ASSESSING MARINEQUEST:

A FOLLOW-UP STUDY ON EFFECTS OF A SUMMER RESIDENTIAL MARINE ENVIRONMENTAL EDUCATION PROGRAM ON KNOWLEDGE AND ATTITUDES

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ABSTRACT

The purpose of this study was to investigate the effects of a one-week marine science education program, UNCW's *MarineQuest* program, on the participants' knowledge and attitudes towards the marine environment. This study is the second of a multi-year assessment examining the effectiveness of an informal environmental education program.

Subjects were instructed on creating concept maps using techniques developed by Novak and Gowin (1984). Knowledge content and structure scores were obtained from concept maps and multiple choice surveys. Attitude scores were obtained using the Marine Life Attitude Inventory created by Andrews (2003) based on Kellert's (1985) attitudinal dimensions towards wildlife. Data sets (2003 and 2006) were combined and analyzed using Chi-squared, Kruskal-Wallis, Wilcoxon, and Tukey-Kramer tests.

The results of this study show significant differences favoring the Experimental Group I in structural complexity and knowledge content of participants. Differences in Mastery of Learning Objectives and Marine Animal Life Attitude Inventory posttest scores were significant, favoring the experimental group in all cases. These findings further support the *MarineQuest* program's significant influence on participants' knowledge and attitudes towards the marine environment and provide future guidelines for developing curricular and assessment efforts in environmental education.

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INTRODUCTION

The *MarineQuest* program is an environmental education outreach effort located at the University of North Carolina Wilmington. Created in the early 1980's, *MarineQuest* provides marine science and environmental education in the form of field trips during the school year and summer camps to adolescents' ages 5-18. Having been in operation for over twenty-five years, the *MarineQuest* program is one of the longest running marine science education efforts in the United States. Through a combination of 'hands-on, feet-wet' field explorations, laboratory studies, and classroom activities the program explores topics including salt marsh ecology/zonation, river ecology, barrier island dynamics, as well as more advanced topics like marine technology.

As a follow-up to Andrews 2005 work, this study investigated the effects of the *MarineQuest* one-week marine science summer session on the participants' knowledge and attitudes towards marine life. As a result of the first assessment, a more standardized curriculum and staff development effort has been implemented to optimize the learning experience. The *MarineQuest* staff has been comprised historically of UNCW graduate and undergraduate students from a variety of fields. The diversity of the backgrounds of the staff, and the frequent turnover due to graduation, presented multiple staffing problems.

To optimize the participants' learning experience, programs have been modified to reflect the curriculum for each age group set by the North Carolina Department of Public Instruction, and incorporated in strategies from NOAA's education initiative. This study aimed to evaluate the effects of a week long residential summer program on the knowledge and attitudes of the participants and the effectiveness of the changes made to the curriculum. Comparisons of both the 2003 and 2006 assessments will be drawn upon to recommend future modifications in shaping the *MarineQuest* program.

BACKGROUND

The need for education about the environment was not fully recognized until the early 1960s. Many credit Rachel Carson's book, ***The Silent Spring***, as the catalyst for the environmental movement of the 1960s and 1970's. During this time period federal laws, including the National Environmental Policy Act of 1969 and the National Environmental Education Act of 1970, were enacted to address public awareness of complex environmental issues (NEEAC, 1996). On an international level, the first milestone in Environmental Education was the United Nations' Conference on the Human Environment, taking place in Stockholm, 1972 (UNESCO, 2005). This conference stressed the need for an international framework developing environmental education, which led to many follow up meetings on the international and regional levels. During the 1978 UNESCO conference, environmental education was defined as

> "…a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address the challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action" (UNESCO, Tbilisi Declaration, 1978).

This conference repeated the stress for development of environmental education at the national, regional and global levels and set categories of environmental education objectives: *awareness, skills, participation, knowledge,* and *attitudes* (UNESCO, Tbilisi Declaration, 1978).

Further meetings and conferences suggested that the benefits of environmental education could exceed those of initial expectations. In the 1990 amendment of the National Environmental Education Act, Congress found that "effective response to complex environmental problems requires understanding of the natural and built environment, awareness of environmental problems and their origins (including those in urban areas), and the skills to solve those problems." Furthermore, since environmental education does not advocate a particular viewpoint, it is believed that environmental education can enhance critical thinking, problem-solving, and effective decision-making skills, while teaching individuals to weigh environmental issues and make informed, responsible decisions (NEEAC, 1996). Throughout the mid 1980s and the 1990s, many new techniques to accurately assess knowledge and attitudes of participants in environmental education programs were created (Novak and Gowin, 1984; Kellert, Mintzes et al, 1998; Ruiz-Primo and Shavelson, 2000).

Formal v. Informal Classrooms

Environmental education programs can be subdivided into two main groups depending on where the intervention is administered, formal vs. informal. Assessments of these two settings have been compared in great detail. Zelenzy (1999) constructed a meta-analysis of 18 studies that focused on environmental behavior, nine in formal settings and nine in non-traditional settings. His findings suggest that classroom interventions may be more effective than non-traditional settings. The review found that students were more likely to be actively engaged and learn more in classroom settings than in informal settings, although many of the non-traditional settings provided minimal interventions, such as consumption labels and fuel-usage modeling.

The study revealed three important findings: active participation is positively related to effectiveness in improving environmental behavior; the younger the students, the more their attitudes change; and, the longer the intervention, the more attitudes and behaviors changed.

Armstrong and Impara (1991) evaluated the effects of *Naturescope* magazine on the knowledge and attitudes of 5th and 7th grade students. An increase of knowledge but no change in attitude was found, and this was attributed to a lack of participation and critical thinking about issues present in the study.

A considerably greater number of research studies concerning the effects of environmental programs in non-traditional settings have been performed. These informal settings include a wide variety of locations, including zoos, aquariums, museums, nature reserves, parks, even sidewalks. Due to the complexity of these locations a standard set of guidelines to assess programs has rarely been used, making comparison of these interventions difficult.

Short-term Interventions v. Long-term Interventions

Despite the lack of uniformity in these studies, one variable that seems to impact program effectiveness is the length of the intervention. Short-term interventions (1 day or less), have been found to be highly ineffective. Ryan (1991) assessed the attitudinal changes in 5th and 6th graders after a single-day conservation awareness program. He found no statistically significant long-term change in attitudes, although he reported students had a greater appreciation of the environment as park visits increased. Another study of conservation programs at a Columbian zoo showed that there was no significant difference in knowledge or attitudes after a 2-hour visit to the zoo (de White and Jacobson, 1994). This study included a second intervention in which the teachers attended workshops before the visit. A positive influence in the students experience was only reported in those groups with teachers who attended the workshop, demonstrating the influence of the teacher on the students learning experience.

While short term interventions seem to be ineffective, a positive correlation in the time spent on interventions and the effect of the intervention has been shown (Ryan, 1991, Zelenzy, 1999). Bogner (1998) compared the effects of both short and long-term interventions. Data from the study "indicate that outdoor ecology programs can influence a student's behavior toward a more positive environmental attitude, provided the intervention is of sufficient duration"(Bogner, 1998). A similar study by Shepard and Speelman (1986) studied a 4-H group and compared test groups of 3 and 5-day durations. A stronger change in attitude was shown with the longer intervention period. These findings were consistent with other studies in showing a positive relationship with greater change in knowledge and attitudes with an increase in time of intervention.

Effects of Knowledge about Biodiversity

Over the past decade a major focus of environmental concern worldwide has been biodiversity. Due to accelerated decline of biodiversity from human actions, it has become one of the most pressing environmental issues (Lindemann-Matthies, 2002). Yen,Yao, and Mintzes (2007) have stressed the importance of biodiversity in education as a basic groundwork necessary to understanding more complex scientific principles e.g. ecosystems, energy flow, food chains, photosynthesis, genetics, and evolution. Both of these papers describe the need for understanding biodiversity as a necessary building block in the meaningful learning process.

Significance of Prior Studies

Historically a well-established methodology for environmental education research has been lacking. In reviewing the literature on this topic, it is evident that many of the studies published have major design flaws. Although these flaws are evident, few have offered any suggestions for improvement or made an attempt to create uniform standards for research.

In one of the few papers to offer suggestions for improvement, Leeming et al. (1993) conducted a meta-analysis reviewing 34 previous studies of environmental education programs and their effects on student's attitudes, knowledge and behaviors. The main problems with prior studies were: 1) *lack of validated testing instruments*, 2) *lack of appropriate analytical techniques to quantify results*, 3) *bias of the researcher as the primary educator*, and 4) *lack of follow-up data*.

Smith-Sebasto (2001) addressed the issue of non-uniformity in environmental educational research of the experimental design and analysis of data. A set of guidelines was compiled by the North American Association for Environmental Education (NAAEE). This work attempts to aid future studies by setting a standard for experimental design and data analysis.

In her study, Andrews (2005) concluded with several suggestions for improving the *MarineQuest* program. Included among these is using pretests to frame students' knowledge, allowing them to build upon that knowledge constructively. Other suggestions include having a set agenda that defines educational, attitudinal, and recreational goals for each intervention; setting up a learning environment that encourages meaningful learning; and having instructors follow a unified teaching theme to optimize the learning experience. These improvements have been implemented in the *MarineQuest* program and comparisons will be made on the effects they have on attitudes and knowledge structure.

Hypotheses

Based on data collected in the summers of 2003 (by Andrews) and 2006 (by Tressler), this study will examine the following hypotheses:

(1) H_0 : Knowledge structure about life in the marine environment is not affected by the MarineQuest program.

(2) H_0 : Knowledge content about life in the marine environment is not affected by the MarineQuest program.

(3) H_0 : Mastery of Learning Objectives about life in the marine environment are not affected by the MarineQuest program.

(4) H_0 : Attitudes towards life in the marine environment are not affected by the MarineQuest program

METHODS

Program Description

MarineQuest programs were designed at the University of North Carolina Wilmington (UNCW) to offer marine science-based environmental education programs to both children and adults of the area and across the region. Established for over 25 years, the programs provide “hands-on, feet wet” field excursions complimented with laboratory activities to enhance the learning experience. The *MarineQuest* goals are to expand the participant’s knowledge of the marine environment, but to also promote positive environmental attitudes. A description of cognitive and affective objectives of the programs is given in Tables 1 and 2.

Part of the *MarineQuest* summer camp programs, *Coast Trek* was developed for children ages 11-13. This age group was selected for the study because its curriculum and activities during the summer of 2006 overlapped with those of the subjects of the 2003 summer study. An agenda of the weekly activities is listed in Appendix (A).

Subjects

Residential and commuter participants of the *Coast Trek* summer program, ages 11-13, were used as subjects. 2006 summer sessions were offered as either residential or commuter. Residential participants slept in dormitories at UNCW, and engaged in evening social activities including watching movies and going to the campus recreation center; commuters went home every evening. Both received the same daily instruction. Each student received approximately 35 hours of instruction time over the course of the week.

During the 2006 season, 113 participants (57 female and 56 male) were enrolled in the *Coast Trek* program. *MarineQuest* registration fees for the summer of 2006 ranged between $650 (residential), and $260 (commuter). Using zip code 2000 census data of *Coast Trek* participants, family economic demographics were examined, and mean household income was found to be $63.7 thousand annually.

Students attending a local private, secular high school, Cape Fear Academy, were used as control group subjects. Age of the control group subjects ranged from 11-14 years. The total number of control subjects was 55 (30 female and 25 male). All students were currently enrolled in Biology or Honors Biology classes. During the 2006-07 school year tuition for enrollment at Cape Fear Academy was approximately $11,050-$11,500 per year. Using combined zip code 2000 census data for the greater Wilmington area, mean household income was estimated at $70,000 annually.

All subjects participated in this study under the voluntary consent of their parents or legal guardians. Prior to initiating this study approval of the protocol and consent forms was obtained from the UNCW Institutional Review Board.

Testing Instruments

All instruments used for this experiment were in accordance with those used in the previous testing regime (Andrews, 2003).

Knowledge: Structural Complexity and Content Validity

Concept maps (Novak and Gowan, 1984) were used to assess participants' personal knowledge about marine animal life. Development, administration, scoring and interpretation of all concept maps were done in accordance with Novak and Gowin (1984) and Mintzes, Wandersee and Novak (2000).

Knowledge: Mastery of Learning Objectives

To evaluate the extent to which students have mastered the cognitive learning objectives of the program, a multiple-choice instrument was administered. Questions (Appendix C.6) were developed from the learning objectives of the program (Table 1). The multiple-choice instrument consisted of twelve items each with a correct response, and three incorrect responses. Each item was followed with a confidence index with answers on a Likert-type scale, i.e.: very sure, sure, unsure or very unsure.

