Building	10	Post	3-12	.884	48.66 (8.098)	10 - 70 (40)
VS Action Orientation	9	Post	13-21	.953	49.34 (9.510)	9 - 63 (36)
BB Action Orientation	9	Post	13-21	.928	39.81 (8.543)	9 - 63 (36)
VS Intention	3	Post	22,23,24	.935	14.69 (4.775)	3 - 21 (12)
BB Intention	3	Post	22,23,24	.919	12.40 (5.047)	3 - 21 (12)

Several items were excluded from the variable constructs as a result of the reliability analyses. Pre-workshop questionnaire item 17/mid-workshop questionnaire item 14 ("Regulating the speed of commercial shipping to protect NARWs is an example of costly government interference… Strongly Disagree ↔ Strongly Agree") was removed from the pre- and mid-workshop questionnaire 'North Atlantic right whale Threat Mitigation Attitudes' constructs, as well as from the mid-workshop "North Atlantic right whale Conservation Attitudes' construct. Mid-workshop questionnaire item 30 ("I would be willing to teach the material presented in today's workshop even if it was not encouraged by my future school's culture… Strongly Disagree ↔ Strongly Agree") was removed from the 'Subjective Norms' construct. Mid-workshop questionnaire item 32 ("I believe implementing the material from today's workshop in my future classes would be… Very Difficult ↔ Very Easy) was removed from the 'Implementation Attitudes' construct. Results of the descriptive and comparative analyses conducted for these items are displayed in Tables 2 and 3, respectively. The only one of these items that differed significantly between the groups was participants' rating of the ease/difficulty of implementing their initial lesson ($p < .001$, Cohen's $d = 1.367$). The Red

Group rated their initial lesson, the Vessel Strikes lesson, as more difficult to implement ($\bar{y}$ = 3.65, *s* = 1.272) than the Blue Group rated the Baleen & Blubber lesson ($\bar{y}$ = 5.30, *s* = 1.174).

Table 3: *Descriptive Statistics for Items Excluded from Summated Scales*

Variable	Min–Max	Blue Group Mean (S.D.)	Red Group Mean (S.D.)	Total Sample Mean (S.D.)
(Pre17RC) 'Mitigation = Costly Government Interference'	1 – 7	4.10 (1.294)	4.21 (1.532)	4.16 (1.413)
(Mid14RC) 'Mitigation = Costly Government Interference'	1 – 7	3.63 (.930)	3.67 (1.404)	3.65 (1.199)
(Mid30RC) 'Teach even if against school culture"	1 – 7	3.23 (1.473)	3.13 (1.154)	3.17 (1.294)
(Mid32)'Difficult ↔ Easy'	1 – 7	5.30 (1.174)	3.65 (1.272)	4.40 (1.471)

Table 4: *Independent-Samples T-tests Comparing Items Excluded from Summated Scales Between Treatment Groups*

Variable	Blue Group Mean (S.D.)	n	Red Group Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
(Pre17RC) 'Mitigation = Costly Government Interference'	4.10 (1.294)	20	4.21 (1.532)	24	42	-.250	.830	-.077
(Mid14RC) 'Mitigation = Costly Government Interference'	3.63 (.930)	20	3.67 (1.404)	24	42	-.096	.924	-.030
(Mid30RC) 'Teach even if against school culture"	3.23 (1.473)	20	3.13 (1.154)	24	42	.253	.802	.078
(Mid32)'Difficult ↔ Easy'	5.30 (1.174)	20	3.65 (1.272)	24	42	4.429	.000**	1.367

Objective 1: Describe the study sample (participants)

The methods used to analyze the descriptive variables measured in the pre-workshop questionnaire differed based on whether the variables were categorical or continuous. For categorical variables, frequencies (Table 5) and crosstabulations (Table 6) were used to describe the sample and to determine if any possibly confounding differences existed between the two treatment groups. For continuous variables, means and standard deviations (Table 7) were

calculated for descriptive purposes, and independent samples t-tests (Table 8) were run to test for differences between the treatment groups.

Demographic characteristics of participants.

The study sample consisted of two classes of pre-service science teachers attending the University of Georgia College of Education, for a total of 44 participants. One class (the Blue Group) was enrolled in the Middle School Education licensure program and the other (the Red Group) was enrolled in the Secondary Education licensure program. The two most common subject specializations of the Blue Group were science and either math or social studies. Biology was the most common subject specialization of participants in the Red Group. The groups did not differ significantly in age, measured by birth year ($\bar{y}$ = 1987.45, *s* = 4.459), or gender. The gender ratio of female to male participants was 3 to 1. The groups also did not significantly differ in their expressed likelihoods to pursue careers in formal or nonformal education. Participants of both groups expressed a high likelihood of pursuing careers in formal education ($\bar{y}$ = 3.91, *s* = .362) and a relatively low likelihood of pursuing careers in nonformal education ($\bar{y}$ = 1.79, *s* = .820), though the responses to the latter were more varied. The groups did, however, differ significantly in terms of level of degree ($p < .001$, Cramer's V = .624) and anticipated graduation date ($p < .001$, Cramer's V = .821). All of the participants in the Blue Group were undergraduate students who expected to graduate in the spring of 2013. Alternately, the Red Group contained a mixture of undergraduate and graduate students whose anticipated graduation dates ranged from the spring of 2012 to the spring of 2013.

Descriptives of participants' prior level of environmental literacy.

In the context of this study, it was deemed important to establish a baseline of participants' level of environmental literacy prior to the North Atlantic right whale education

workshop. Both groups showed moderate levels of engagement in responsible environmental behavior ($\bar{y}$ = 2.30, *s* = 1.025), which did not differ significantly between groups. The groups did, however, differ in their levels of involvement in environmental education and learning about environmental topics (p = .020, Cohen's *d* = -.804). The Red Group showed a greater level of involvement ($\bar{y}$ = 1.33, *s* = 1.007) than the Blue Group ($\bar{y}$ = .75, *s* = .550), but the scores were low for both groups.

As assumed from personal communication with North Atlantic right whale education specialists, participants' environmental literacy about the North Atlantic right whale was very low prior to the workshop. Only one participant out of the entire sample correctly identified a North Atlantic right whale from a picture without indicating that she was guessing. Likewise, participants' responses indicated very low levels of knowledge and engagement with North Atlantic right whales ($\bar{y}$ = .34, *s* = .805). However, the participants showed fairly strong positive attitudes toward the mitigation of threats to North Atlantic right whale survival ($\bar{y}$ = 23.85, *s* = 5.410). Initial attitudes towards threat mitigation did not differ significantly between groups. Both groups of participants expressed a moderate level of initial interest in implementing the North Atlantic right whale materials in their future classes ($\bar{y}$ = 2.72, *s* = .958), which did not differ significantly between the groups. However, a much larger proportion of participants indicated that they did not know how interested they were in implementing the workshop material at the time of the pre-workshop questionnaire in the Red Group (10 out of 24 participants) than responded likewise in the Blue Group (2 out of 20 participants).

Table 5: *Frequencies of Categorical Variables*

Variable & Responses		Blue Group	Red Group	Total Sample
Gender:	Male	3	8	11
	Female	17	16	33
Level of Degree:	Undergraduate	20	10	30
	Graduate	0	14	14
Graduation Date:	Spring 2012	0	6	6
	Summer 2012	0	6	6
	Fall 2012	0	5	5
	Spring 2013	20	4	24
	Missing	0	3	3
Subject Specialization:	Science & Math	9	0	9
	Science & Social Studies	9	0	9
	Science & English	2	0	2
	Science	0	1	1
	Biology	0	13	13
	Earth Science	0	2	2
	Chemistry	0	3	3
	Ecology/ Environment Science/ Marine Biology	0	1	1
	Anatomy/ Poultry Science	0	1	1
	Missing	0	3	3
Initial NARW Identification:	Correct	1	0	1
	(Don't Know) Correct	1	4	5
	Incorrect	18	20	38

Table 6: *Crosstabulations of Categorical Demographic Variables*

Variable		Test Group (TG)			χ^2	2-tailed sig. **p≤.05	Cramer's V
		Blue	Red	Total			
Gender							
Female	Count	17	16	33			
	% within TG	85.0%	66.7%	75.0%			
Male	Count	3	8	11			
	% within TG	15.0%	33.3%	25.0%			
Total	Count	20	24	44			
	% within TG	100.0%	100.0%	100.0%	1.956	.162	.211
Degree Level							
Undergrad.	Count	20	10	30			
	% within TG	100.0%	41.7%	68.2%			
Graduate	Count	0	14	14			
	% within TG	.0%	58.3%	31.8%			
Total	Count	20	24	44			
	% within TG	100.0%	100.0%	100.0%	17.111	.000**	.624

Graduation Date							
Spring 2012	Count	0	6	6			
	% within TG	.0%	28.6%	14.6%			
Summer 2012	Count	0	6	6			
	% within TG	.0%	28.6%	14.6%			
Fall 2012	Count	0	5	5			
	% within TG	.0%	23.8%	12.2%			
Spring 2013	Count	20	4	24			
	% within TG	100.0%	19.0%	58.5%			
Total	Count	20	21	41			
	% within TG	100.0%	100.0%	100.0%	27.659	.000**	.821

Table 7: *Descriptive Statistics for Continuous Descriptive Variables from the Pre-workshop Questionnaire*

Variable	Min–Max	Blue Group Mean (S.D.)	Red Group Mean (S.D.)	Total Sample Mean (S.D.)
Birth Year (19_ _)	n/a	88.85 (3.787)	86.29 (4.713)	87.45 (4.459)
Formal Education Career	1 – 4	4.00 (.000)	3.83 (.482)	3.91 (.362)
Non-formal Education Career	1 – 4	1.53 (.640)	2.00 (.907)	1.79 (.820)
EE Involvement & Envir. Learning	0 – 4	.75 (.550)	1.33 (1.007)	1.07 (.873)
Responsible Envir. Behavior	0 – 5	2.15 (1.089)	2.42 (.974)	2.30 (1.025)
Prior NARW Knowledge/Engagement	0 – 3	.15 (.489)	.50 (.978)	.34 (.805)
Pretest Threat Mitigation Attitudes	5 – 35	24.06 (4.574)	23.67 (6.112)	23.85 (5.410)
Initial Implementation Interest	1 – 4	3.00 (.767)	2.36 (1.082)	2.72 (.958)

Table 8: *Independent-Samples T-tests Comparing Continuous Descriptive Variables from the Pre-workshop Questionnaire Between Treatment Groups*

Variable	Blue Group Mean (S.D.)	n	Red Group Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Birth Year (Age)	1988.85 (3.787)	20	1986.29 (4.713)	24	42	1.116	.057*	.344
Formal Education Career	4.00 (0)	20	3.83 (.482)	24	23	1.696	.103	.707
Non-formal Education Career	1.53 (.640)	15	2.00 (.907)	18	31	-1.673	.104	-.601
EE Involvement & Environmental Learning	.75 (.550)	20	1.33 (1.007)	24	36.718	-2.435	.020**	-.804
Responsible Environmental Behavior	2.15 (1.089)	20	2.42 (.974)	24	42	-.857	.396	-.264

Prior NARW Knowledge/ Engagement	.15 (.589)	20	.50 (.978)	24	35.065	-1.537	.153	-.519
Pretest Threat Mitigation Attitudes	24.06 (4.574)	20	23.67 (6.112)	24	42	.239	.812	.074
Initial Implementation Interest	3.00 (.767)	18	2.36 (1.082)	14	30	1.968	.058*	.719

Objective 2: Describe whether the lessons of contrasting contextual frameworks differentially affect preservice teachers' environmental literacy

The results of this study do not indicate that the environmental education lessons had any significant direct or differential effects on the participants' North Atlantic right whale environmental literacy. Neither lesson served to significantly increase participants' attitudes towards the mitigation of threats to the North Atlantic right whale survival (see Table 9). Also, The lessons do not appear to have differentially affected participants' environmental literacy in terms of their knowledge about the species, the observed change in their attitudes towards threat mitigation, their overall attitudes towards the conservation of the species, or their locus of control or feelings of personal responsibility relating to actively contributing to North Atlantic right whale conservation (see Table 10).