Attitude

A *Marine Life Attitude Inventory* was created to evaluate changes in attitudes towards the marine environment. The inventory was created using Stephen Kellert's (1985, 1986) ten theoretical attitudinal dimensions towards animals and wildlife (Table 3). The finalized valid inventory created by Andrews (2003), was used in this experiment. To validate the testing instrument Andrews created a pilot inventory using the methods of Barney (2002) and Thompson (2000), composed of 60 statements (six for each dimension). The pilot inventory was administered to BIO 105 students (n=103) at the University of North Carolina Wilmington. Results were entered into the JMP 4.0 program and factor analyzed, resulting in attitudinal dimensions described by four components: *Factor I: Negativistic/Utilitarian* (10 items); *Factor II: Naturalistic/Aesthetic* (8 items); *Factor III: Ecologistic/Scientific* (4 items); *Factor IV: Moralistic/Dominionistic* (4 items). These final statements (n=26) were then randomized to create a final attitude inventory (Appendix C.7), assembled by Andrews (2003).

Experimental Design

The experiment used a non-randomized version of the Solomon 4-group design (Campbell and Stanley, 1963). This design uses four groups of subjects: two groups that receive the treatment (*experimental*) and two groups that did not (*control*). Among these two groups (*experimental* and *control*), half of the subjects were given a pre-test and post-test, while the other half received only a post-test. Intact groups were assigned to treatments using a random number table. This design was used to examine the effects of the intervention (*MarineQuest* program), and also effects of pre-testing on post-test results.

Instrument Administration

All testing sessions consisted of a concept mapping activity (30min maximum time limit) followed by completion of the attitude inventory, and then the multiple-choice survey. This order was preserved throughout testing. Each group received an introductory lesson on concept mapping during their initial testing session.

Subjects were given white sheets of poster paper and pencils to create concept maps. Participants were asked to create maps that portrayed everything they knew about 'Marine Animal Life'. To aid in the development of their maps, subjects were given six seed concepts (*plankton, seaweed, saltwater, fish, jellyfish, and whale*) to be included in their maps. Upon completion of the concept maps, subjects were given the *Marine Life Attitude Inventory* and a scantron sheet to enter their responses. After completion of the attitude inventory, subjects were asked to complete the multiple-choice survey.

Subjects in Groups I and III, were administered the same instruments during their post-test sessions. Concept maps were returned, and subjects were asked to revise and expand the originals using a different colored pencil. Post-test sessions were given the same seed concepts and same time limit for completion of concept maps. Upon completion of the concept maps, attitude inventories and multiple-choice surveys were administered similarly.

Scoring

Concept Mapping

Scoring of concept maps followed methods described by Thompson and Mintzes (2002) and Andrews (2006). Structural complexity of subjects' knowledge was assessed by counting the total number of: (i) non-redundant concepts, (ii) scientifically-correct relationships, (iii) branches, (iv) levels of hierarchy, and (iv) scientifically-correct cross-links.

In order to evaluate the content validity of the subjects' concept maps, a list of "critical concepts" was created by experts familiar with the *MarineQuest* program. Due to changes made in the program after Andrews' (2003) study, a different list of concepts was created. An initial master list of concepts was discussed and condensed (Table 4). Subjects' maps were scored for the presence or absence of these concepts. Maps from the initial study by Andrews (2003), were rescored for further data analysis.

Multiple Choice

Responses for multiple-choice questions and their respective confidence indices were combined into twelve answers. Each response was categorized as: (1) correct and confident, (2) correct and not confident, (3) incorrect and confident, (4) incorrect and not confident.

Attitude Inventory

Responses for the Marine Animal Attitude Inventory statements were collapsed into two final categories: agree (strongly agree and agree), and disagree (strongly disagree and disagree). Each response was given a numerical value; zero for disagree and one for agree. The total scores for each of the four dimensions were normalized to create a possible score out of one hundred for each scale.

Data Analysis

Four sets of comparisons were comprised to address the hypotheses (Table 5). Pre-test scores (groups I and III) were evaluated to determine the equivalency of the treatment and control group subjects. Post-test scores of treatment and control groups with and without pre-tests (groups I and III, and groups II and IV, respectively) were analyzed to test the effect of the intervention. Finally all post-test scores were compared.

All data analysis was performed using JMP 4.0 software (SAS 2000). Data analysis was performed following methods of Sokal and Rohlf (1969) and Andrews (2003). A re-analysis of Andrews' (2003) data was also performed.

Table 1. Cognitive learning objectives for the UNCW MarineQuest *Coast Trek* program during the 2006 summer season. Created by instructors based upon program goals.

1. Identify the most common marine animal phyla and give examples.
2. Identify animals that live in fouling communities and the adaptations that allow them to live there.
3. When given a basic model of a fish, identify the different parts
4. Define the two types of zooplankton.
5. Explain the importance of zooplankton to the food web.
6. Identify the types of sea turtles indigenous to NC
7. Explain why sea turtles are threatened or endangered animals.
8. Identify animals found in a salt marsh and the adaptations that allow them to live there.
9. Identify the animals that live in the Coquina and adaptations that allow them to live there.
10. Be able to use identification guides to identify specimens taxonomically
11. Explain characteristics for the most common animal phyla

Table 2. Affective learning objectives for the UNCW MarineQuest *Coast Trek* program during the 2006 summer season. Created based upon components addressed by *Marine Life Attitude Inventory* (Andrews, 2003).

1. Decrease the agreement with statements that portray negativistic or utilitarian attitudes
2. Increase the agreement with statements that portray naturalistic or aesthetic attitudes
3. Increase the agreement with statements that portray ecologistic or scientific attitudes
4. Increase the agreement with statements that portray moralistic attitudes while decreasing the agreement with statements that portray dominionistic attitudes

Table 3. Ten attitude dimensions towards animals and wildlife as described by Stephen R. Kellert (1984).

1. Humanistic-	Primary interest and strong affection for individual animals, particularly pets
2. Utilitarian-	Primary concern for the practical and material value of animals or an animal's habit
3. Ecologistic-	Primary concern for the environment as a system, for interrelationships between wildlife systems and natural habitats
4. Scientific-	Primary interest in the physical attributes and biological functioning of animals
5. Negativistic-	Primary orientation an avoidance of animals due to dislike or fear
6. Naturalistic-	Primary interest and affection for wildlife and the outdoors
7. Neutral istic-	Primary orientation a passive avoidance of animals due to indifference
8. Moralistic-	Primary concern for the right and wrong treatment of animals, with strong opposition to exploitation or cruelty towards animals
9. Aesthetic-	Primary interest in the artistic and symbolic characteristics of animals
10. Dominionistic-	Primary interest in the mastery and control of animals, typically in sporting situations

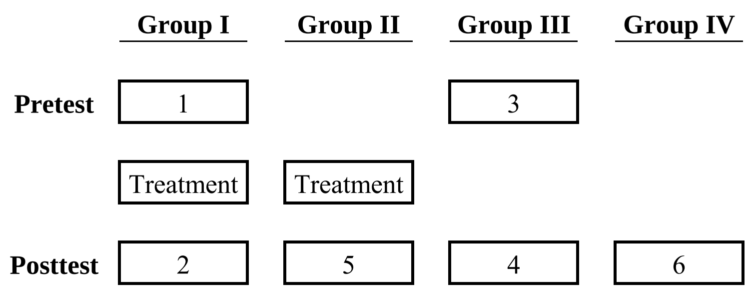


Figure 1. Modified Solomon Four Group Design. Modeled after Solomon Four group design (Campbell and Stanley, 1963), but does not use randomly assigned subjects. Empty boxes indicate the presence of testing.

Table 4 . List of critical concepts used to evaluate content validity of concept maps of participants attending MarineQuest's 2003 *Coast Trek or Ocean Lab* and 2006 *Coast Trek*. Seed concepts in italicizes.

1. *Fish*
2. *Seaweed*
3. *Saltwater*
4. *Whales*
5. *Plankton*
6. *Jellyfish*
7. Food
8. Fish Examples
9. Jellyfish Examples
10. Whale Examples
11. Plankton Examples
12. Dolphin
13. Plant
14. Plant Examples
15. Crustaceans
16. Crustaceans Examples
17. Cartilaginous Fish
18. Cartilaginous Fish Examples
19. Mammal
20. Mammal Examples
21. People
22. Shellfish/Mollusks
23. Shellfish/Mollusks Examples
24. Reptile
25. Reptile Examples
26. Bony Fish
27. Land
28. Birds
29. Amphibian
30. Amphibian Examples
31. Animals

Table 5. Summary of Data Analyses

Differences in:	Instrument Used:	Comparison of:	Method of analysis:
Structural Complexity of Knowledge	Concept Map	Pretests I, III	Wilcoxon
		Posttests I, III	Wilcoxon
		Posttests I, II, III, IV	Kruskal-Wallis
		Posttests Group Pairs	Tukey-Kramer
Content Validity of Knowledge	Concept Map	Pretests I, III	Chi-squared
		Posttests I, III	Chi-squared
		Posttests I, II, III, IV	Chi-squared
		Posttests Group Pairs	Chi-squared
Mastery of Learning Objectives	Multiple Choice	Pretests I, III	Chi-squared
		Posttests I, III	Chi-squared
		Posttests I, II, III, IV	Chi-squared
		Posttests Group Pairs	Chi-squared
Attitude	Attitude Inventory	Pretests I, III	Wilcoxon
		Posttests I, III	Wilcoxon
		Posttests I, II, III, IV	Kruskal-Wallis
		Posttests Group Pairs	Tukey-Kramer

RESULTS

Results of data analyses for both years of this study, 2003 and 2006, are presented here. Data were collected and analyzed by Andrews (2003) for the 2003 phase of this study. Those data were re-analyzed here. The analyses examined the effects of the *MarineQuest* program and the pretest administration on: 1) Structural Complexity of Knowledge, 2) Content Validity of Knowledge, 3) Mastery of Learning Objectives, and 4) Attitudes towards Marine Life. For each of these four objectives, several types of analyses were made (Figure 1 and Table 5):

a) Comparison of pretest scores between experimental (O_1) and control (O_3) groups to determine possible differences between subjects prior to the intervention.
b) Comparison of posttest scores among the experimental (O_2) and control (O_4) to determine differences from the combined effects of both the pretesting administration and the intervention.
c) Comparison of posttest scores across all groups (O_2, O_4, O_5, O_6) to determine trends independent of intervention or pretesting administration, and
d) Post hoc, pairwise comparisons of posttest scores to determine the origin of posttest differences

Structural Complexity of Knowledge

Pretest scores for Groups I and III are summarized in Figure 2. Results of the Wilcoxon tests show no significant differences among any structural complexity measures for the 2003 treatment, while analyses show a significant difference on one of the five measures (i.e. branching) for the 2006 treatment. Posttest comparisons for Groups I and III (Figures 3 and 4) revealed significant differences ($p<.05$) on four of the five measures in 2003, while only two of the five measures showed significant differences favoring Group I in 2006 (i.e. cross-links, $p<.05$, and hierarchy $p<.01$).

Comparisons of structural complexity measures among posttest scores of all four treatment groups were made using a Kruskal-Wallis analysis (Figures 5 and 6). Significant differences ($p<.01$) were observed on four of the five measures in 2003, and on all five measures in 2006. Tukey-Kramer pairwise comparison tests for the 2003 treatment showed significant differences ($p<.05$) in four of the five measures between groups I-II, and in three of the five measures between groups I-III, and I-IV. Post hoc, pairwise comparison tests of the 2006 data revealed significant differences ($p<.05$) in all five measures between groups I-IV, and in only on measure between groups I-II, and groups I-III (Table 6).

Content Validity of Knowledge

Chi-squared analysis of pretest frequencies of groups I and III from 2003 revealed significant differences ($p<.05$) for three critical concepts – bony fish, dolphins, and people. Similarly, chi-squared analysis of pretest frequencies of groups I and III from 2006 found differences ($p<.05$) for two of the thirty one critical concepts – examples of fish and food. Comparisons of posttest frequencies between groups I and III found significant differences ($p<.05$) in eleven concepts from 2003, and four critical concepts from 2006, with all differences favoring the experimental group I.

A summary of posttest frequencies and results of the chi-squared analysis between all groups are given in Figures 7, 8, and 9. Significant differences ($p<.05$) were revealed in seventeen concepts in 2003, and in nine critical concepts in 2006. Post hoc, pairwise comparisons of the 2003 data found significant differences in eighteen concepts between groups I-II, differences in ten concepts between groups I-III, and differences in fifteen concepts between groups I-IV. Pairwise comparisons of 2006 data revealed significant differences ($p<.05$) in eleven concepts between groups I-II, differences in five concepts between groups I-III, and differences in nine concepts between groups I-IV.

Mastery of Learning Objectives

Summarized 2003 and 2006 pretest frequencies for Groups I and III and results of the chi-squared analysis are shown in Tables 7 and 8, respectively. The analysis of 2003 pretests found differences in four of the twelve multiple-choice objects, while significant differences only were found in two multiple choice items from pretests administered in 2006. Comparisons among posttests for Groups I and III (Tables 9 and10) revealed significant differences ($p<.05$) in eight multiple choice items in 2003, and differences in nine of the items in 2006.

Comparisons of posttest frequencies along all groups and pairwise comparisons based on the Tukey-Kramer criterion are shown in Tables 11 and 12. Significant differences ($p<.05$) were shown in ten of the twelve multiple choice items between all groups in 2003, and in seven items between all groups in 2006.

Attitude

Pretest scores from 2003 and 2006 of Groups I and III, as well as results of the Wilcoxon test are shown in Figure 10. Differences were revealed among two of the attitudinal dimensions in 2003; Negativistic/Utilitarian, in favor of the control group (III), and Dominionistic/Moralistic, favoring the experimental group (I). No differences were seen among pretests in 2006. Posttest comparisons for Groups I and III (Figure 11 and 12) show significant differences ($p<.05$) in three of the four dimensions in 2003, while only showing a significant difference in one of the four dimensions (i.e. Naturalistic/Aesthetic) favoring the experimental group in 2006.

Comparisons of posttest scores across all four groups, done by a Kruskal-Wallis analysis, are given in Figures 13 and 14. Differences ($p<.05$) were revealed in three of the four dimensions in 2003 and in two of the four attitudinal dimensions in 2006. Pairwise tests using The Tukey-Kramer HSD criterion found two differences in the I-III and three differences in the I-IV comparisons in 2003, and one difference in the I-III, and two differences in the I-IV comparisons in 2006 (Table 13).

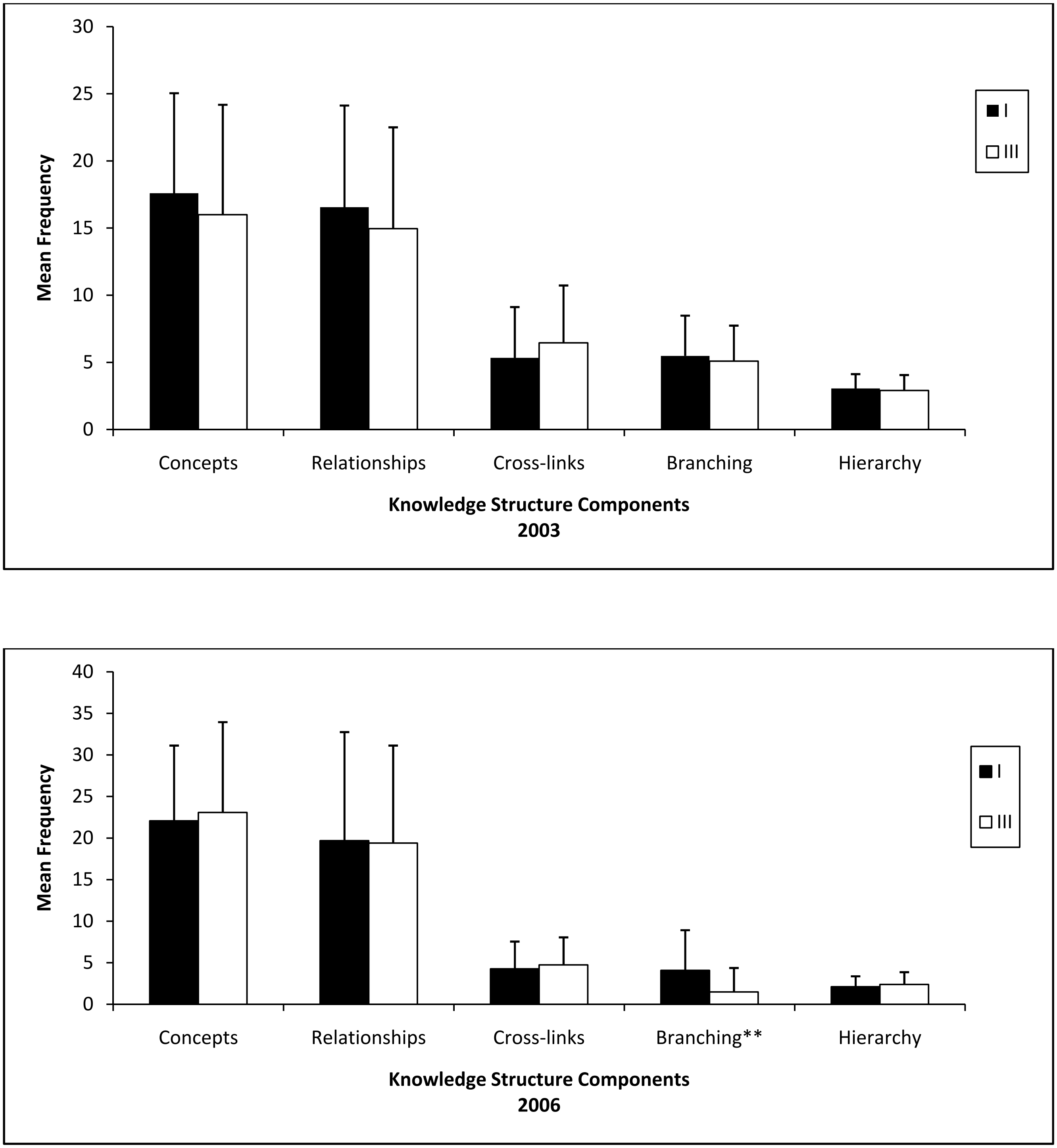


Figure 2. Comparison of Structural Complexity Pretest Scores for Groups I (Experimental) and III (Control). Bars represent standard deviation; *=p<0.05, **=p<0.01

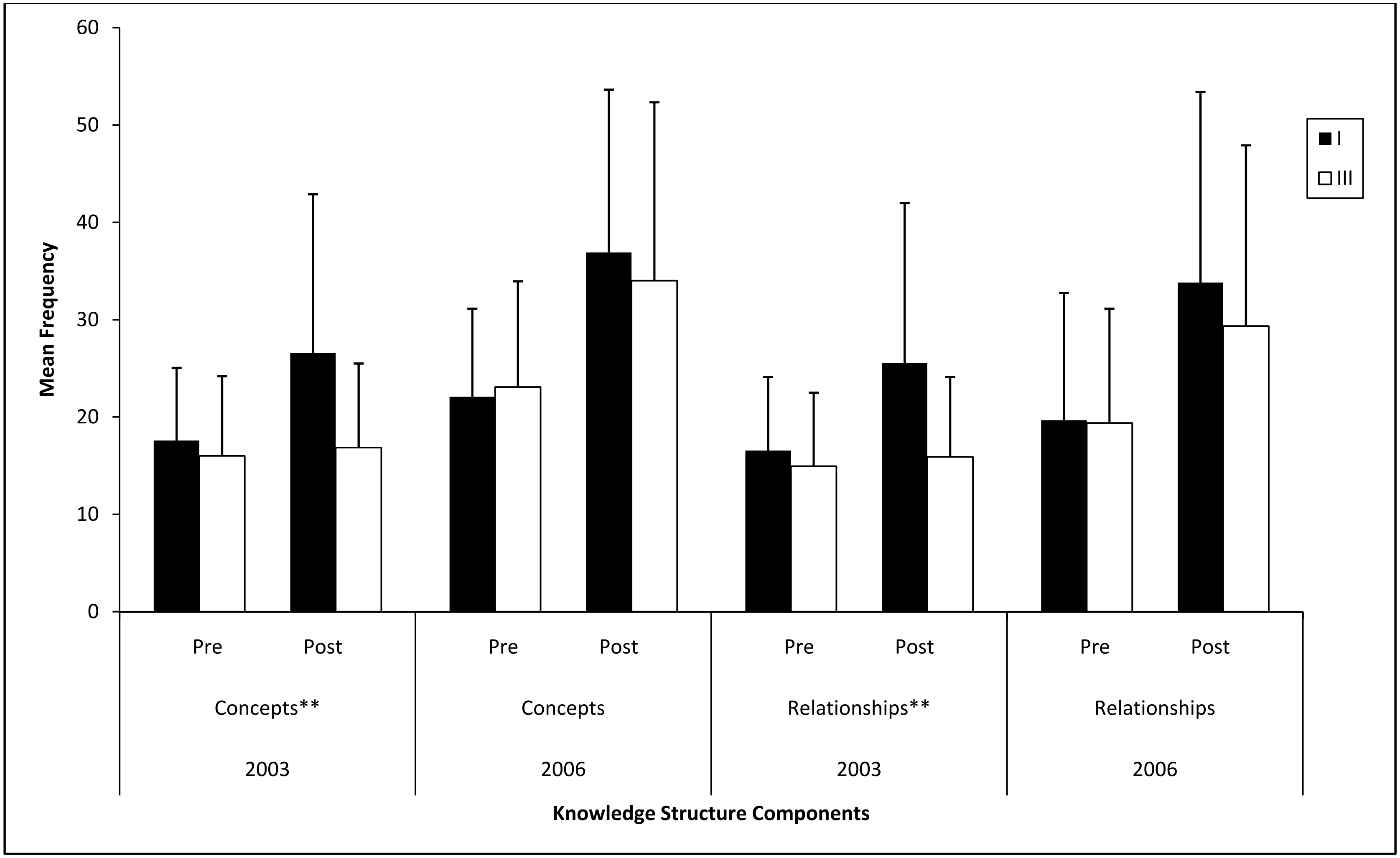


Figure 3. Comparison of Pretest and Posttest Structural Complexity Scores for Groups I (Experimental) and III (Control). Bars represent standard deviation; *=p<0.05, **=p<0.01

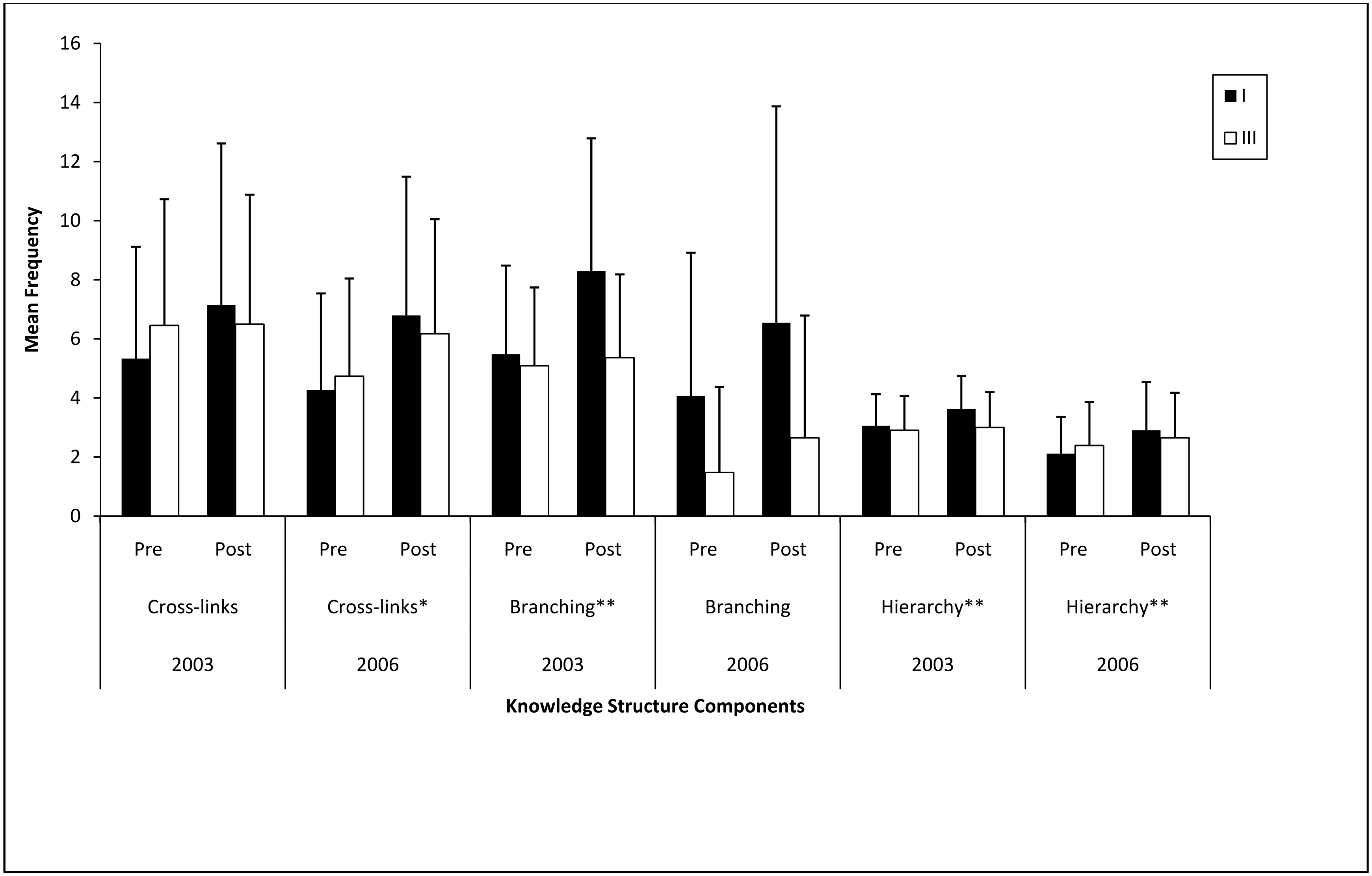


Figure 4. Comparison of Pretest and Posttest Structural Complexity Scores for Groups I (Experimental) and III (Control). Bars represent standard deviation; *=p<0.05, **=p<0.01