Table 9: *Paired-Samples T-tests Comparing Participants' Attitudes Toward Threat Mitigation Between the Mid- and Pre-workshop Questionnaires*

Group	Pre-workshop Questionnaire Mean (S.D.)	Mid-workshop Questionnaire Mean (S.D.)	Mid-Pre Mean Difference	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Blue	24.06 (4.574)	25.10 (4.564)	1.037	20	19	1.286	.214	.228
Red	23.67 (6.112)	24.33 (5.198)	.667	24	23	1.290	.210	.116
Both	23.85 (5.410)	24.68 (4.879)	.825	44	43	1.825	.075*	.161

Table 10: *Independent-Samples T-tests Comparing Direct Measures of Participants' Environmental Literacy Between Treatment Groups*

Variable	Blue Group Mean (S.D.)	n	Red Group Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Knowledge Score	4.10 (1.095)	20	4.52 (1.137)	24	42	-1.243	.221	-.384
Change in Threat Mitigation Attitudes	1.04 (3.606)	20	.67 (2.531)	24	42	.399	.692	.123
Conservation Attitudes	58.45 (7.584)	20	55.54 (10.304)	24	42	1.047	.301	.323
Locus of Control	20.80 (3.722)	20	19.58 (4.393)	24	42	.981	.332	.303
Personal Responsibility	18.94 (3.992)	20	17.96 (4.438)	24	42	.768	.447	.237

Objective 3: Describe whether the lessons of contrasting contextual frameworks differ in preservice teachers' perceptions of their effectiveness at promoting environmental literacy

Although the data do not indicate that the lessons directly or differentially affected participants' environmentally literacy, participants' ratings of the lessons' effectiveness indicate that the lessons have positive, yet differential capacities to promote the environmental literacy of the materials' target audience (see Table 11). Both groups rated the Vessel Strikes lesson as significantly more effective than the Baleen & Blubber lesson at promoting all four strands of environmental literacy: knowledge, affect, skills, and behavior. Also, it had been expected that no significant between-group differences would exist for these variables because all participants had experienced both lessons by the time data was collected on these variables in the post-workshop questionnaire. However, analyses revealed significant differences between how the groups rated the Baleen & Blubber lesson in terms of 'Skills Building' ($p = .039$, Cohen's $d = .658$), 'Action Orientation' ($p = .002$, Cohen's $d = 1.006$), and promoting positive attitudes ($p < .001$, Cohen's $d = 1.392$; see Table 12). For these three strands, the Blue Group rated the Baleen

& Blubber lesson as significantly more effective than did the Red Group. Lastly, even though paired-samples t-tests show that participants consistently and significantly rated the Vessel Strikes lesson as more effective than the Baleen & Blubber lesson at promoting all four strands of environmental literacy, when the data from the groups' initial lessons were compared, no significant difference was apparent (see Table 13).

Table 11: *Paired-Samples T-tests Comparing Participants' Perceptions of the Lessons' Effectiveness at Promoting Environmental Literacy*

Group	Variable	Vessel Strikes lesson Mean (S.D.)	Baleen & Blubber lesson Mean (S.D.)	VS-BB Mean Diff.	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Blue	'Skills Building'	57.39 (5.001)	51.40 (7.044)	5.994	20	19	4.137	.001**	.981
	'Action Orientation'	51.73 (4.834)	43.79 (7.562)	7.937	20	19	4.285	.000**	1.251
	Increasing Knowledge	6.10 (1.071)	5.60 (1.142)	.500	20	19	3.249	.004**	.452
	Promoting Positive Attitudes	6.10 (.641)	5.60 (.883)	.500	20	19	2.517	.021**	.648
Red	'Skills Building'	54.13 (8.253)	46.38 (8.345)	7.750	24	23	5.474	.000**	.934
	'Action Orientation'	47.52 (11.756)	36.33 (7.557)	11.187	24	23	7.311	.000**	1.132
	Increasing Knowledge	6.21 (.558)	5.00 (1.285)	1.208	24	23	3.938	.001**	1.221
	Promoting Positive Attitudes	5.83 (1.007)	4.33 (.963)	1.500	24	23	5.313	.000**	1.522
Both	'Skills Building'	55.61 (7.085)	48.66 (8.098)	6.952	44	43	6.869	.000**	.913
	'Action Orientation'	49.43 (9.420)	39.72 (8.362)	9.709	44	43	8.111	.000**	1.090
	Increasing Knowledge	6.16 (.834)	5.27 (1.246)	.886	44	43	4.730	.000**	.839
	Promoting Positive Attitudes	5.95 (.861)	4.91 (1.117)	1.045	44	43	5.439	.000**	1.043

Table 12: *Independent-Samples T-tests Comparing Participants' Perceptions of the Lessons' Effectiveness at Promoting Environmental Literacy Between Treatment Groups*

Variable	Blue Group Mean (S.D.)	n	Red Group Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Vessel Strikes lesson 'Skills Building'	57.39 (5.001)	20	54.13 (8.253)	24	42	1.549	.129	.478
Baleen & Blubber lesson 'Skills Building'	51.40 (7.044)	20	46.38 (8.345)	24	42	2.132	.039**	.658
Vessel Strikes lesson 'Action Orientation'	51.73 (4.834)	20	47.52 (11.756)	24	31.701	1.599	.120	.568
Baleen & Blubber lesson 'Action Orientation'	43.79 (7.562)	20	36.33 (7.557)	24	42	3.259	.002**	1.006
Vessel Strikes lesson effectiveness at increasing knowledge	6.10 (1.071)	20	6.21 (.558)	24	42	-.425	.673	-.131
Baleen & Blubber lesson effectiveness at increasing knowledge	5.60 (1.142)	20	5.00 (1.285)	24	42	1.621	.113	.500
Vessel Strikes lesson effectiveness at promoting positive attitudes	6.10 (.641)	20	5.83 (1.007)	24	42	1.023	.312	.316
Baleen & Blubber lesson effectiveness at promoting positive attitudes	5.60 (.883)	20	4.33 (.963)	24	42	4.511	.000*	1.392

Table 13: *Independent-Samples T-tests Comparing Participants' Perceptions of the Effectiveness at Promoting Environmental Literacy of Their Treatment Group's Initial Lesson*

Variable	Red Group Vessel Strikes Lesson Mean (S.D.)	n	Blue Group Baleen & Blubber Lesson Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
'Skills Building'	54.13 (8.253)	24	51.40 (7.044)	20	42	1.164	.251	.359
'Action Orientation'	47.52 (11.756)	24	43.79 (7.562)	20	42	1.222	.228	.377
Increasing Knowledge	6.21 (.558)	24	5.60 (1.142)	20	27.224	2.155	.028**	.826
Promoting Positive Attitudes	5.83 (1.007)	24	5.60 (.883)	20	42	.819	.423	.253

Objective 4: Describe whether the lessons of contrasting contextual frameworks differentially affect factors likely to predict preservice teachers' behavioral intentions

The results of this study indicate that the North Atlantic right whale environmental education lessons did not have any significant differential effects on factors likely to predict the participants' behavioral intentions, as outlined by the Theory of Planned Behavior (Ajzen, 1985), see Table 14. However, as shown earlier in Table 4, the groups did differ in the level of ease/difficulty their participants anticipated in regard to implementing their initial lesson in future classes, an item that was removed from the 'Implementation Attitudes' construct. The Red Group rated the Vessel Strikes lesson as more difficult to implement than the Blue Group rated the Baleen & Blubber lesson.

Table 14: *Independent-Samples T-tests Comparing Theory of Planned Behavior Variables Between Treatment Groups*

Variable	Blue Group Mean (S.D.)	n	Red Group Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Implementation Attitudes	27.65 (4.368)	20	26.94 (4.197)	24	42	.548	.586	.169
Subjective Norms	11.00 (2.675)	20	10.83 (3.002)	24	42	.193	.848	.060
Confidence/ Perceived Behavioral Control	14.65 (3.870)	20	14.58 (3.283)	24	42	.062	.951	.019
Barriers	61.59 (13.029)	20	58.88 (13.882)	24	42	.664	.510	.205

Objective 5: Describe whether the lessons of contrasting contextual frameworks differ in preservice teachers' intentions to implement them in their future classes

The data are inconclusive as to whether participants' implementation intentions differed between the North Atlantic right whale education lessons. Paired-samples t-tests (Table 15) revealed that both the Red Group ($p = .019$, Cohen's $d = .627$) and the entire combined sample (p

= .012, Cohen's *d* = .425) expressed significantly greater intentions to implement the Vessel Strikes lesson than the Baleen & Blubber activity. However, this significant difference was not apparent in the intentions of the Blue Group when analyzed separately. As with participants' rating of the lessons' effectiveness, it was expected that the groups intention scores would not differ significantly because all participants had experienced both lessons by the time intention data was collected in the post-workshop questionnaire. However, even though the groups did not differ significantly in their intentions to implement the Vessel Strikes lesson, they did significantly differ in their intentions to implement the Baleen & Blubber lesson (p = .018, Cohen's *d* = .799; Table 16). Lastly, even though paired-samples t-tests show that, overall, participants expressed significantly higher intentions to implement the Vessel Strikes lesson than the Baleen & Blubber lesson, when the data from the groups' initial lessons were compared, no significant difference was apparent (see Table 17).

Table 15: *Paired-Samples T-tests Comparing Participants' Intentions to Implement the Lessons*

Group	Vessel Strikes (VS) Lesson Mean (S.D.)	Baleen & Blubber (BB) Lesson Mean (S.D.)	VS-BB Mean Difference	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Blue	15.22 (4.236)	14.44 (4.501)	.778	18	17	.932	.364	.178
Red	14.24 (5.253)	11.10 (4.742)	3.143	21	20	2.553	.019**	.627
Both	14.69 (4.775)	12.64 (4.875)	2.051	39	38	2.627	.012**	.425

Table 16: *Independent-Samples T-tests Comparing Participants' Intentions to Implement the Lessons Between Treatment Groups*

Variable	Blue Group Mean (S.D.)	n	Red Group Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Vessel Strikes Lesson Intention	15.22 (4.236)	18	14.24 (5.253)	21	37	.637	.528	.209
Baleen & Blubber Lesson Intention	14.44 (4.501)	18	10.73 (4.939)	22	38	2.463	.018**	.799

Table 17: *Independent-Samples T-tests Comparing Participants' Intentions to Implement Their Treatment Group's Initial Lesson*

Variable	Red Group Vessel Strikes Lesson Mean (S.D.)	n	Blue Group Baleen & Blubber Lesson Mean (S.D.)	n	d.f.	t-value	2-tailed sig. **p≤.05 *p≤.1	Cohen's *d*
Intention	14.24 (5.253)	21	14.44 (4.501)	18	37	-.131	.897	-.043

Objective 6: Describe whether the degree to which the lessons promote environmental literacy makes a significant contribution to predicting preservice teachers' intentions to implement an environmental education lesson

In preparation for the multiple regression analysis, all of variables analyzed under the previously discussed objectives were regressed as independent variables against the dependent variable of intention. The results of these analyses are displayed in Table 18.