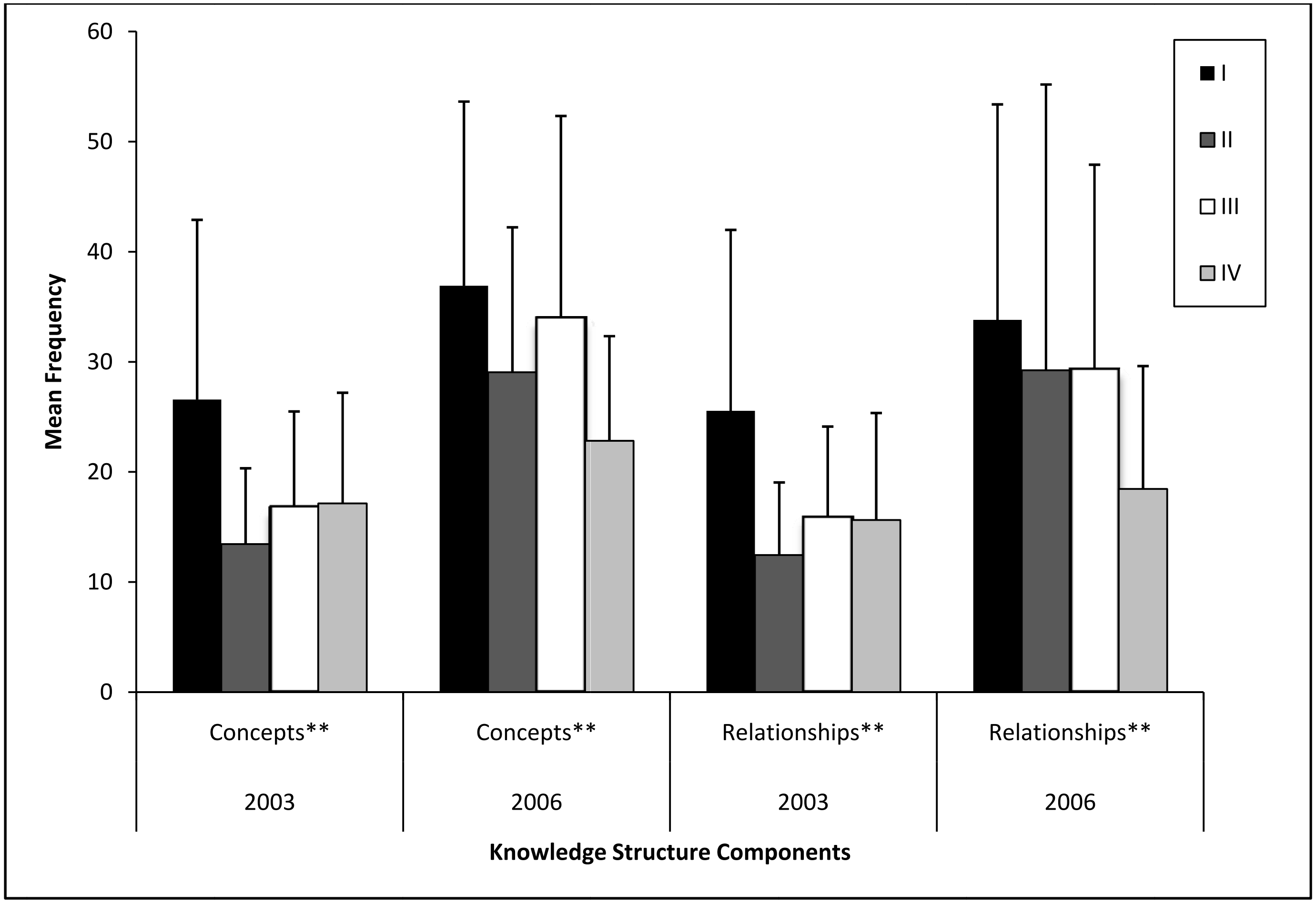


Figure 5. Comparison of Structural Complexity Posttest Scores (Frequency of Components) for all groups. Bars represent standard deviation; *=p<0.05, **=p<0.01

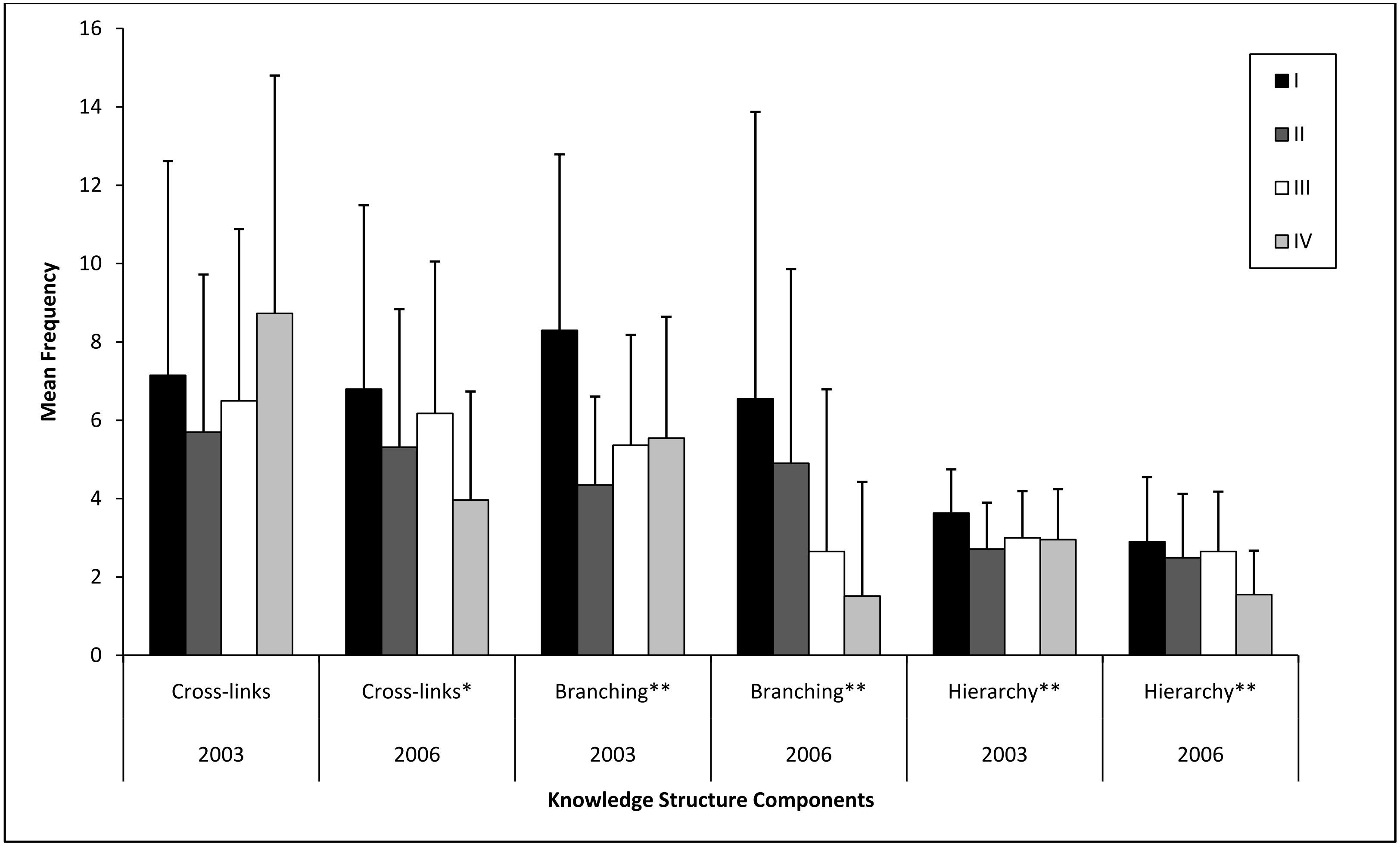


Figure 6. Comparison of Structural Complexity Posttest Scores (Frequency of Components) for all groups. Bars represent standard deviation; *=p<0.05, **=p<0.01

Table 6. Pairwise Comparison (Tukey Kramer HSD) of Structural Complexity Scores.

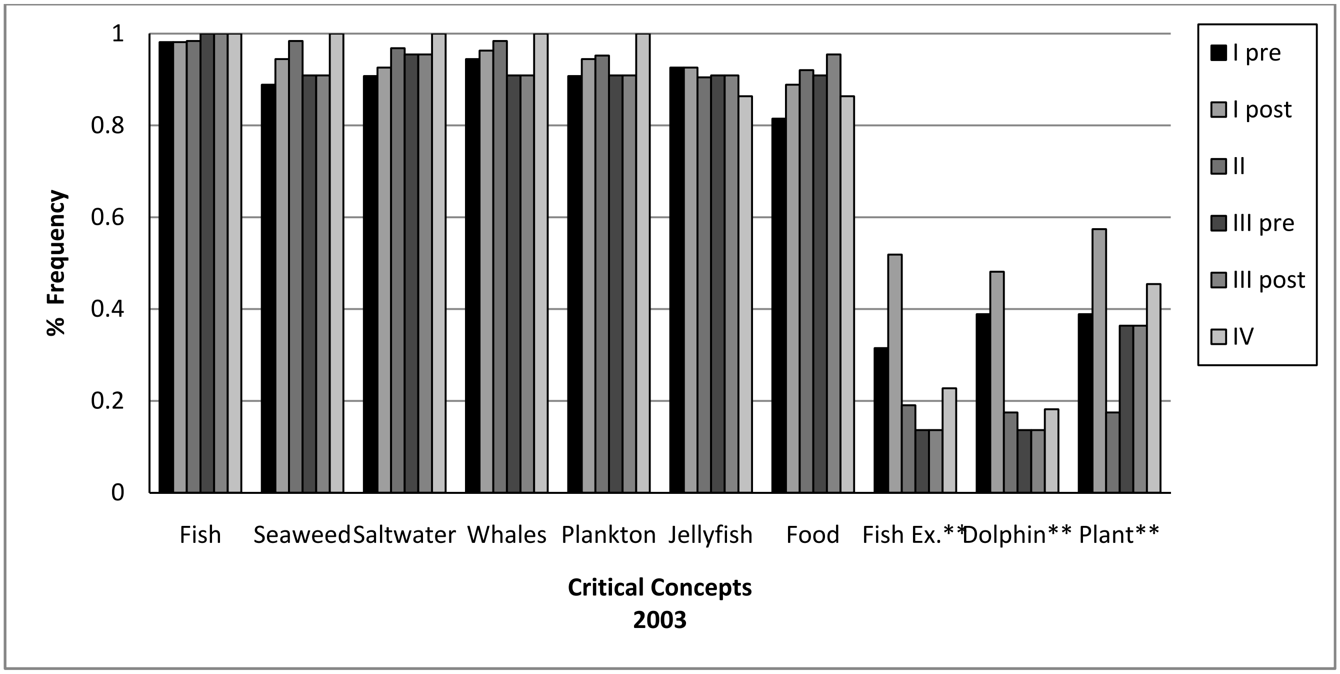
2003

Component	Kruskal Wallis	Pairwise Comparisons I, II	I, III	I, IV
Concept	**	*	*	*
Relationship	**	*	*	*
Crosslink				
Branching	**	*	*	*
Hierarchy	**	*		

2006

Component	Kruskal Wallis	Pairwise Comparisons I, II	I, III	I, IV
Concept	**	*		*
Relationship	**			*
Crosslink	*			*
Branching	**		*	*
Hierarchy	**			*

Note: *=p<0.05, **=p<0.01



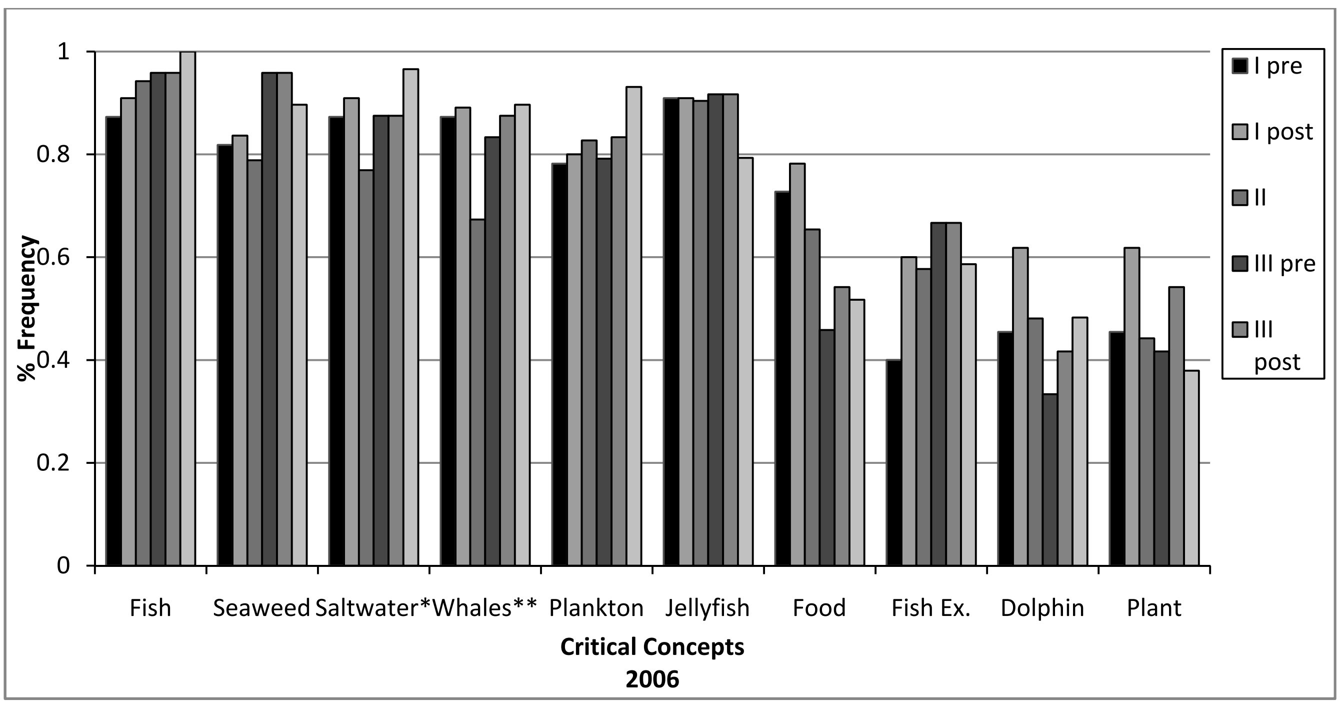
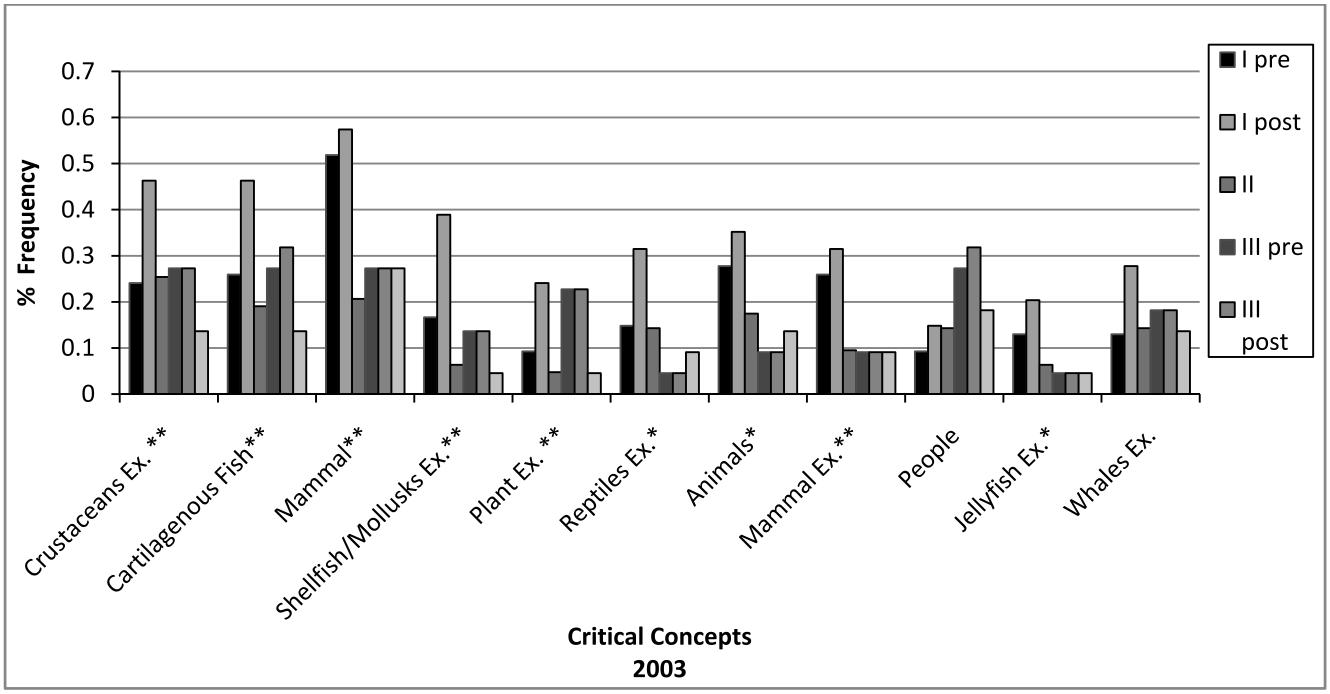


Figure 7. Comparison of Content Validity Posttest Scores (Frequency of Critical Concepts) for all Groups. *=p<.05, **=p<.01



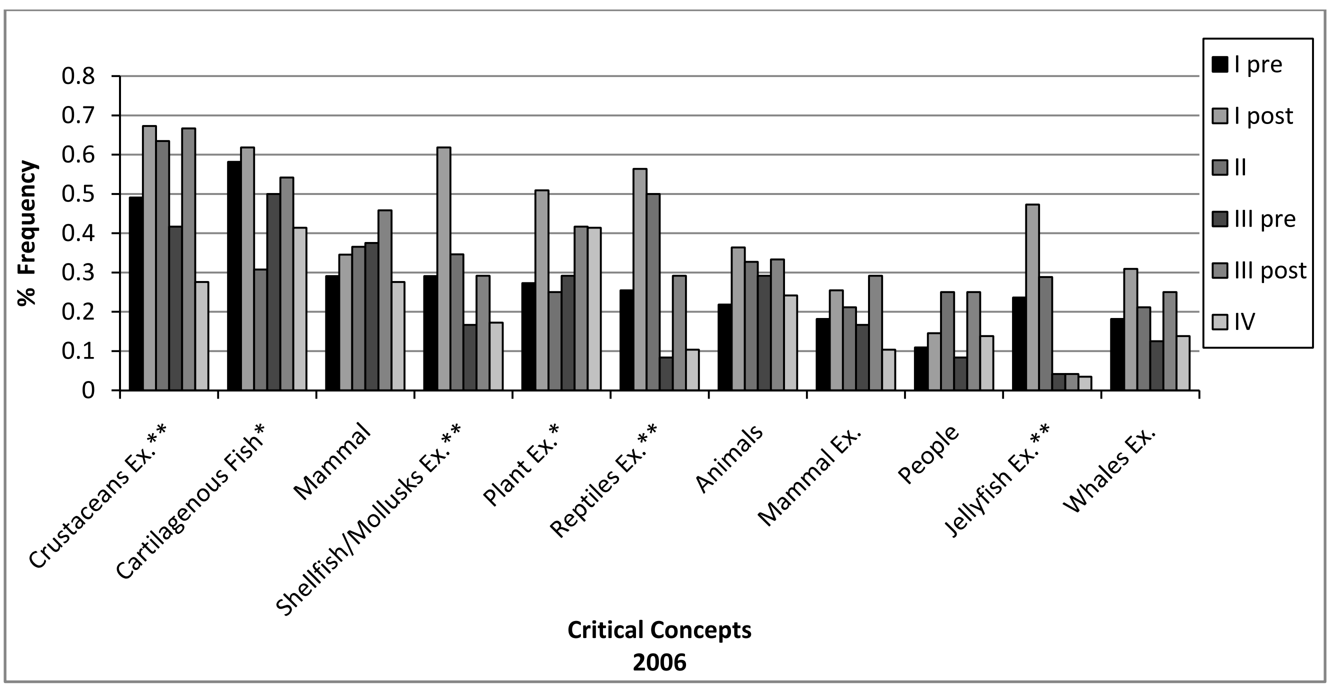
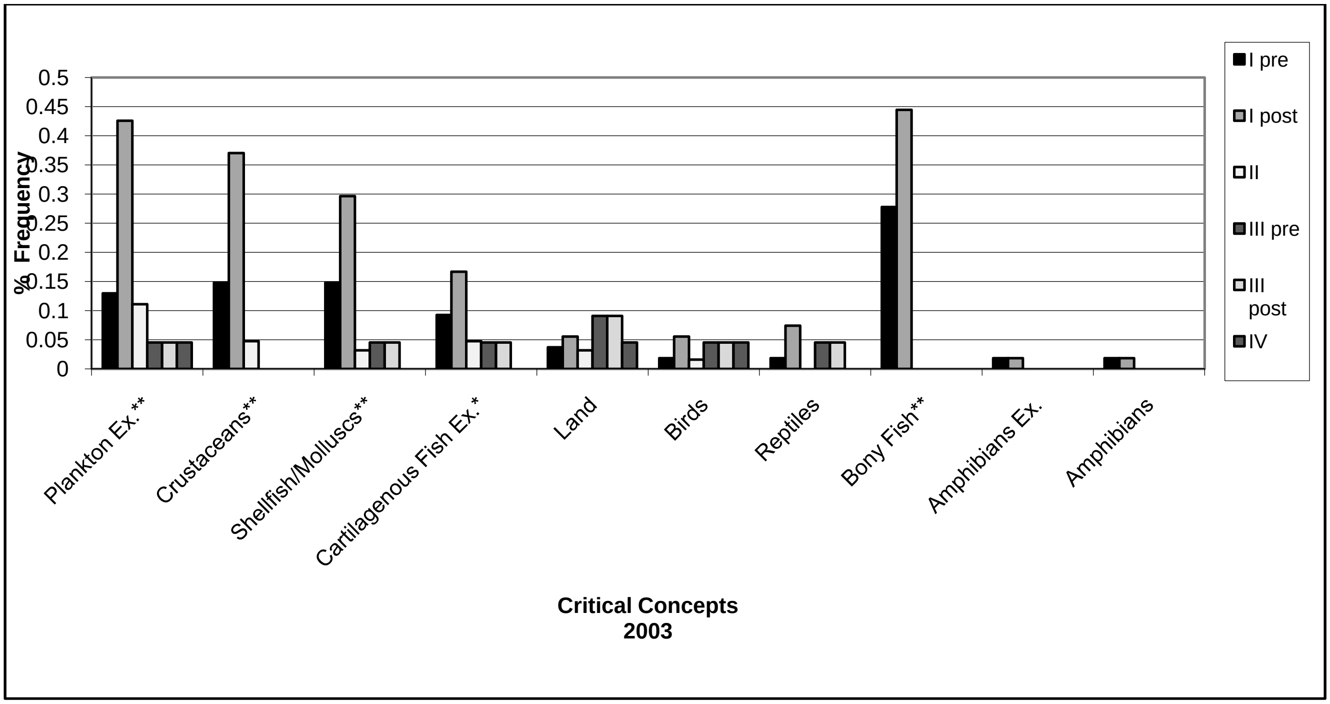