Table 18: *Simple Regression of Independent Variables Against Dependent Variable of Intention*

Independent Variables	R^2	2-sided sig. **p≤.05 *p≤.1
Treatment Group	.001	.897
Gender	.004	.701
Level of Degree	.011	.533
Graduation Date	.029	.809
Birth Year (19_ _)	.006	.641
Formal Education Career	.032	.276
Non-formal Education Career	.008	.651
Environmental Education (EE) Involvement & Environmental Learning	.256	.001**
Responsible Environmental Behavior	.062	.127
Prior NARW Knowledge/Engagement	.031	.281
Pretest Threat Mitigation Attitudes	.091	.062*
Initial Implementation Interest	.264	.004**
Knowledge Score	.119	.031
Change in Threat Mitigation Attitudes	.001	.886
Conservation Attitudes	.083	.076*
Locus of Control	.153	.014**
Personal Responsibility	.215	.003**
Skills Building	.283	.000**
Action Orientation	.283	.000**

Increasing Knowledge	.016	.443
Promoting Positive Attitudes	.083	.075*
Implementation Attitudes	.208	.004**
Subjective Norms	.004	.704
Confidence/ Perceived Behavioral Control	.095	.057*
Barriers	.140	.019**
(Pre17RC) 'Mitigation = Costly Government Interference'	.045	.196
(Mid14RC) 'Mitigation = Costly Government Interference'	.008	.595
(Mid30RC) 'Teach even if against school culture"	.208	.004**
(Mid32)'Difficult ↔ Easy'	.032	.274

The simple regression analyses revealed that the following variables significantly predicted participants' intentions to implement their initial lesson in future classes: Environmental Education Involvement & Environmental Learning, Initial Implementation Interest, Locus of Control, Personal Responsibility, Skills Building, Action Orientation, Implementation Attitudes, Barriers, and (Mid30RC) 'Teach even if against school culture'. These variables were used to construct a correlation matrix (Table 19). The variables 'Skills Building' and 'Action Orientation' correlated highly to one another, and because they were both indirect measures of the lessons capacity to promote environmental literacy, they were added together to create the variable 'Lesson Effectiveness'. The process of removing collinear variables from the variable set based on the number of other variables with which they correlated is shown in Table 20. 'Locus of Control' and 'Personal Responsibility' were removed first because they correlated with the largest number of other independent variables. After they were removed, the number of significant correlations was again counted for each of the variables in the remaining set, and "Initial Implementation' and '(Mid30RC Teach even if against school culture"' were subsequently removed. This left a set of four variables, of which only two significantly correlated with each other.

Table 19: *Correlation Matrix of Significant Predictors of Intention Showing Process of Eliminating Collinear Variables*

		Lesson Effectiveness	EE Involvement & Environmental Learning	Initial Implementation Interest [b]	Locus of Control [a]	Personal Responsibility [a]	Implementation Attitudes	Barriers	'Teach even if against school culture" [b]
Lesson Effectiveness	Correlation	1	.365*	.142	.336*	.363*	.222	-.290	-.151
	2-tailed sig.		.015	.439	.026	.015	.147	.057	.328
	n	44	44	32	44	44	44	44	44
EE Involvement & Environmental Learning	Correlation	.365*	1	.352*	.160	.149	.265	-.108	-.144
	2-tailed sig.	.015		.048	.300	.333	.082	.485	.350
	n	44	44	32	44	44	44	44	44
Initial Implementation Interest [b]	Correlation	.142	.352*	1	.540*	.551*	.328	-.387*	-.350*
	2-tailed sig.	.439	.048		.001	.001	.067	.029	.050
	n	32	32	32	32	32	32	32	32
Locus of Control [a]	Correlation	.336*	.160	.540*	1	.740*	.482*	-.520*	-.588*
	2-tailed sig.	.026	.300	.001		.000	.001	.000	.000
	n	44	44	32	44	44	44	44	44
Personal Responsibility [a]	Correlation	.363*	.149	.551*	.740*	1	.619*	-.376*	-.572*
	2-tailed sig.	.015	.333	.001	.000		.000	.012	.000
	n	44	44	32	44	44	44	44	44
Implementation Attitudes	Correlation	.222	.265	.328	.482*	.619*	1	-.280	-.608*
	2-tailed sig.	.147	.082	.067	.001	.000		.066	.000
	n	44	44	32	44	44	44	44	44
Barriers	Correlation	-.290	-.108	-.387*	-.520*	-.376*	-.280	1	.457*
	2-tailed sig.	.057	.485	.029	.000	.012	.066		.002
	n	44	44	32	44	44	44	44	44
'Teach even if against school culture" [b]	Correlation	-.151	-.144	-.350*	-.588*	-.572*	-.608*	.457*	1
	2-tailed sig.	.328	.350	.050	.000	.000	.000	.002	
	n	44	44	32	44	44	44	44	44

Notes: [a] Dark gray cells indicate variables removed in the first round of deletions
[b] Light gray cells indicate variables removed in the second round of deletions
Yellow highlighted correlations indicate significant correlations between IVs

Table 20: *Process of Eliminating Collinear Predictors of Intention*

Independent Variable	Number of Correlated Variables:		
	No Deletions	1st Round of Deletions	2nd Round of Deletions
Lesson Effectiveness	3	1	1
EE Involvement & Environmental Learning	2	2	1
Initial Implementation Interest	5	3	[b]
Locus of Control	6	[a]	
Personal Responsibility	6	[a]	
Implementation Attitudes	3	1	0
Barriers	4	2	0
(Mid30RC) 'Teach even if against school culture"	5	3	[b]

Notes: [a] Dark gray cells indicate variables removed in the first round of deletions
[b] Light gray cells indicate variables removed in the second round of deletions

The final variable set that was used in the calculation of overall predictive model of preservice teachers' intentions to implement the North Atlantic right whale lessons included: Lesson Effectiveness, Environmental Education Involvement & Environmental Learning, Implementation Attitudes, and Barriers. Backwards regression of these variables against the dependent variable of intention produced the two models shown in Table 30, of which the second model was selected as the overall predictive model of preservice teachers' intentions to implement a North Atlantic right whale lesson in future classes: $Y = -5.201 + .107X_1 + 1.464X_2 + .273X_3$, where:

- Y = Preservice teachers' intentions to implement a North Atlantic right whale lesson plan
- X_1 = Preservice teachers' ratings of the effectiveness of the lesson at promoting environmental literacy

- X_2 = Preservice teachers previous involvement in environmental education and learning about the environment, and

- $X_{3\,=}$ Preservice teachers' attitudes relating to the implementation of the North Atlantic right whale lesson.

This model was highly significant and accounted for 41.6% of the variance in participants' intentions to implement their initial activity in future classes (Adjusted R^2 = .416, p =.000018).

Table 21: *Models Produced using Backwards Regression*

Model		β	t-vales	2-sided sig. **p≤.05 *p≤.1
1	Constant	.304	.050	.960
	Lesson Effectiveness	.095	2.702	.010**
	EE Involvement & Environmental Learning	1.505	2.268	.029**
	Implementation Attitudes	.232	1.733	.091*
	Barriers	-.055	-1.305	.199
2	Constant	-5.201	-1.187	.242
	Lesson Effectiveness	.107	3.088	.004**
	EE Involvement & Environmental Learning	1.464	2.191	.034**
	Implementation Attitudes	.273	2.081	.044**

CHAPTER 5

DISCUSSION

This chapter discusses implications of the results presented in the previous chapter in the context of each of the study's five hypotheses (listed below). When pertinent, suggestions for improvements to the evaluation methodology and the possible implications of these changes are discussed in relation to specific hypotheses. The chapter concludes with a discussion of avenues for future research.

Hypothesis 1: Preservice teachers who experience the Vessel Strikes lesson (conservation-action approach) will exhibit greater environmental literacy pertaining to North Atlantic right whales than those who experience the Baleen & Blubber lesson (general-knowledge approach).

Hypothesis 2: Preservice teachers will perceive the Vessel Strikes lesson (conservation-action approach) as more effective at promoting environmental literacy than the Baleen & Blubber lesson (general-knowledge approach).

Hypothesis 3: Preservice teachers who experience the Vessel Strikes lesson (conservation-action approach) in comparison with those who experience the Baleen & Blubber lesson (general-knowledge approach) will (a) exhibit more positive attitudes towards implementing the education materials in their future classes, (b) will perceive more negative subjective norms, (c) will show no significant difference in terms of self-efficacy, and (d) will perceive more barriers in relation to implementing the education materials in their future classes.

Hypothesis 4: Preservice teachers will express higher levels of intention to implement the Vessel Strikes lesson (conservation-action approach) than the Baleen & Blubber lesson (general-knowledge approach).

Hypothesis 5: The contextual approach of environmental education materials' content makes a significant contribution to predicting preservice teachers' intentions to implement an environmental education lesson.

Hypotheses 1 & 2: Contextual Approach and Environmental Literacy

Hypotheses 1 and 2 contained predictions relating, respectively, to the direct and indirect measures of the two North Atlantic right whale lessons' capacities to improve learners' environmental literacy. Although the results of this study do not support the prediction of Hypothesis 1, they provide strong support for Hypothesis 2: neither of the lessons directly served to significantly or differentially influence participants' environmental literacy, but the preservice teachers consistently and significantly rated the Vessel Strikes lesson as more effective than the Baleen & Blubber lesson at promoting environmental literacy.

Hypothesis 1.

Hypothesis 1 predicted that the participants who experienced the Vessel Strikes lesson as their initial lesson would exhibit higher levels of environmental literacy about North Atlantic right whales (measured using constructs on knowledge, attitudes, locus of control, and sense of personal responsibility) than participants who initially experienced the Baleen & Blubber lesson. It also predicted that the Vessel Strikes lesson, in comparison with the Baleen & Blubber lesson, would result in greater attitudinal changes toward the mitigation of threats to North Atlantic right whale survival between the pre- and mid-workshop questionnaires.

Knowledge.

Results of this study show that the contrasting contextual approaches of the North Atlantic right whale lessons did not appear to have any direct effects on participants' environmental literacy above the level of increasing their knowledge and awareness about North Atlantic right whales and their conservation. Prior to the workshop, only 8 of the 44 participants claimed any level of familiarity with the topics of North Atlantic right whale natural history or conservation, or involvement with teaching about North Atlantic right whales in some capacity. Also, only one participant who did not indicate that her response was not a guess correctly identified a picture of a North Atlantic right whale. Interestingly, this person claimed no prior knowledge or involvement with North Atlantic right whale topics. After their initial activity, participants scored an average of 4.33 (s = 1.125) questions correct out of a total of six questions. The two groups did not significantly differ in their knowledge quiz scores.

It is believed that the fairly low average knowledge scores and the lack of a difference in the scores of the two groups may be due in part to measurement error. Two of the six questions in the knowledge quiz utilized an open-ended question format (mid-workshop questionnaire items 5 and 6) and participants scored much lower on these two questions than on any of the multiple choice questions. A conservative approach to grading participants' responses was adopted in order to minimize the possibility of giving too much credit to participants who did not in fact know the exact correct answer. It is likely that this conservative grading approach did not make much of a difference in participants' scores on item 6; the measurement error for this item is more likely due to the fact that the researcher should not have expected the participants to remember the specific wording of the legislations' long name, the Ship Strike Reduction Rule. However, the conservative grading approach might have under-assessed participants' knowledge

about the right whales' greatest threat (item 5). For this question, full credit (1 point) was given to participants whose answer mentioned collisions and half-credit was given for responses such as "ships," "boats," or "propellers." It is believed that had the answer to this question been multiple-choice with "vessel collisions" as a response, a much greater portion of participants would have answered the question correctly. Measurement error might also have existed in questions asking participants to identify North Atlantic right whales, possibly due to similarities in the drawings of the North Atlantic right whale and the gray whale.

Lastly, the lack of a significant difference in the scores of the two groups is likely due, at least in part, to the differing timetables of the treatment groups' workshops. The first workshop session with the Blue Group ended at the conclusion of the group's initial lesson. Since their next workshop session was not held for another two days, participants in the Blue Group were given a brief, but thorough review to refresh their memories on the topics taught during the previous workshop sessions. Presenting this review could easily have functioned to increase the knowledge quiz scores of Blue Group participants, but given the scheduling situation it is still believed that this was a better option than asking the Blue Group participants to complete the mid-workshop questionnaire with a two-day lapse between the end of the initial lesson and its evaluation.

Attitudes, locus of control, personal responsibility.