Figure 8. Comparison of Content Validity Posttest Scores (Frequency of Critical Concepts) for all Groups. *=p<.05, **=p<.01



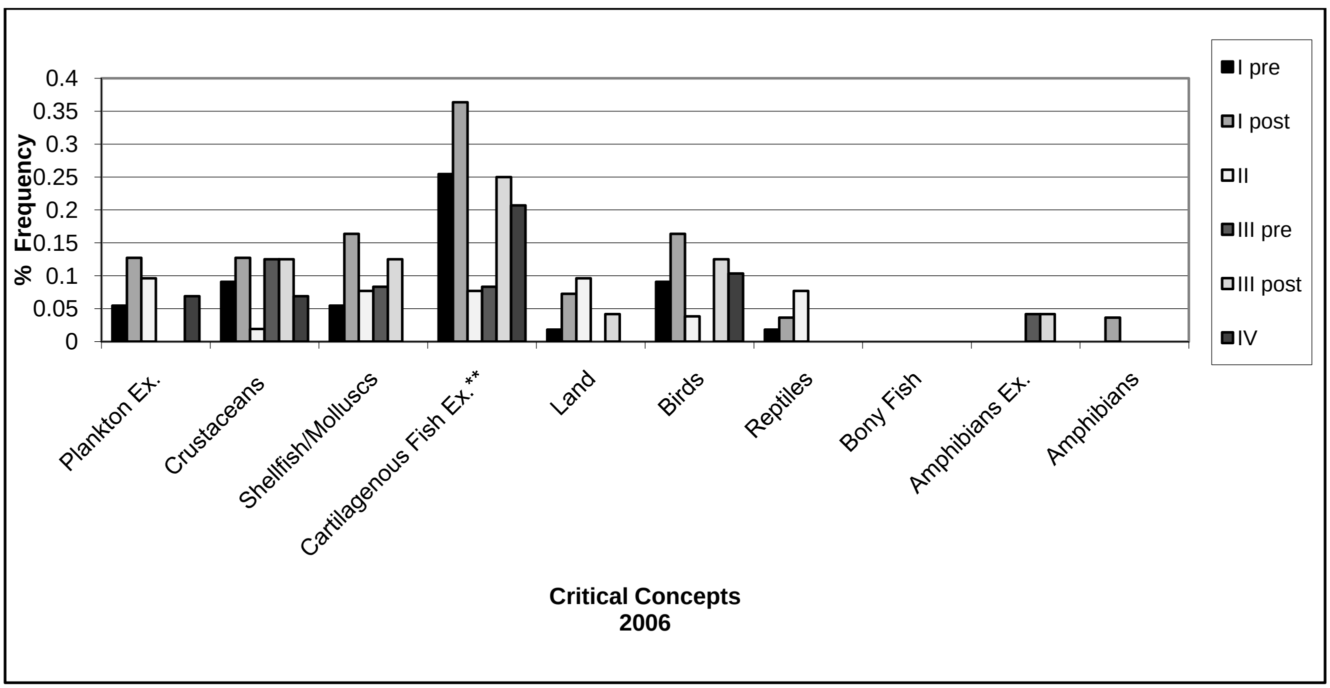


Figure 9. Comparison of Content Validity Posttest Scores (Frequency of Critical Concepts) for all Groups. *=p<.05, **=p<.01

Table 7. Comparison of Mastery of Learning Objectives Pretest Scores (Frequencies of Correctness and Confidence) for Groups I (Experimental) and III (Control), 2003.

	Correct / Confident		Correct / Not Confident		Incorrect / Not Confident		Incorrect / Confident		χ^2
Item	I	III	I	III	I	III	I	III	
1	24	27	20	41	52	23	4	9	
2	7	0	22	27	44	41	26	32	
3	2	0	11	9	65	59	22	32	
4	91	50	2	9	4	14	4	27	**
5	69	23	4	5	19	41	9	32	**
6	2	0	20	0	59	77	19	23	*
7	43	27	33	27	17	23	7	23	
8	11	9	28	14	37	64	24	14	
9	26	27	7	18	20	14	46	41	
10	56	46	7	5	22	36	15	14	
11	22	14	28	32	37	41	13	14	
12	61	18	4	14	9	36	26	32	**

Note: *=p<0.05, **=p<0.01

Table 8. Comparison of Mastery of Learning Objectives Pretest Scores (Frequencies of Correctness and Confidence) for Groups I (Experimental) and III (Control), 2006.

	Correct / Confident		Correct / Not Confident		Incorrect / Not Confident		Incorrect / Confident		χ^2
Item	I	III	I	III	I	III	I	III	
1	7	0	11	42	11	4	71	54	*
2	9	8	15	13	30	4	46	75	*
3	16	8	14	33	21	13	49	46	
4	79	88	7	8	9	4	5	0	
5	42	33	4	17	28	21	26	29	
6	0	0	9	4	19	8	72	88	
7	35	21	28	38	18	12	19	29	
8	30	38	11	4	35	25	24	33	
9	30	33	5	8	42	38	23	21	
10	60	83	16	4	12	4	12	8	
11	12	8	11	33	23	8	54	50	
12	58	54	5	4	16	21	21	21	

Note: *=p<0.05, **=p<0.01

Table 9. Comparison of Mastery of Learning Objectives Posttest Scores (Percent Frequencies) for Groups I (Experimental) and III (Control), 2003.

Item	Correct / Confident		Correct / Not Confident		Incorrect/ Not Confident		Incorrect / Confident		χ^2
	I	III	I	III	I	III	I	III	
1	27	5	3	8	17	5	7	4	**
2	21	3	5	5	10	7	18	7	
3	7	0	4	1	12	13	31	8	**
4	52	11	1	0	1	7	0	4	**
5	37	6	3	0	6	8	8	8	**
6	13	0	9	0	20	12	12	10	**
7	43	6	9	5	1	5	1	6	**
8	22	4	8	1	14	9	10	8	
9	26	7	6	2	6	5	16	8	
10	48	12	2	3	2	3	3	4	**
11	31	4	10	2	10	12	10	4	**
12	39	10	1	2	1	5	10	5	

Note: *=p<0.05, **=p<0.01

Table 10. Comparison of Mastery of Learning Objectives Posttest Scores (Percent Frequencies) for Groups I (Experimental) and III (Control), 2006.

Item	Correct / Confident		Correct / Not Confident		Incorrect/ Not Confident		Incorrect / Confident		χ^2
	I	III	I	III	I	III	I	III	
1	28	0	19	12	23	12	30	75	**
2	40	4	4	17	44	12	12	67	**
3	30	4	16	21	35	17	19	58	**
4	82	83	2	13	9	4	7	0	
5	61	42	2	8	21	21	16	29	
6	2	0	2	4	37	13	59	83	**
7	46	21	19	25	12	8	23	46	**
8	70	38	4	21	19	16	7	25	**
9	42	25	7	13	44	29	7	33	*
10	86	46	2	29	7	17	5	8	**
11	46	13	9	21	24	12	21	54	*
12	70	46	2	12	12	17	16	25	

Note: *=p<0.05, **=p<0.01

Table 11. Comparison of Mastery of Learning Objectives Posttest Scores (Percent Frequencies) for all Groups and Pairwise Comparisons (Tukey Kramer HSD), 2003.

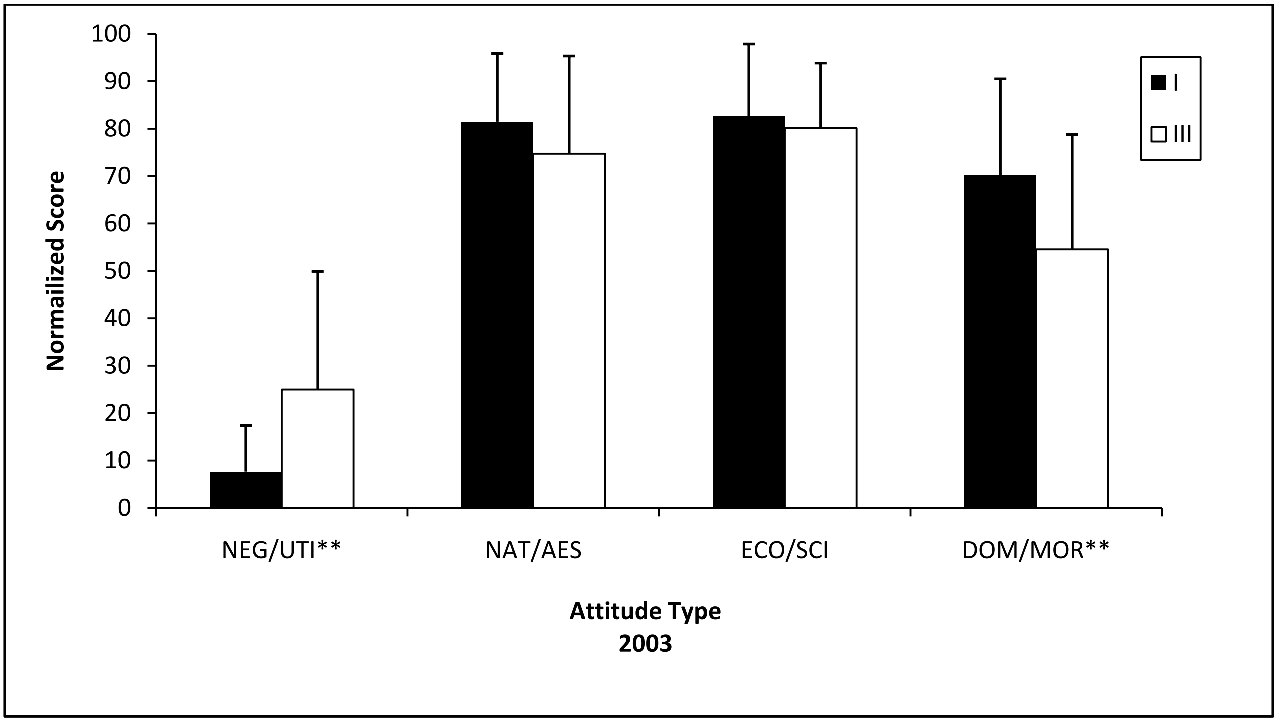
	Correct / Confident				Correct / Not Confident				Incorrect / Not Confident				Incorrect / Confident							
Item	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	χ^2	I, II	I, III	I, IV
1	27	22	5	2	3	13	8	7	17	17	5	11	7	11	4	2				
2	21	26	3	0	5	11	5	2	10	16	7	12	18	10	7	8	**			*
3	7	5	0	3	4	7	1	5	12	28	13	10	31	23	8	4	*		*	
4	52	56	11	17	1	4	0	4	1	2	7	1	0	1	4	0	**		*	
5	37	43	6	9	3	5	0	2	6	7	8	5	8	8	8	6	**		*	
6	13	8	0	2	9	11	0	3	20	32	12	12	12	12	10	5	*		*	
7	43	41	6	13	9	14	5	1	1	6	5	7	1	2	6	1	**		*	*
8	22	26	4	3	8	6	1	2	14	19	9	13	10	12	8	4	**			*
9	26	17	7	7	6	10	2	5	6	11	5	1	16	25	8	9				
10	48	56	12	12	2	5	3	3	2	0	3	2	3	2	4	5	**		*	*
11	31	34	4	5	10	14	2	7	10	9	12	6	10	6	4	4	**		*	*
12	39	37	10	9	1	4	2	0	1	9	5	6	10	13	5	7	*			*

Note: *=p<0.05, **=p<0.01

Table 12. Comparison of Mastery of Learning Objectives Posttest Scores (Percent Frequencies) for all Groups and Pairwise Comparisons (Tukey Kramer HSD), 2006.