The results of this study failed to show any significant change in participants' environmental literacy or and significant differences in the environmental literacy measures of participants who experienced different lessons. No significant increases in attitudes toward the mitigation of threats to North Atlantic right whales were observed. On average, participants expressed relatively neutral attitudes on both the pre- and mid-workshop questionnaires. Results

also did not indicate that the lessons differentially influenced participants' environmental literacy in terms of their attitudes towards North Atlantic right whale conservation, locus of control, or feelings of personal responsibility. On average, participants exhibited moderately high attitudes toward North Atlantic right whale conservation and neutral opinions relating to locus of control and feelings of personal responsibility. Change in attitudes towards North Atlantic right whale conservation, locus of control, and feelings of personal responsibility was not measured because it was thought that participants would be unable to give valid responses on these variables until after they had experienced their initial activity. However, if the instrument was to be used in the future, it may be beneficial to use a retrospective post-then-pre questionnaire design that would allow participants to reflect on their prior opinions in relation to their present experiences. If this design was implemented it would likely behoove researches to add "No Opinion" as a response option.

These results were not as predicted by Hypothesis 1, but are not surprising given the audience and the short-duration of the contact time with participants. Studies have shown that environmental education interventions with adult audiences tend to be less effective than interventions targeting age groups 18 years old and younger (Zelezny, 1999). This difference is possibly due to younger participants being "(a) more influenced by interventions because they learn new pro-environmental behaviors more easily, (b) more interested in environmental issues and improving the environment, or (c) more eager to present themselves as pro-environmental if that is interpreted to be more socially desirable" (Zelezny, 1999, p. 12). Furthermore, the duration of environmental education programs is has been shown to affect the amount of influence those programs have on participants' environmental literacy (Stern, Powell, & Ardoin, 2008). Thus, it is not surprising that a short, 3-hour professional development workshop did not

function to significantly influence the environmental literacy of the young-adult and adult participants.

The results obtained in this study may not necessarily predict the lessons' capacities to directly influence the environmental literacy of their middle-school student target audience. Short-term, narrowly-focused environmental education programs have been shown to have significant and long-lasting effects on children's attitudes and motivations. In a study evaluating the effects of a 3 hour environmental education program on invertebrates, Drissner, Haase, & Hille (2010) found that students' attitudes toward the utilization of nature and their intrinsic motivation to learn about invertebrates increased significantly as a result of the program. Furthermore, these positive attitudes persisted even five years after students participated in the program. Another study on the effects of a half-day environmental education program about primate conservation showed increases in knowledge and attitudes (Kuhar, Bettinger, Lehnhardt, Townsend, & Cox, 2007). A continuation of this study demonstrated that the knowledge gained from the program was retained for at least two years, however the persistence of positive attitudes was not reported (Kuhar, et al., 2010). Thus, even though the participants in this study did not exhibit significant increases in environmental attitudes and the lessons were not shown to significantly differ in their capacity to directly promote learners' environmental literacy, findings may differ when the lessons were implemented with middle school students, their target audience.

Hypothesis 2.

Although the lessons' contextual approaches resulted in few direct effects on participants' environmental literacy, the lessons did differ significantly in terms of indirect measures of their capacity to promote environmental literacy. Teachers from both groups

consistently and significantly rated the Vessel Strikes lesson as more effective than the Baleen & Blubber lesson at increasing learner knowledge about an environmental issue, promoting positive attitudes towards an environmental issue, and effectively accomplishing the indicators used to measure the 'Skills Building' and 'Action Orientation' key concepts. These results, which support the prediction of Hypothesis 2, are not particularly surprising given the Vessel Strikes lesson's conservation-action approach. The lesson was specifically designed with the purpose of teaching students about a specific conservation issue and its mitigation (the threat of vessel collisions and the Ship Strike Reduction Rule), encouraging them to think critically about both the ecological and socio-economic impacts of potential methods for addressing the conservation issue, and urging them to use their judgments to evaluate the course of action they believe should be taken in order to most effectively and ethically address the conservation issue.

Participants' more positive evaluation of the effectiveness of the Vessel Strikes activity is in line with what the published literature says about the design of effective environmental education materials. The conservation-action approach of the Vessel Strikes lesson is consistent with many of the curriculum and pedagogical practices that Stevenson (2007) promotes as necessary to the achievement of the goals of environmental education: action-orientation, inquiry into current real-life environmental problems, and a problem-solving orientation focused on working towards the resolution of those environmental problems. The Vessel Strikes lesson also addresses North Atlantic right whale conservation with a specificity lacking in the Baleen & Blubber lesson. According to implications of both the Theory of Planned Behavior (Ajzen, 1991) and the Model of Responsible Environmental Behavior (Hines, et al., 1986-87), this specificity is more likely to promote behavior to help conserve the North Atlantic right whale.

The pair-samples analyses, which revealed the results described above, yielded the predicted results. However, the independent-samples analyses used to check for possibly confounding differences between the groups found that for three of the four constructs used to measure the effectiveness of promoting environmental literacy (promoting positive attitudes, 'Skills Building,' and 'Action Orientation'), the Blue Group rated the Baleen & Blubber lesson as significantly more effective than did the Red Group. As a result, when the Red Group's data on the effectiveness of the Vessels Strikes lesson was compared to the Blue Group's data on the effectiveness of the Baleen & Blubber lesson, no significant differences were found despite the fact that all paired-samples analyses showed that participants rated the Vessel Strikes lesson as more effective than the Baleen & Blubber lesson. Further analysis into the reason for this difference is beyond the scope of this study, however further research should be conducted to ensure that the difference is due to chance and not to a physically or statistically controllable factor such as lesson order or demographic characteristics.

Hypothesis 3: Contextual Approach and the Theory of Planned Behavior

Results of this suggest that the contextual approaches of the two North Atlantic right whale lessons did not differentially influence the predictors of behavioral intention described in the Theory of Planned Behavior (Ajzen, 1985). As predicted by Hypothesis 3c, preservice teachers' self-efficacy relating to their confidence in implementing their initial lesson did not differ between the groups. On average, participants from both groups experienced a relatively neutral level of confidence. Since the lessons were both presented in the same fashion and discussed with the same thoroughness, there was no reason to predict that the lessons would differentially influence preservice teachers perceptions of their efficacy to implementing their initial lesson.

In Hypothesis 3a, it had also been predicted that the preservice teachers would exhibit more positive attitudes toward the Vessel Strikes lesson due to the fact that the conservation-action approach contained more of the expert-espoused components that the literature describes as being important to teachers (Grace & Sharp, 2000). Contrary to this prediction, the groups did not differ in their attitudes toward lesson implementation; both expressed moderately positive evaluations of their initial North Atlantic right whale lesson. Though the methods used to evaluate this construct were sound, if the instrument was to be used again in future studies it may behoove researchers to move this construct to the post-workshop questionnaire. Facilitating the direct comparison of participants' attitudes toward the implementation of the two activities may or may not affect the results. It would, however, enable a more accurate comparison of participants' attitudes toward implementing the different lessons.

Lastly, it was predicted that the Vessel Strikes lesson would be rated lower than the Baleen & Blubber lesson in terms of pro-implementation subjective norms (Hypothesis 3b) and that preservice teachers' would perceive a greater influence of barriers on their implementing the Vessel Strikes lesson (Hypothesis 3d). This was hypothesized because the Vessel Strikes lesson espoused the Ship Strike Reduction Rule, a politically controversial conservation regulation. Thus, it was believed that this lesson would present greater barriers for teachers, both in terms of social pressure and control over implementing the lesson, than the noncontroversial, purely fact-based Baleen & Blubber lesson (Cotton, 2006a). However, no significant differences existed to support either of these hypotheses. On average, participants of both groups exhibited neutral opinions relating to the subjective norms construct and perceived the barriers as having a moderate influence on their decisions to implement their initial lesson. The absence of significant differences between the lessons may potentially result from reduced validity in

preservice teachers' responses on the constructs of subjective norms and barriers. Since the research sample was comprised of preservice, not inservice teachers, the measurement of these constructs may be less valid because participants' responses are largely hypothetical. Preservice teachers' responses might be inflated in comparison to those of inservice teachers because, having never experienced them first-hand, they may not have a full appreciation for the influences of social pressures and external factors on their teaching practices.

Hypothesis 4: Intention and Contextual Approach

Results of the study are inconclusive in regard to Hypothesis 4. The results from the combined sample and the Red Group are in line with the prediction of Hypothesis 4; participants expressed significantly higher levels of intention to implement the Vessel Strikes lesson than they did the Baleen & Blubber lesson. However, the Blue Group showed no significant difference between its participants' intentions to implement either of the two lessons. Overall, both groups' mean intention scores relating to the two lessons were relatively neutral, ranging between slightly unlikely to slightly likely. Furthermore, similar to findings of the independent-samples analyses comparing the treatment groups' responses on the effectiveness of the lessons at promoting environmental literacy, the Blue Group rated their intentions to implement the Baleen & Blubber lesson has significantly higher than the Red Group. As a result, when the Red Group's participants' intentions to implement the Vessels Strikes lesson were compared to the Blue Group's participants' intentions to implement the Baleen & Blubber lesson, no significant difference was found. As conveyed in the earlier instance when the groups' responses differed in relation to the Baleen & Blubber lesson when they should have remained constant, future research should investigate this discrepancy further to ensure that these results are not due to some controllable confounding factor.

Hypothesis 5: Predicting Preservice Teachers Implementation Intentions

The final overall predictive model of preservice teachers' intentions to implement a North Atlantic right whale lesson in future classes included three predictor variables: (a) lesson effectiveness, the sum of 'Skills Building' and 'Action Orientation,' (b) previous involvement in environmental education and learning about the environment, and (c) attitudes towards the implementation of the lesson. Interestingly, the only intention-predicting variable from the Theory of Planned Behavior that was included in the final model was 'attitudes towards the implementation' of the North Atlantic right whale activity. Of the three intention-predicting variables described by the Theory of Planned Behavior, it is understandable that implementation attitudes would function as a significant predictor when the others did not. Whereas the measures of perceived behavioral control and subjective norms pertained to participants' anticipations about the future, the measure of implementation attitudes evaluated immediate cognitions. Also, in comparison to subjective norms, attitudes tend to be a more consistent predictor of behavioral intentions (Ajzen, 1991). Attitudes have been found to occasionally overshadow the influence of subjective norms. Even though self-efficacy did not significantly predict intentions, the influence of perceived barriers did significantly predict intentions when using simple regression. The influence of perceived barriers was even one of the four variables that was entered into the final multiple-regression analysis, but it was removed during the process of backwards regression because it failed to add significant predictive power to the model. Perceived barriers to implementing environmental education might have been included as a significant predictor in the final predictive equation if the sample had been larger (see Table 30).

Previous involvement with environmental education and learning about the environment can be seen as a measure of participants' environmental literacy prior to their participation in this study's workshop. Even though Ajzen's (1991) review of the predictive power of past behavior in relation to the sufficiency if the Theory of Planned Behavior demonstrates that its usefulness as a predictive variable is varied, research on teachers' intentions to implement environmental education programs have shown that past behavior can be a strong predictor of future behavior (Zint, 2002). Previous involvement with environmental education and learning about the environment likely gets much of its predictive power from the fact that the behaviors measured in this construct are specifically related to the intention of implementing North Atlantic right whale education materials. Through these behaviors, teachers express their interest and motivation to teach and learn about environmental topics.

The final variable in the predictor model is the capacity of the North Atlantic right whale lesson to effectively promote learners' environmental literacy. The contextual approach (i.e. treatment group) was not a significant predictor of teachers' intentions to implement their initial North Atlantic right whale lesson, thus the results of this study failed to support Hypothesis 5. However, this hypothesis warrants additional study for two reasons. First, there is potential that if the discrepancy in the groups' ratings of intentions to implement the Baleen & Blubber lesson can be resolved, either by using a different sample or controlling for a confounding factor, significant differences may become apparent between treatment groups' intention ratings for their initial lessons. If intentions to perform the two lessons differ significantly between the treatment groups, participants' treatment group (defined by the contextual approach of their initial activity) may still have predictive value. Secondly, 'lesson effectiveness' embodies the fundamental difference between the two contextual approaches. The significance of 'lesson

effectiveness' as a significant predictor of behavioral intention carries great implications for the concept of the contextual approach of environmental education materials.