	Correct / Confident				Correct / Not Confident				Incorrect / Not Confident				Incorrect / Confident							
Item	I	II	III	IV	I	II	III	IV	I	II	III	IV	I	II	III	IV	χ^2	I, II	I, III	I, IV
1	28	28	0	3	19	20	12	24	23	11	12	10	30	41	75	62	**		**	**
2	40	61	4	0	4	9	17	10	44	21	12	17	12	9	67	73	**	*	**	**
3	30	35	4	7	16	15	21	24	35	26	17	17	19	24	58	52	**		**	**
4	82	89	83	83	2	0	13	7	9	9	4	0	7	2	0	10				
5	61	67	42	41	2	4	8	14	21	17	21	21	16	12	29	24				
6	2	0	0	3	2	19	4	3	37	11	13	0	59	70	83	94		**		**
7	46	44	21	17	19	24	25	34	12	4	8	0	23	28	46	49				**
8	70	80	38	37	4	0	21	21	19	4	16	21	7	16	25	21	**	*	**	**
9	42	52	25	24	7	6	13	14	44	26	29	41	7	16	33	21	*		*	
10	86	92	46	72	2	2	29	14	7	2	17	0	5	4	8	14	**		**	*
11	46	33	13	7	9	15	21	28	24	20	12	17	21	32	54	48	*		*	**
12	70	61	46	66	2	6	12	7	12	22	17	10	16	11	25	17				

Note: *=p<0.05, **=p<0.01



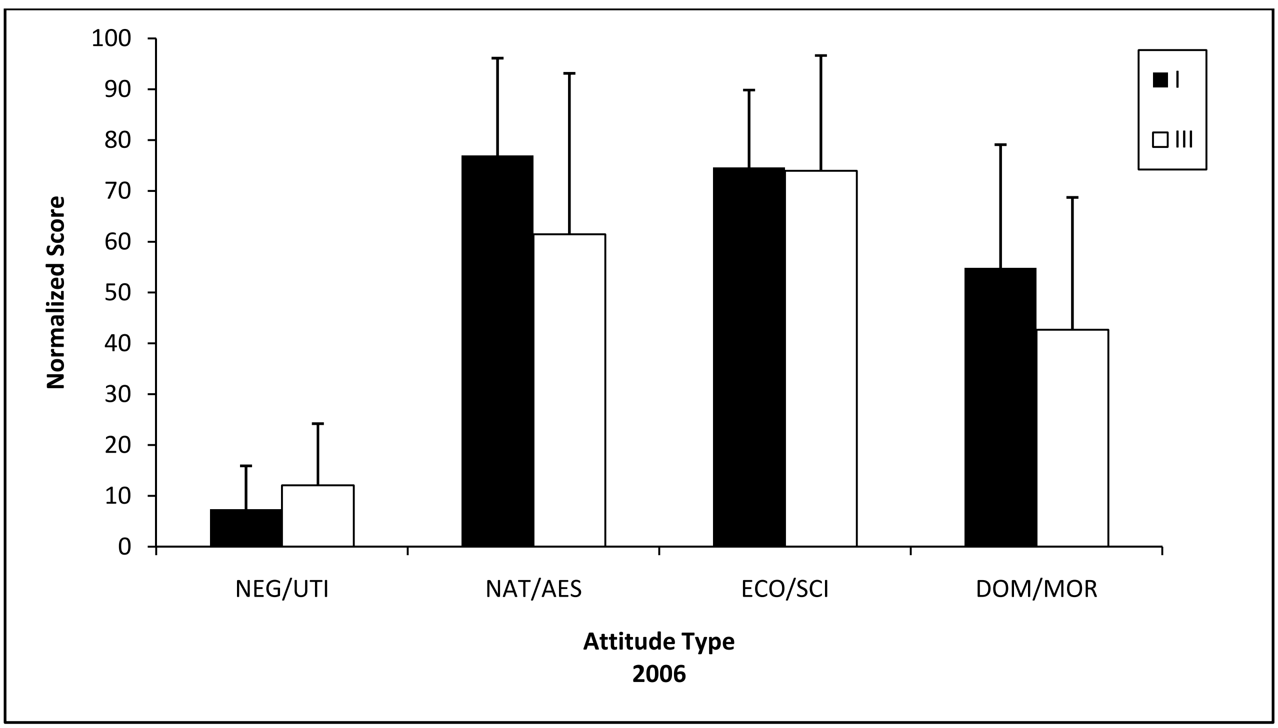


Figure 10. Comparison of Attitudinal Dimension Pretest Scores (Frequencies) for Groups I (Experimental) and III (Control). Bars represent standard deviation; *=p<0.05, **=p<0.01

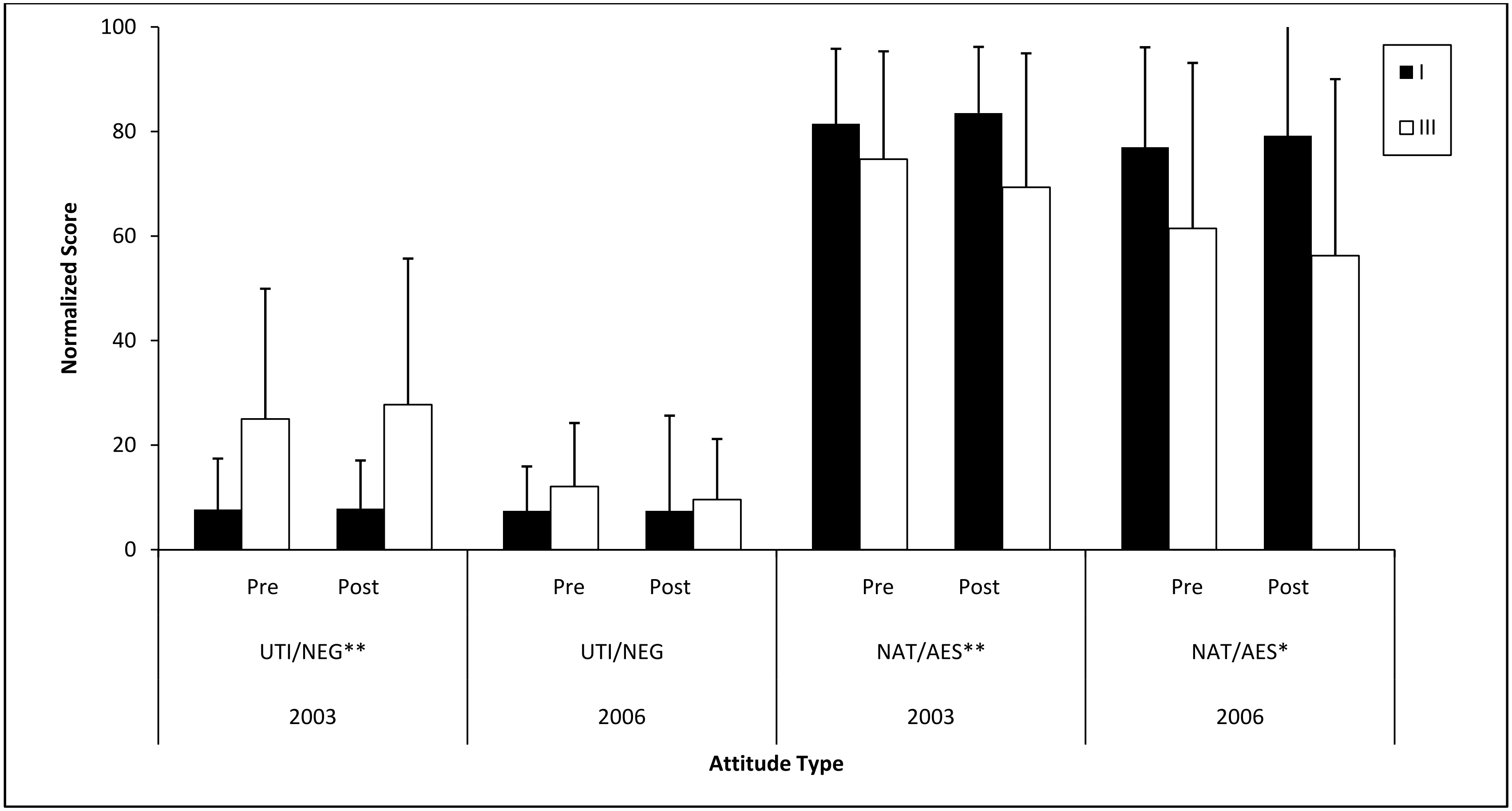


Figure 11. Comparison of Attitudinal Dimension pretest and posttest scores for Groups I (Experimental) and III (Control). Bars represent standard deviation; *=p<0.05, **=p<0.01

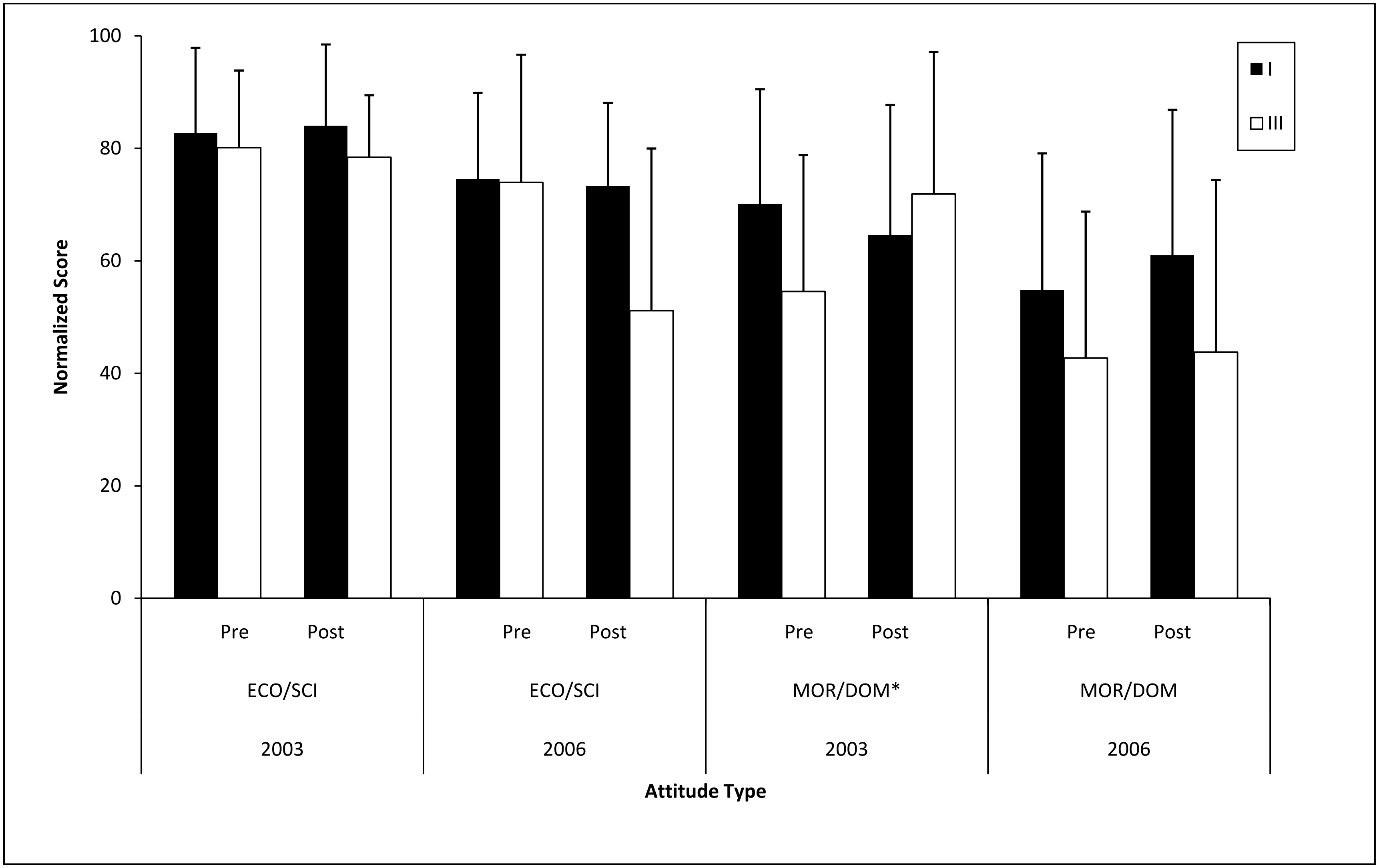


Figure 12. Comparison of Attitudinal Dimension pretest and posttest scores for Groups I (Experimental) and III (Control). Bars represent standard deviation; *=p<0.05, **=p<0.01