In this study, the purpose of devising the concept of the contextual approach was to put a name to an aspect of the content of environmental education materials for which no specific term or literature could be found, but which the author believed was strongly tied to behavior change theory and to the theoretical underpinnings of environmental education and environmental literacy. In accordance with established literature, it was believed that the more specific, conservation-action contextual approach would exhibit a greater capacity to promote environmental literacy than the broader, general-knowledge approach. The first evidence supporting the concept of the contextual approach was presented when participants significantly and consistently rated the lesson designed from the conservation action approach (the Vessel Strikes lesson) as more effective at promoting environmental literacy than the lesson designed from the general-knowledge approach (the Baleen & Blubber lesson). Then, subsequently, in the development of a model to predict behavioral intention, the capacity of an environmental education lesson to affect learners' environmental literacy is found to be one of three significant predictors of preservice teachers' intentions. Thus, this study débuts the concept of the contextual approach of environmental education materials as a statistically relevant factor in both environmental education/ environmental literacy-based theory and the prediction of teachers' intentions to implement specific environmental education materials.

Limitations of the Study

This study has three main limitations: the total size on the study sample, the drawing of the sample from only two classes of preservice teachers, and the limited contact time with participants. The study's small sample decreased the statistical power of the analyses, possibly

masking the significance of certain effects. Drawing each of the treatment groups from only one of the two classes makes it much more difficult to control for within-group variation of the treatment groups. If this study were to be repeated in the future, it is suggested that the researchers employ at least four classes, two per treatment group, in order to both increase the sample size and better distribute the within-group error among the treatment groups.

Lastly, the limited contact time with participants decreased the level of environmental literacy the workshop could impart on participants. This is particularly apparent in the fact that too little time existed for the activities to focus on the development of particular conservation skills. If there had been sufficient time, a second section would have been added to the Vessel Strikes activity, during which students (or the preservice teachers in the context of this study) would learn the skills needed to write their congressional representatives about an environmental issue of their choice. Thus, the current iteration of the conservation-action lesson is not as action-oriented as would have been preferred. Although the lessons did have the capacity to emphasize skills such as critical thinking and the use of the scientific method, barely enough time was available to provide participants with even the basic level of North Atlantic right whale-related environmental literacy delivered by the current iteration of the lesson. No time was available to teach specific conservation skills. This is why it was not deemed feasible to measure preservice teachers' intentions to perform any behavior directed at North Atlantic right whale conservation other than that of teaching the lessons they experienced in their future classes. In the future, it may be more beneficial to conduct testing during a stand-alone, half- or full-day workshop, during which more time could be spent teaching specific conservation skills.

Implications for Endangered Species Education and Outreach

This study has important implications for practitioners of environmental education. With regard to informing the SEIT E&O Committee about which contextual approach to use in developing new North Atlantic right whale environmental education materials, this study concludes the conservation-action approach would best promote the committee's conservation goals. Of the two contextual approaches, the conservation action approach was shown to have the greater capacity to improve the lessons' target audience's environmental literacy regarding North Atlantic right whales. Studies on species-specific environmental education efforts have shown that improving people's environmental literacy regarding locally threatened species can lead to increases in behaviors to reduce their impacts on the species (Barney, et al., 2005; Curti & Valdez, 2009; Savage, et al., 2010; Trewhella, et al., 2005), which can ultimately influence the recovery of those species (Curti & Valdez, 2009; Trewhella, et al., 2005). Given the importance of reducing behaviors that are detrimental to the recovery of a species as critically endangered as the North Atlantic right whale, species-centered environmental education materials should be developed with the contextual approach that is most likely to foster these behaviors.

The use of the conservation-action approach in materials teaching about endangered species is further supported by preservice teachers' perceptions of these materials. Preservice teachers' positive perception of the capacity of specific education materials to promote the environmental literacy of their students was the most significant predictor of their intentions to implement those materials. This supports Grace and Sharp's (2000) findings that teachers have positive attitudes towards components of environmental education that stem from the goal of promoting environmental literacy. Furthermore, the results of this study stand in contrast to other studies that have found that teachers prefer not to teach materials that promote potentially

controversial environmental attitudes and behaviors (Cotton, 2006a, 2006b). North Atlantic right whale educators employed by federal and state government agencies had expressed hesitation about utilizing a more action-oriented and thus more controversial contextual approach in the development of new education materials. However this study suggests that this hesitation is unfounded, at least in regard to preservice teachers' intentions to use specific materials. The conservation-action approach did not negatively influence intention or any of the variables described by the Theory of Planned Behavior (Ajzen, 1985) as influencing intention. Thus, this study suggests that environmental education materials designed with conservation-action approach have a greater capacity to promote students' environmental literacy not only because their objectives are better aligned with the goals of environmental education, but because teachers perceive these goals as important and are more inclined to implement materials they perceive as effective at promoting students' environmental literacy.

Future Directions

Continuing research on the contextual approaches of environmental education materials should consider three future directions: expanding the knowledge base on contextual approaches of environmental education materials, evaluating the effectiveness of different materials' contextual approaches with the materials' target audiences, and continuing educator evaluations of contextual approaches. Expanding the understanding of contextual approaches to the development of environmental education materials should include studies that investigate and evaluate specific characteristics of various contextual approaches. For instance, one such study could teach the Baleen & Blubber lesson in its current format and, alternately, in the context of the potential impacts of climate change on the right whales' food resources. Another exercise to

expand the general understanding about contextual approaches might be to examine the approaches used in the development of various prominent environmental education curricula.

Future research should also evaluate the effectiveness of different contextual approaches of environmental education materials in various formal and nonformal education settings. Studies following this research direction should place particular emphasis on the materials' effectiveness at influencing the students' environmental literacy. Other research objectives might include developing a list of attributes that describes how best to tailor the contextual approach of given materials to best fit the needs of their target education audiences without compromising their effectiveness.

Lastly, research should continue to evaluate educators' cognitions and behaviors relating to materials with various contextual approaches. This study focused on evaluating preservice teachers' perceptions of two different contextual approaches to environmental education materials. Future studies should also endeavor to investigate the perceptions of inservice teachers and nonformal educators. Together, these three research directions should help to improve practices for developing effective environmental education materials.

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APPENDIX A

IRB APPROVAL FORM & INFORMED CONSENT DOCUMENTATION

The University of Georgia

Office of The Vice President for Research
DHHS Assurance ID No. : FWA00003901

Institutional Review Board
Human Subjects Office
612 Boyd GSRC
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APPROVAL FORM

Date Proposal Received: 2011-07-05 **Project Number:** 2012-10007-0

Name	Title	Dept/Phone	Address	Email
Dr. Nick Fuhrman	PI	ALEC 139 Four Towers 706-542-8828		fuhrman@uga.edu
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Title of Study: A "right" way to teach about endangered species? An analysis and comparison of two environmental education approaches using North Atlantic right whales as a case study

45 CFR 46 Category: Administrative 1,2
Parameters:
None;

Change(s) Required for Approval:
Revised Application;
Revised Consent Document(s);

Approved : 2011-09-12 Begin date : 2011-09-12 Expiration date : 2016-09-11

NOTE: Any research conducted before the approval date or after the end date collection date shown above is not covered by IRB approval, and cannot be retroactively approved.

Number Assigned by Sponsored Programs:

Funding Agency:

Your human subjects study has been approved.

Please be aware that it is your responsibility to inform the IRB:
. . . of any adverse events or unanticipated risks to the subjects or others within 24 to 72 hours;
. . . of any significant changes or additions to your study and obtain approval of them before they are put into effect;
. . . that you need to extend the approval period beyond the expiration date shown above;
. . . that you have completed your data collection as approved, within the approval period shown above, so that your file may be closed.

For additional information regarding your responsibilities as an investigtor refer to the IRB Guidelines.
Use the attached Researcher Request Form for requesting renewals, changes, or closures.
Keep this original approval form for your records.

Chairperson or Designee,
Institutional Review Board

Documentation of Informed Consent

I agree to take part in a research study titled "A 'right' way to teach about endangered species? An analysis and comparison of two environmental education approaches using North Atlantic right whales as a case study", which is being conducted by Jessica Hardy (Warnell School of Forestry and Natural Resources, University of Georgia, 770-778-3656) under the direction of Dr. Nick Fuhrman, (College of Agriculture and Environmental Sciences, University of Georgia, 706-542-8828). My participation is voluntary; I can refuse to participate or stop taking part at any time without giving any reason, and without penalty or loss of benefits to which I am otherwise entitled. I can ask to have information related to me returned to me, removed from the research records, or destroyed.

The purpose of this research is to determine what type of environmental education activity best promotes learners' environmental literacy (i.e. knowledge, positive attitudes, skills, and responsible behavior relating to environmental issues), and pre-service teachers' intentions to use specific environmental education materials. The findings of this study will be used to help improve the practice of environmental education as part of endangered species conservation efforts.

If I volunteer to take part in this study, I understand that I will be asked to complete pre-, mid-, and post-workshop questionnaires (about 10-15 minutes each) in response to the educational activities of the workshop. I understand that my participation is completely voluntary and that I may choose not to participate or to stop at any time without penalty or consequence. My responses to the questionnaires will be anonymous. My name will not appear on the questionnaires and my consent form will be filed separately from my questionnaire booklet. Summarized results of this research may be reported in scientific and academic journals.

I understand that I may partake in the workshop activities even if you do not wish to participate in the research study. I will benefit directly from my participation in today's workshop by receiving a copy of the activities to take home with me whether or not I choose to participate in the research study. There are no anticipated risks associated with my participation. The only discomfort I may experience during this workshop is that of viewing a short video clip of a reenacted whaling expedition and images of right whales that died from vessel collisions.

My signature below indicates that the researchers have answered all of my questions to my satisfaction and that I consent to volunteer for this study. I have been given a copy of this form.

Jessica Hardy	Jessica Hardy	September , 2011
Name of Researcher	**Signature**	**Date**

Telephone: 770-778-3656
Email: hardyj@warnell.uga.edu

Name of Participant	**Signature**	**Date**

Please sign or initial both copies of this form. Keep one for your records and return one to the researcher.

Additional questions or problems regarding your rights as a research participant should be addressed to The Chairperson, Institutional Review Board, University of Georgia, 629 Boyd Graduate Studies Research Center, Athens, Georgia 30602; Telephone (706) 542-3199; E-Mail Address IRB@uga.edu

APPENDIX B

INSTRUMENT

North Atlantic Right Whale Workshop Questionnaire Booklet

**"A 'right' way to teach about endangered species?
An analysis and comparison of two environmental education approaches using North Atlantic right whales as a case study."**

North Atlantic Right Whale Education Workshop: Pre-workshop Questionnaire

Section 1: This section asks a few questions about your involvement in environmental education-related topics. Please read the definition of environmental education in the outlined box and use it when answering questions 2 through 4. Respond by filling in the circles or blanks.

> **Environmental education** is that which develops people's **environmental literacy**, the "capacity to perceive and interpret the relative health of environmental systems and to take appropriate action to maintain, restore, or improve the health of those ecosystems."

1. How many college level environmental science or conservation courses (such as Marine Biology, Ecology, or Natural Resources Conservation) have you taken, including any in which you are currently enrolled?

   ○ None ○ 1 – 2 ○ 3 – 4 ○ 5 or more

2. Have you been certified to teach any of the following environmental education materials? *(Please fill in all that apply)*

   ○ Project Learning Tree ○ Project WILD ○ Project WET

   ○ Other: _____

3. Have you ever attended any other workshops, programs, or classes about teaching environmental education? ○ Yes ○ No

   ↳ If "Yes", please explain: _____

   _____

4. How experienced are you in teaching environmental education?

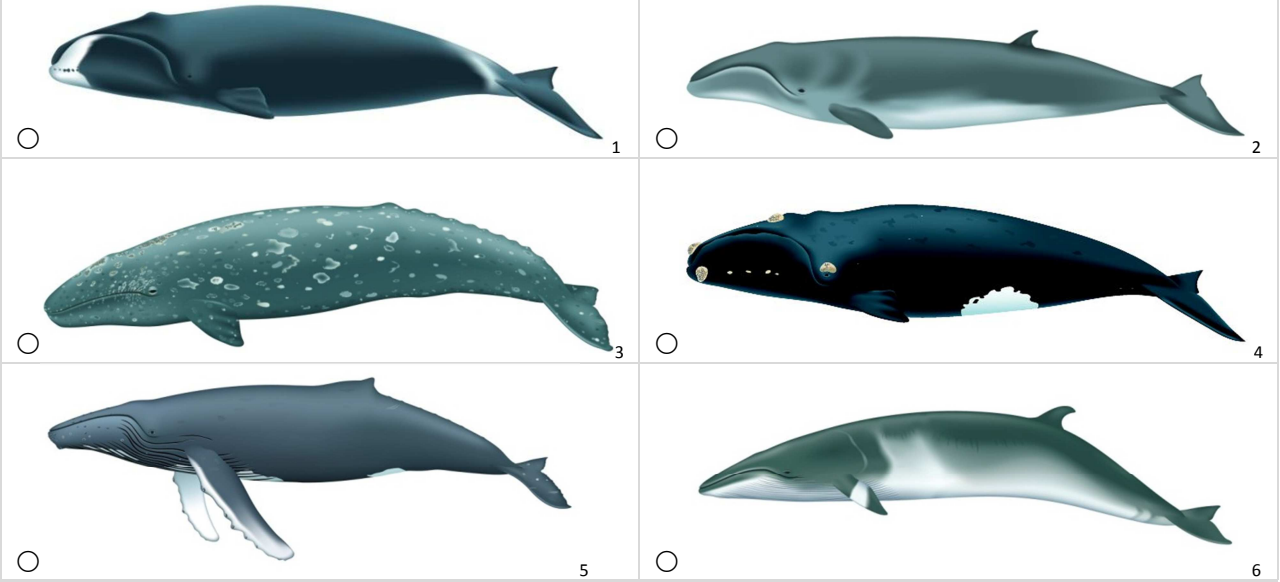
   ○ Not experienced ○ Slightly experienced ○ Experienced ○ Very experienced

Section 2: This section gives a few statements about things you may do to promote environmental conservation. Please circle "Y" (for 'Yes') if you have performed the behavior and "N" (for 'No') if you have not.

In the past six months, I have…	**Yes**	**No**
5. … discussed environmental conservation with others.	Y	N
6. … taken steps to engage in environmentally responsible behaviors at home (such as recycling, installing energy efficient lighting or appliances, etc.)	Y	N
7. … been a member of an environmentally-related organization (such as the Sierra Club, Nature Conservancy, Upper Chattahoochee Riverkeeper, etc.)?	Y	N
8. … volunteered for an environmentally-related cause (such as Adopt-a-Highway, wildlife rehabilitation, habitat restoration, a local stream cleanup, etc.)?	Y	N
9. … donated money or other material resources (excluding membership fees) to an environmentally-related organization or cause?	Y	N

Section 3: The topic of this workshop is environmental education about the North Atlantic right whale. This section asks a few questions to let us gauge your knowledge and engagement with North Atlantic right whale topics. Please respond by filling in the circles or blanks for applicable responses.

10. Which of the following is a North Atlantic right whale? *(note: pictures are not drawn to scale)*



11. How familiar are you with North Atlantic right whale natural history?

○ Not familiar ○ Slightly familiar ○ Familiar ○ Very familiar

12. How familiar are you with North Atlantic right whale conservation?

○ Not familiar ○ Slightly familiar ○ Familiar ○ Very familiar

13. Have you ever taught about North Atlantic right whales before? ○ Yes ○ No

↳ If "Yes", please explain: _____

_____

14. In general, what is your level of interest in implementing at least part of the material from today's workshop with your future classes?

○ Not interested ○ Slightly interested ○ Interested ○ Very interested ○ Don't Know

Section 4: This section asks about your opinions on some North Atlantic right whale (NARW) conservation issues. Please indicate how much you agree or disagree with the following statements by circling the number that best corresponds to your opinion.

	Strongly disagree	Disagree	Slightly disagree	Neither	Slightly agree	Agree	Strongly agree
15. We should restrict the speed of commercial ships that might injure NARWs even if it results in higher shipping costs for the consumer.	1	2	3	4	5	6	7

Section 4 (continued):

	Strongly disagree	Disagree	Slightly disagree	Neither	Slightly agree	Agree	Strongly agree
16. I would support legislation to protect the NARW even if the resulting regulations would decrease the revenue of commercial shipping companies.	1	2	3	4	5	6	7
17. Regulating the speed of commercial shipping to protect NARWs is an example of costly government interference in the economy.	1	2	3	4	5	6	7
18. I would pay a little more for seafood if I knew it was caught using methods that harmed the fewest number of NARWs.	1	2	3	4	5	6	7
19. We should outlaw certain fishing practices that harm significant numbers of NARWs even if it results in slight increases in the price of seafood.	1	2	3	4	5	6	7
20. I would support outlawing certain fishing practices that harm significant numbers of NARWs even if local fishermen lost money as a result.	1	2	3	4	5	6	7

Section 5: This section asks you a few general demographic questions. Please respond by filling in the circles or blanks with applicable responses.

21. I was born in… 19 ☐☐

22. I am… ○ Female ○ Male

23. I am a(n) ___ student ○ Undergraduate ○ Graduate

24. My expected graduation date for my current degree is…

Term: ○ Spring ○ Summer ○ Fall *Year:* 201☐

25. My intended teaching licensure program is…

○ Early Childhood/ Elementary School ○ Middle School ○ Secondary

○ Other_____

26. *(If applicable)* My subject(s) or area(s) of specialization are:_____

_____

27. How likely is it that you will pursue a career as a classroom teacher after completing your education?

○ Not likely ○ Slightly likely ○ Likely ○ Very likely ○ Don't Know

28. How likely is it that you will pursue a career as a nonformal educator after completing your education?

○ Not likely ○ Slightly likely ○ Likely ○ Very likely ○ Don't Know

Please stop here. We will finish the booklet later in the workshop.

North Atlantic Right Whale Education Workshop: Mid-workshop Questionnaire

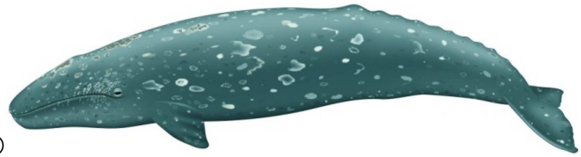
Which group were you in? ○ Blue Group ○ Red Group
(If you do not remember which group you were in, please ask the researcher.)

Section 1: This first section asks a few review questions about the content of the workshop. Please answer them to the best of your ability. Respond by filling in the corresponding circles or the blanks with the correct answer. Each question has only one correct answer.

1. Which of the following is a North Atlantic right whale? *(note: pictures are not drawn to scale)*

○  1

○  2

○  3

○  4

○  5

○  6

2. How many North Atlantic right whales survive today?
   ○ Less than 99 ○ 100 – 299 ○ 300 – 499 ○ 500 – 699 ○ 700 or more

3. Where do mother North Atlantic right whales give birth to their calves?
   ○ Off the southern Florida coast ○ Off the coasts of Georgia and northern Florida
   ○ Off the U.S. mid-Atlantic coast ○ Off the coast of Massachusetts
   ○ In the Bay of Fundy, Canada

4. North Atlantic right whales feed on…
   ○ A variety of fish and zooplankton ○ Small fish ○ Whale lice ○ Copepods ○ Algae

5. What is the greatest threat to North Atlantic right whale survival?

   _____

6. What is the name of the legislation that specifically helps protect North Atlantic right whales against their greatest threat?

   _____

Section 2: This section asks about your opinions on some North Atlantic right whale (NARW) conservation issues. Please indicate how much you agree or disagree with the following statements by circling the number that best corresponds to your opinion.

	Strongly disagree	Disagree	Slightly disagree	Neither	Slightly agree	Agree	Strongly agree
7. All necessary actions should be taken to prevent the NARW from going extinct.	1	2	3	4	5	6	7
8. Human activities caused the NARW to become critically endangered, thus it is our responsibility to ensure the species' recovery.	1	2	3	4	5	6	7
9. Trying to recover a species as critically endangered as the NARW is a lost cause.	1	2	3	4	5	6	7
10. Trying to recover a species as critically endangered as the NARW is not worth the resources it requires.	1	2	3	4	5	6	7
11. Enacting speed regulations on commercial ships is essential to conserving the NARW.	1	2	3	4	5	6	7
12. The federal government should be responsible for limiting the speed of commercial ships in order to help protect NARWs.	1	2	3	4	5	6	7
13. We should restrict the speed of commercial ships that might injure or kill NARWs even if it results in higher shipping costs for the consumer.	1	2	3	4	5	6	7
14. Regulating the speed of commercial ships to protect NARWs is an example of costly government interference in the economy.	1	2	3	4	5	6	7
15. I would support legislation to protect the NARW even if the resulting regulations would decrease the revenue of commercial shipping companies.	1	2	3	4	5	6	7
16. I would pay a little more for seafood if I knew it was caught using methods that harmed the fewest number of NARWs.	1	2	3	4	5	6	7
17. We should outlaw certain fishing practices that harm significant numbers of NARWs even if it results in slight increases in the price of seafood.	1	2	3	4	5	6	7
18. I would support outlawing certain fishing practices that harm significant numbers of NARWs even if local fishermen lost money as a result.	1	2	3	4	5	6	7

Section 3: This section asks about your opinions regarding personal involvement in North Atlantic right whale (NARW) conservation. Please respond by circling the number that best corresponds to your opinion of each statement.

	Strongly disagree	Disagree	Slightly disagree	Neither	Slightly agree	Agree	Strongly agree
19. In the end, no effort I take would make a difference to the survival of the NARW.	1	2	3	4	5	6	7
20. Conservation of the NARW is out of my hands.	1	2	3	4	5	6	7
21. I feel I could meaningfully contribute to NARW conservation by implementing material from today's workshop.	1	2	3	4	5	6	7
22. I feel I could meaningfully contribute to NARW conservation by telling others about NARW conservation issues.	1	2	3	4	5	6	7
23. I do not feel that promoting NARW conservation is my responsibility.	1	2	3	4	5	6	7
24. Given what I learned in today's workshop, I feel personally responsible to help promote NARW conservation.	1	2	3	4	5	6	7
25. Given what I learned in today's workshop, I feel personally responsible to teach my future classes about NARW conservation issues.	1	2	3	4	5	6	7
26. Given what I learned in today's workshop, I feel personally responsible to tell others about NARW conservation issues.	1	2	3	4	5	6	7

Section 4: This section asks a few questions in regards to implementing the activity you have experienced in today's workshop in your future classes. Please respond by circling the number that best corresponds to your opinion.

	Strongly disagree	Disagree	Slightly disagree	Neither	Slightly agree	Agree	Strongly agree
27. Others will expect me to implement material from today's workshop in my future classes.	1	2	3	4	5	6	7
28. I feel under social pressure to implement material from today's workshop in my future classes.	1	2	3	4	5	6	7
29. People who are professionally important to me think I should implement material from today's workshop in my future classes.	1	2	3	4	5	6	7
30. I would be willing to teach the material presented in today's workshop even if it was not encouraged by my future school's culture.	1	2	3	4	5	6	7

Section 5, Part 1: This section asks about your opinions toward implementing the activity you experienced in your future classes. Please respond by circling the number that best corresponds to your opinion of each completion of the following statement.

I believe implementing the material from today's workshop in my future classes would be_____.

		Very		Slightly	Neither	Slightly		Very	
31.	Unpleasant	1	2	3	4	5	6	7	Pleasant
32.	Difficult	1	2	3	4	5	6	7	Easy
33.	Unrewarding	1	2	3	4	5	6	7	Rewarding
34.	Worthless	1	2	3	4	5	6	7	Worthwhile
35.	Boring	1	2	3	4	5	6	7	Engaging
36.	Irrelevant	1	2	3	4	5	6	7	Relevant

Section 5, Part 2: Please respond by circling the number that best corresponds to your opinion for each statement.

	Very unconfident	Unconfident	Slightly unconfident	Neither	Slightly confident	Confident	Very confident
37. How confident would you feel in teaching the content of the material presented in today's workshop to your future classes?	1	2	3	4	5	6	7
38. How confident would you feel leading your future classes in the activity presented in today's workshop?	1	2	3	4	5	6	7
39. How confident would you feel training other teachers or administrators to teach the material presented in today's workshop?	1	2	3	4	5	6	7

Section 6: This section asks about potential barriers that might prevent you from implementing the activity you experienced in today's workshop in your future classes. Please respond by circling the number that best corresponds to your perception of the influence of each potential barrier.

Picture yourself as a classroom teacher. How much influence would each of these potential barriers have on preventing you from implementing <u>any part of the material</u> from today's workshop in your future classes?

	No influence			Moderate influence			Extreme influence
40. Insufficient adherence to Georgia Performance Standards	1	2	3	4	5	6	7
41. Difficulty integrating activity into existing curriculum	1	2	3	4	5	6	7
42. Difficulty integrating environmental issues into existing curriculum	1	2	3	4	5	6	7

Section 6 (continued):	No influence			Moderate influence			Extreme influence
43. Difficulty integrating conservation policy issues into existing curriculum	1	2	3	4	5	6	7
44. Discomfort with teaching lesson material	1	2	3	4	5	6	7
45. Insufficient teaching time	1	2	3	4	5	6	7
46. Lack of personal interest	1	2	3	4	5	6	7
47. Lack of student interest	1	2	3	4	5	6	7
48. Lack of administrative support	1	2	3	4	5	6	7
49. Lack of peer support	1	2	3	4	5	6	7
50. Lack of parent support	1	2	3	4	5	6	7
51. Unavailability of materials needed for the activity	1	2	3	4	5	6	7
52. Unavailability of space needed for the activity	1	2	3	4	5	6	7
53. Class size (too big or small)	1	2	3	4	5	6	7
54. Safety and liability issues	1	2	3	4	5	6	7

Please stop here. We will finish the booklet at the end of the workshop.

North Atlantic Right Whale Education Workshop:
Post-workshop Questionnaire

Section 1: This section asks about your opinions of the effectiveness of the activities you experienced at promoting environmental literacy. Please respond by circling the number that best corresponds to your opinion.

How effective were the activities you experienced today at accomplishing each of the following:	Vessel Strikes Activity							Baleen & Blubber Activities						
	Very ineffective	Ineffective	Slightly ineffective	Neither	Slightly effective	Effective	Very effective	Very ineffective	Ineffective	Slightly ineffective	Neither	Slightly effective	Effective	Very effective
1. Increasing learner knowledge about an environmental topic or issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7
2. Promoting learners' positive attitudes towards an environmental topic or issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7
3. Challenging learners to use and improve their critical thinking skills (such as problem definition, forming hypotheses, collecting and organizing information, analyzing information, synthesizing, drawing conclusions, formulating possible solutions, and identifying opportunities for action)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
4. Challenging learners to use and improve their creative skills (such as modeling, using metaphors and analogies, and formulating questions)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
5. Challenging learners to use higher level thinking processes (such as identifying bias, inferring, relating, applying, and reflecting)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
6. Helping students learn to identify, define, and evaluate issues on the basis of evidence, different perspectives, and ethical and value considerations	1	2	3	4	5	6	7	1	2	3	4	5	6	7
7. Compelling learners to consider the implications of a range of possible solutions to a conservation issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7

Section 1 (continued): How effective were the activities you experienced today at accomplishing each of the following:	Vessel Strikes Activity							Baleen & Blubber Activities						
	Very ineffective	Ineffective	Slightly ineffective	Neither	Slightly effective	Effective	Very effective	Very ineffective	Ineffective	Slightly ineffective	Neither	Slightly effective	Effective	Very effective
8. Encouraging learners to arrive at their own conclusions about what needs to be done to resolve an environmental issue based on research and study, rather than teaching that a certain course of action is best	1	2	3	4	5	6	7	1	2	3	4	5	6	7
9. Providing opportunities for learners to practice their interpersonal and communication skills	1	2	3	4	5	6	7	1	2	3	4	5	6	7
10. Providing opportunities for learners to develop citizenship skills (such as participation in the political or regulatory process, consumer action, using the media, and community service)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
11. Developing learners basic laboratory and field skills (such as observation, data collection & analysis, and experimental design)	1	2	3	4	5	6	7	1	2	3	4	5	6	7
12. Developing basic skills needed by learners in order to participate in resolving an environmental issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7
13. Promoting learners' senses intergenerational and global responsibility by linking historical and current actions with future and distant consequences	1	2	3	4	5	6	7	1	2	3	4	5	6	7
14. Promoting learners' senses of personal stake and responsibility toward an environmental issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7
15. Helping learners to examine the possible impacts of their behaviors on the environment	1	2	3	4	5	6	7	1	2	3	4	5	6	7
16. Helping learners to evaluate choices they can make which may help resolve an environmental issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7
17. Promoting learners' understanding of how many individual actions have cumulative effects, both in creating and addressing environmental issues	1	2	3	4	5	6	7	1	2	3	4	5	6	7

Section 1 (continued): How effective were the activities you experienced today at accomplishing each of the following:

	Vessel Strikes Activity							Baleen & Blubber Activities						
	Very ineffective	Ineffective	Slightly ineffective	Neither	Slightly effective	Effective	Very effective	Very ineffective	Ineffective	Slightly ineffective	Neither	Slightly effective	Effective	Very effective
18. Challenging learners to apply their thinking and act on their conclusions to help resolve an environmental issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7
19. Helping to strengthen learners' perception of their ability to influence the outcome of a situation	1	2	3	4	5	6	7	1	2	3	4	5	6	7
20. Providing opportunities for learners to practice a variety of individual and community strategies for citizen involvement	1	2	3	4	5	6	7	1	2	3	4	5	6	7
21. Promoting students taking action to help resolve an environmental issue	1	2	3	4	5	6	7	1	2	3	4	5	6	7

Section 2: This section asks about your intentions to implement material you experienced in today's workshop in your classes. Please respond by circling the number that best corresponds to your opinion.

How likely is it that you will implement <u>any part of the activities</u> from today's workshop in one or more of your future classes…?	Vessel Strike Activity								Baleen & Blubber Activities							
	Very unlikely	Unlikely	Slightly unlikely	Neither	Slightly likely	Likely	Very likely	Don't Know	Very unlikely	Unlikely	Slightly unlikely	Neither	Slightly likely	Likely	Very likely	Don't Know
22. … during your student teaching?	1	2	3	4	5	6	7	?	1	2	3	4	5	6	7	?
23. … during your first year of teaching?	1	2	3	4	5	6	7	?	1	2	3	4	5	6	7	?
24. … after your first year of teaching?	1	2	3	4	5	6	7	?	1	2	3	4	5	6	7	?

Section 3: Please use the space below if you would like to leave any comments about the activities you experienced or any other aspect of the workshop.

Thank you so much for your participation!

 [7]

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APPENDIX C

ITEM ADAPTATIONS & ORIGINAL ITEMS

Test	Question in Current Study	Original Question	Author
Pre	1. How many college level environmental science or conservation courses (such as Marine Biology, Ecology, or Natural Resources Conservation) have you taken, including any in which you are currently enrolled? • [None, 1 – 2, 3 – 4, 5 or more]	Have you ever taken any college level economics courses? • [Yes, No] If yes, how many? _____	Kang 2007, p 130
Pre	2. Have you been certified to teach any of the following environmental education materials? *(Please fill in all that apply)* • [Project Learning Tree, Project Wild, Project Wet, Other_____]	18. Have you taught from any other environmental education program? • [No, Yes] If yes, what did you teach from? • [Project Wet, Project Wild, Project Learning Tree, Other_____]	Cheng 2008, p 110
Pre	3. Have you ever attended any other workshops, programs, or classes about teaching environmental education? • [Yes, No] If "Yes", please explain: _____	Have you ever attended any workshops/ programs in teaching economics? • [Yes, No] If yes, how many? _____	Kang 2007, p 130
Pre	4. How experienced are you in teaching environmental education? • [Not experienced, Slightly experienced, Experienced, Very experienced]		Original
Pre	In the past six months, I have… 5. … discussed environmental conservation with others. 6. … taken steps to engage in environmentally responsible behaviors at home (such as recycling, installing energy efficient lighting or appliances, etc.) 7. … been a member of an environmentally-related organization (such as the Sierra Club, Nature Conservancy, Upper Chattahoochee Riverkeeper, etc.)? 8. … volunteered for an environmentally-related cause (such as Adopt-a-Highway, wildlife rehabilitation, habitat restoration, a local stream cleanup, etc.)? 9. … donated money or other material resources (excluding membership fees) to an environmentally-related organization or cause? • [Yes, No]		Original

Pre/ Mid	10./1. Which of the following is a North Atlantic right whale? • Pictures of: [1 Bowhead whale, 2 Pygmy right whale, 3 Gray whale, **4 North Atlantic right whale**, 5 Humpback whale, 6 Minke whale]	9. In this section, please identify the mammal species in the photographs provided. If you are not familiar with the animal in the picture, write 'don't know' in the blank.	Wong 2009, p 141
Pre	11. How familiar are you with North Atlantic right whale natural history? 12. How familiar are you with North Atlantic right whale conservation? • [Not familiar, Slightly familiar, Familiar, Very familiar] 13. Have you ever taught about North Atlantic right whales before? • [Yes, No] If "Yes", please explain: _____	11. In regard to the areas listed below, I rate my knowledge as: - Knowledge of astronomy - Experience with teaching astronomy • [Very little, Basic, Intermediate, Advanced] 3. I am familiar with the environmental issues that are the topic of today's workshop • [1 Strongly agree, 2, 3, 4, 5 Strongly disagree]	Danter 2005, p 194 Sheehan 2008, p 79
Pre	14. In general, what is your level of interest in implementing at least part of the material from today's workshop with your future classes? • [Not interested, Slightly interested, Interested, Very interested, Don't Know]	10. Please check <u>one</u>: __ **I do intend** to implement at least part of this workshop material in my classroom. __ **I do not intend** to implement at least part of this workshop material in my classroom. __ **I do not know** if I will implement at least part of this workshop material in my classroom.	Danter 2005, p 194
Pre/ Mid	15./13. We should restrict the speed of commercial ships that might injure NARWs even if it results in higher shipping costs for the consumer. • 7-point Agreement Likert Scale: [Strongly disagree, Disagree, Slightly disagree, Neither, Slightly agree, Agree, Strongly agree]	31. We should restrict the routes of commercial ships that might injure marine mammals even if it results in higher shipping costs • [Strongly agree, Moderately agree, Moderately disagree, Strongly disagree, No opinion, No answer]	Kellert 1999, p 280
Pre/ Mid	16./15. I would support legislation to protect the NARW even if the resulting regulations would decrease the revenue of commercial shipping companies. • 7-point Agreement Likert Scale		Original

Pre/ Mid	17./14. Regulating the speed of commercial shipping to protect NARWs is an example of costly government interference in the economy. • 7-point Agreement Likert Scale	47. Regulating the routes of commercial shipping to protect marine mammals is an example of costly government interference in the economy • [Strongly agree, Moderately agree, Moderately disagree, Strongly disagree, No opinion, No answer]	Kellert 1999, p 282
Pre/ Mid	18./16 I would pay a little more for seafood if I knew it was caught using methods that harmed the fewest number of NARWs. • 7-point Agreement Likert Scale	6. I would pay a little more for fish if I knew they were caught using methods that harmed the fewest number of marine mammals • [Strongly agree, Moderately agree, Moderately disagree, Strongly disagree, No opinion, No answer]	Kellert 1999, p 277
Pre/ Mid	19./17. We should outlaw certain fishing practices that harm significant numbers of NARWs even if it results in slight increases in the price of seafood. • 7-point Agreement Likert Scale	36. We should outlaw certain fishing practices that kill large numbers of marine mammals even if it results in slight increases in the price of fish • [Strongly agree, Moderately agree, Moderately disagree, Strongly disagree, No opinion, No answer]	Kellert 1999, p 281
Pre/ Mid	20./18. I would support outlawing certain fishing practices that harm significant numbers of NARWs even if local fishermen lost money as a result. • 7-point Agreement Likert Scale		Original
Pre	21. I was born in… • 19_ _		Original
Pre	22. I am… • [Female, Male]		Original
Pre	23. I am a(n) __ student? • [Undergraduate, Graduate]		Original
Pre	24. My expected graduation date for my current degree is… • Term: [Spring, Summer, Fall]/ Year: 201_		Original
Pre	25. My intended teaching licensure program is… • [Early Childhood/ Elementary School, Middle School, Secondary, Other: _____]	3. Type the number next to your licensure program area of study [0 General Education (Early Childhood, Middle Childhood, Secondary), 1 Special Education, 2 Fine Arts/Physical Education, 3 Foreign Language, 4 Speech/ Audiology, 5 Undecided, 6 Other] C. Please indicate your intended certification area: • [Early Childhood, Elementary, Secondary, Special]	Alexander 2011, p 226 Jones 2009, p 155

Pre	26. *(If applicable)* My subject(s) or area(s) of specialization are: _____	Original
Pre	27. How likely is it that you will pursue a career as a classroom teacher after completing your education? 28. How likely is it that you will pursue a career as a nonformal educator after completing your education? • [Not likely, Slightly likely, Likely, Very likely, Don't Know]	Original
Mid	2. How many North Atlantic right whales survive today? • [Less than 99, 100 – 299, **300 – 499**, 500 – 699, 700 or more]	Original
Mid	3. Where do mother North Atlantic right whales give birth to their calves? • [Off the southern Florida coast, **Off the coasts of Georgia and northern Florida**, Off the U.S. mid-Atlantic coast, Off the coast of Massachusetts, In the Bay of Fundy, Canada]	Original
Mid	4. North Atlantic right whales feed on… • [A variety of fish and zooplankton, Small fish, Whale lice, **Copepods**, Algae]	Original
Mid	5. What is the greatest threat to North Atlantic right whale survival? _____	Original
Mid	6. What is the name of the legislation that specifically helps protect North Atlantic right whales against their greatest threat? _____	Original
Mid	7. All necessary actions should be taken to prevent the NARW from going extinct. 8. Human activities caused the NARW to become critically endangered, thus it is our responsibility to ensure the species' recovery. 9. Trying to recover a species as critically endangered as the NARW is a lost cause. 10. Trying to recover a species as critically endangered as the NARW is not worth the resources it requires. 11. Enacting speed regulations on commercial ships is essential to conserving the NARW. 12. The federal government should be responsible for limiting the speed of commercial ships in order to help protect NARWs. 19. In the end, no effort I take would make a difference to the survival of the NARW. 20. Conservation of the NARW is out of my hands. 21. I feel I could meaningfully contribute to NARW conservation by implementing material from today's workshop. 22. I feel I could meaningfully contribute to NARW conservation by telling others about NARW conservation issues. 23. I do not feel that promoting NARW conservation is my responsibility. 24. Given what I learned in today's workshop, I feel personally responsible to help promote NARW conservation. 25. Given what I learned in today's workshop, I feel personally responsible to teach my future classes about NARW conservation issues. 26. Given what I learned in today's workshop, I feel personally responsible to tell others about NARW conservation issues. • 7-point Agreement Likert Scale	Original

Mid	27. Others will expect me to implement material from today's workshop in my future classes. • 7-point Agreement Likert Scale	1. Others will expect me to engage in one or more environmental behaviors that I learned in today's workshop. • [Strongly agree, Agree, Neutral, Disagree, Strongly disagree]	Sheehan 2008, p 84
Mid	28. I feel under social pressure to implement material from today's workshop in my future classes. • 7-point Agreement Likert Scale	10. I feel under social pressure to engage in one or more environmental behaviors that I learned in today's workshop. • [Strongly agree, Agree, Neutral, Disagree, Strongly disagree]	Sheehan 2008, p 85
Mid	29. People who are professionally important to me think I should implement material from today's workshop in my future classes. • 7-point Agreement Likert Scale	5. People who are professionally important to me think I should implement this workshop material in with my class(es) in the next school year. • [Strongly disagree, Quite disagree, Slightly disagree, Neither, Slightly agree, Quite agree, Strongly agree]	Danter 2005, p 200
Mid	30. I would be willing to teach the material presented in today's workshop even if it was not encouraged by my future school's culture. 7-point Agreement Likert Scale		Original
Mid	I believe implementing the material from today's workshop in my future classes would be_____. 31. Unpleasant/Pleasant 32. Difficult/Easy 33. Unrewarding/Rewarding 34. Worthless/Worthwhile 35. Boring/Engaging 36. Irrelevant/Relevant • [1 Very, 2, 3 Slightly, 4 Neither, 5 Slightly, 6, 7 Very]	4. From your perspective as a teacher, the experience of implementing this workshop material in the next school year <u>will probably be</u>… - Good/Bad - Pleasant/Unpleasant - Exhausting/Invigorating - Encouraging/Disappointing - Useless/Useful • [Extremely, Very, Slightly, Neither, Slightly, Very, Extremely] 1. Engaging in one or more environmental behaviors that I learned in today's workshop is: - Good/Bad - Useful/Worthless - Pleasant (for me)/Unpleasant (for me) - Harmful/Beneficial [1, 2, 3, 4, 5]	Danter 2005, p 199 Sheehan 2008, p 86

Mid	37. How confident would you feel in teaching the content of the material presented in today's workshop to your future classes? 38. How confident would you feel leading your future classes in the activity presented in today's workshop? 39. How confident would you feel training other teachers or administrators to teach the material presented in today's workshop? • Very unconfident, Unconfident, Slightly unconfident, Neither, Slightly confident, Confident, Very confident]		Original
Mid	40. Insufficient adherence to Georgia Performance Standards 41. Difficulty integrating activity into existing curriculum 42. Difficulty integrating environmental issues into existing curriculum 43. Difficulty integrating conservation policy issues into existing curriculum 44. Discomfort with teaching lesson material 45. Insufficient teaching time 46. Lack of personal interest 47. Lack of student interest 48. Lack of administrative support 49. Lack of peer support 50. Lack of parent support 51. Unavailability of materials needed for the activity 52. Unavailability of space needed for the activity 53. Class size (too big or small) 54. Safety and liability issues • [1 No influence, 2, 3, 4 Moderate influence, 5, 6, 7 Extreme influence]		Original
Post	1. Increasing learner knowledge about an environmental topic or issue • [Very ineffective, Ineffective, Slightly ineffective, Neither, Slightly effective, Effective, Very effective]		Original
Post	2. Promoting learners' positive attitudes towards an environmental topic or issue • [Very ineffective, Ineffective, Slightly ineffective, Neither, Slightly effective, Effective, Very effective]		Original
Post	3. Challenging learners to use and improve their critical thinking skills (such as problem definition, forming hypotheses, collecting and organizing information, analyzing information, synthesizing, drawing conclusions, formulating possible solutions, and identifying opportunities for action)	Materials offer learners opportunities to practice critical thinking processes such as problem definition, forming hypotheses, collecting and organizing information, analyzing information, synthesizing, drawing conclusions, formulating possible solutions, and identifying opportunities for action.	NAAEE, p 9
Post	4. Challenging learners to use and improve their creative skills (such as modeling, using metaphors and analogies, and formulating questions)	Materials provide learners with opportunities to practice creative thinking processes such as modeling, using metaphors and analogies, and formulating questions.	NAAEE, p 9

Post	5. Challenging learners to use higher level thinking processes (such as identifying bias, inferring, relating, applying, and reflecting)	Learners are challenged to use higher level thinking processes such as identifying bias, inferring, relating, applying, and reflecting.	NAAEE, p 9
Post	6. Helping students learn to identify, define, and evaluate issues on the basis of evidence, different perspectives, and ethical and value considerations	Materials help students learn to identify, define, and evaluate issues on the basis of evidence and different perspectives. Ethical and value considerations are included.	NAAEE, p 9
Post	7. Compelling learners to consider the implications of a range of possible solutions to a conservation issue	Environmental issues are presented with a range of possible solutions as well as information about how the problems are currently being addressed. Materials compel learners to consider the implications of different approaches.	NAAEE, p 9
Post	8. Encouraging learners to arrive at their own conclusions about what needs to be done to resolve an environmental issue based on research and study, rather than teaching that a certain course of action is best	3.2) Applying skills to issues. Students should learn to arrive at their own conclusions about what needs to be done based on thorough research and study, rather than being taught that a certain course of action is best.	NAAEE, p 9
Post	9. Providing opportunities for learners to practice their interpersonal and communication skills	Learners practice interpersonal and communication skills, including oral and written communication, group cooperation, leadership, conflict resolution, and others.	NAAEE, p 10
Post	10. Providing opportunities for learners to develop citizenship skills (such as participation in the political or regulatory process, consumer action, using the media, and community service)	Learners are provided with opportunities to develop a variety of citizenship skills, including participation in the political or regulatory process, consumer action, using the media, and community service.	NAAEE, p 10
Post	11. Developing learners basic laboratory and field skills (such as observation, data collection & analysis, and experimental design)	Materials and activities help students sharpen basic laboratory and field skills such as experimental design, observation, data collection, and data analysis.	NAAEE, p 10
Post	12. Developing basic skills needed by learners in order to participate in resolving an environmental issue	3.3) Action skills. Learners should gain basic skills needed to participate in resolving environmental issues.	NAAEE, p 10

Post	13. Promoting learners' senses intergenerational and global responsibility by linking historical and current actions with future and distant consequences	Materials promote intergenerational and global responsibility, linking historical and current actions with future and distant consequences.	NAAEE, p 12
Post	14. Promoting learners' senses of personal stake and responsibility toward an environmental issue 15. Helping learners to examine the possible impacts of their behaviors on the environment 16. Helping learners to evaluate choices they can make which may help resolve an environmental issue	4.1) Sense of personal stake and responsibility. Materials should help learners to examine the possible consequences of their behaviors on the environment and evaluate choices they can make which may help resolve environmental issues.	NAAEE, p 12
Post	17. Promoting learners' understanding of how many individual actions have cumulative effects, both in creating and addressing environmental issues	Materials convey the idea that many individual actions have cumulative effects, both in creating and addressing environmental issues.	NAAEE, p 12
Post	18. Challenging learners to apply their thinking and act on their conclusions to help resolve an environmental issue	Materials challenge learners to apply their thinking and act on their conclusions.	NAAEE, p 12
Post	19. Helping to strengthen learners' perception of their ability to influence the outcome of a situation	4.2) Self-efficacy. Materials should aim to strengthen learners' perception of their ability to influence the outcome of a situation.	NAAEE, p 12
Post	20. Providing opportunities for learners to practice a variety of individual and community strategies for citizen involvement	Materials include a variety of individual and community strategies for citizen involvement and provide learners with opportunities to practice these strategies through projects they generate individually in their school or in the larger community.	NAAEE, p 12
Post	21. Promoting students taking action to help resolve an environmental issue	Environmental education materials should promote civic responsibility, encouraging learners to use their knowledge, personal skills, and assessments of environmental problems and issues as a basis for environmental problem solving and action.	NAAEE, p 12

Post	How likely is it that you will implement any part of the activities from today's workshop in one or more of your future classes…? 22. … during your student teaching? 23. … during your first year of teaching? 24. … after your first year of teaching? • [Very unlikely, Unlikely, Slightly unlikely, Neither, Slightly likely, Likely, Very likely]	3. Do you intend to implement ***any part*** of the material from this workshop with your class(es)… … before January 1, 2005? … between January 2 and May 31, 2005? … after May 31, 2005? • [Extremely unlikely, Unlikely, Slightly unlikely, Undecided, Slightly likely, Likely, Extremely likely]	Danter 2005, p 199