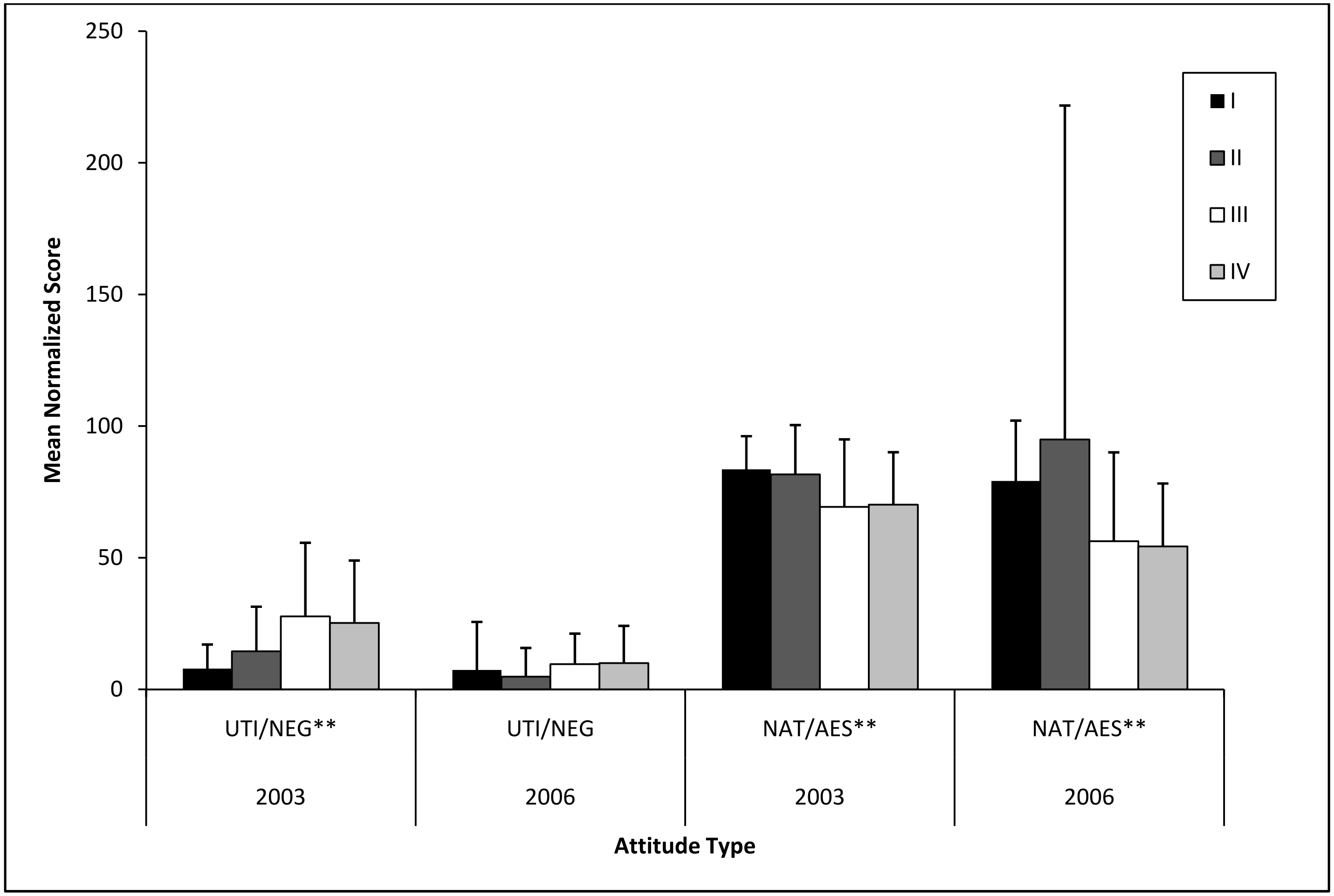


Figure 13. Comparison of normalized Attitudinal Dimension Posttest Scores for all Groups. Bars represent standard deviation; *=p<0.05, **=p<0.01

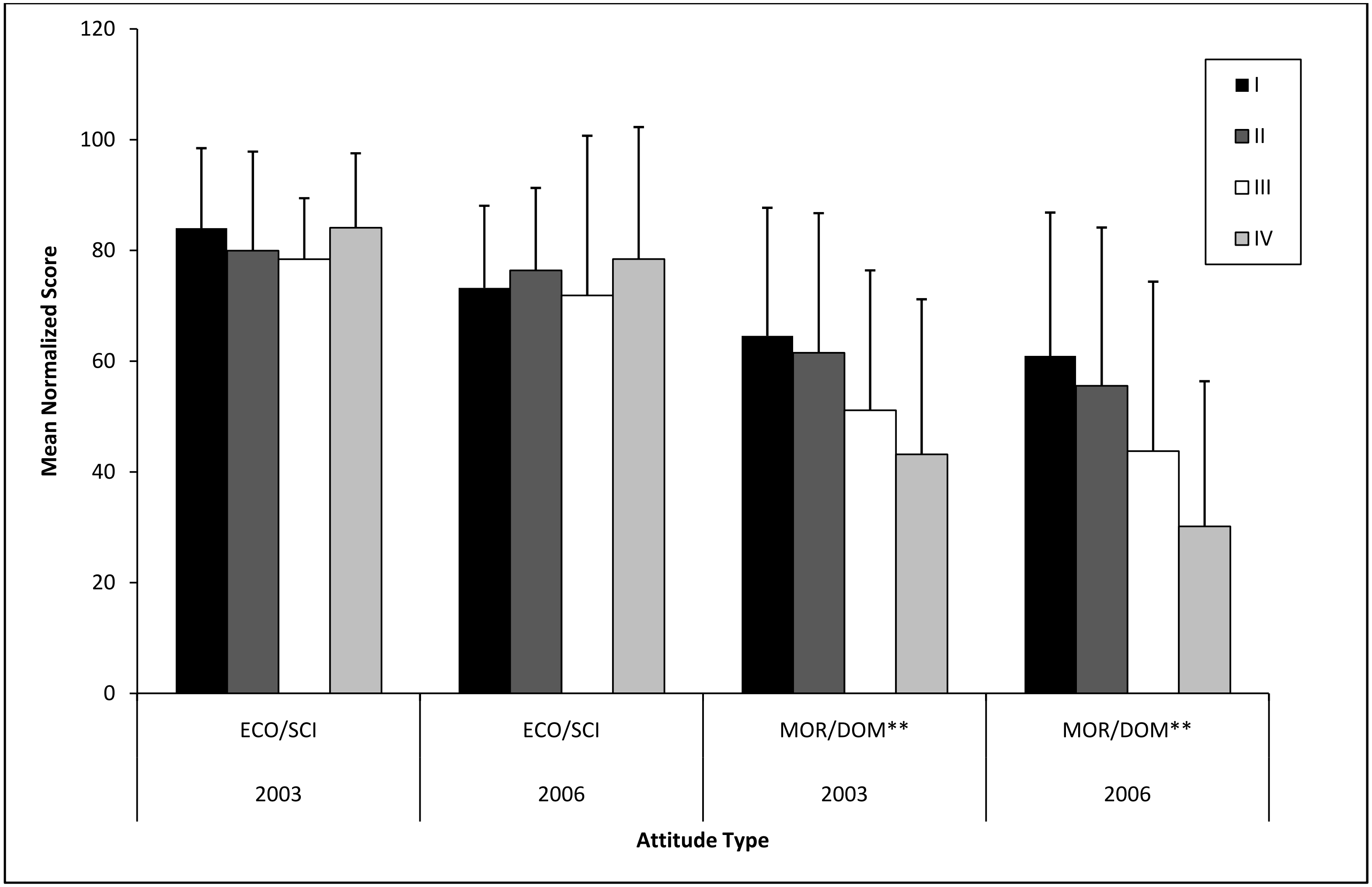


Figure 14. Comparison of normalized Attitudinal Dimension Posttest Scores for all Groups. Bars represent standard deviation; *=p<0.05, **=p<0.01

Table 13. Pairwise Comparison of Attitudinal Dimension Scores (frequencies) (Tukey Kramer HSD). *=p<0.05, **=p<0.01

2003

Dimension	Kruskal Wallis	Pairwise Comparison I, II	Pairwise Comparison I, III	Pairwise Comparison I, IV
Uti/Neg	**		*	*
Nat/Aes	**		*	*
Eco/Sci				
Mor/Dom	**			*

2006

Dimension	Kruskal Wallis	Pairwise Comparison I, II	Pairwise Comparison I, III	Pairwise Comparison I, IV
Uti/Neg			*	*
Nat/Aes	**			
Eco/Sci				
Mor/Dom	**			*

DISCUSSION

Overall, the *MarineQuest* program had substantial positive effects on participant's knowledge and attitudes towards the marine environment during both years of the study. Students' knowledge structure and content, mastery of learning, and attitudes all showed significantly higher results in experimental groups. However, findings of positive effects did vary, in regards to the categories showing significant differences, between Andrews (2003) phase of the study and the current 2006 phase. Although statistical analyses revealed results that varied between the two years of the study, the results of both show overall positive effects of the *MarineQuest* program.

Structural Complexity

Completed concept maps from 2003 and 2006 show significantly greater structural complexity within the experimental group (I) compared to any other group. Andrews' (2003) data revealed pairwise differences between groups I (pre- and posttest experimental) and III (pre- and posttest control) in the number of non-redundant concepts, scientifically correct relationships and superordinate-to-subordinate branching and hierarchy all favoring the experimental group. Similarly 2006 data show positive effects of the *MarineQuest* intervention between groups I and III with an increase in the differentiation of knowledge (branching) and in integrity of knowledge (cross-links) favoring the experimental group.

Pairwise comparisons of the experimental groups (I and II) suggest there may be significant effects of pretesting on participant's knowledge structure. 2003 differences in four knowledge structure components (i.e. concepts, relationships, branching, and hierarchy) show the pretesting regime to have as much of an effect on structural complexity as did the intervention. While 2006 data reveal a positive influence of a pretest, it is only seen in an increase in number of non-redundant concepts between groups I and II.

It should be noted that in 2003 post-hoc pairwise comparisons (I-II, I-III, and I-IV) discovered no differences in number of cross-links among concept maps. Significant differences were reported for cross-links between groups I and IV, and also in a Kruskal Wallis one-way analysis of variance, in the 2006 data. As stated by Andrews (2003), cross-linking of concepts is an indication of higher order thought that is often difficult for children, and may be a result of the limited goals of the *MarineQuest* program. The positive effects seen in cross-linking on maps during the 2006 intervention could be a result of the increased goals and curriculum structure implemented to the program.

Content Validity of Knowledge

Both 2003 and 2006 concept maps showed significant differences among posttests scores for critical concepts present. Differences were seen in groups I and III posttest frequencies in eleven of the thirty-one critical concepts in 2003 and in five of the thirty-one critical concepts in 2006, all favoring the experimental group. The increase in critical concepts should be expected as participants of the *MarineQuest* program are expected to use newly learned terminology in their daily interactions with instructors and other participants. The decrease in number of significantly different concepts from 2003 to 2006 may be a result of the growth of the program as a whole. The *MarineQuest* program has increased the amount of environmental educational sessions offered to local and regional schools during the school year over these three years, and although is was not screened for, it can be imagined there was an increased number of control group subjects who had been exposed to the program previously. Despite this there still was evidence of an overall positive influence of the intervention.

Pairwise comparisons of experimental groups I (pre- and posttest) and II (posttest only) revealed significant differences in eighteen critical concepts in 2003 and eleven critical concepts in 2006. These differences suggest the pretesting regime may have had as much an effect on content validity frequencies as did the intervention.

Mastery of Learning Objectives

Comparison of chi squared analyses for group's I and III posttests discovered significant differences among ten of the twelve items in 2003, and among seven of the twelve items in 2006. All significant differences favored the experimental group. Furthermore comparisons of groups I and II found no differences in 2003 and differences on only three items in 2006. This is evidence the pretesting regime had little measurable effects.

As previously noted by Andrews (2003), students' frustration in comprehending questions was observed in many control groups subjects during both years of this study, which may have led many of the participants to randomly guess answers.

Attitude

Overall analyses of the Marine Life Attitude Inventory showed significant differences favoring experimental group I. In 2003 significant differences were found in three of the four attitudinal dimensions, while differences were found in two of the four dimensions in 2006. Pairwise comparisons between groups I and III found a significantly lower score for the group I Utilitarian/Negativistic dimension compared to group III for both years; and a significantly higher score for the group I Naturalistic/Aesthetic dimension compared to group III for 2003. In both years of the study no significant differences were demonstrated between groups I and II for any of the dimensions.

Interestingly, in both years of the study the Ecologistic/Scientific dimension showed no differences between pre- and posttest or across groups. Statements on the Marine Life Attitude Inventory pertaining to the Ecologistic/Scientific dimension may need to be re-evaluated.

Implications for the MarineQuest Program

It has been shown through this multi-year assessment that the MarineQuest summer program is a very effective intervention in positively influencing participant's perception of the marine environment. Participants have consistently shown significant growth not only in knowledge content but in knowledge structure as well, indicating a more sophisticated understanding of scientifically correct concepts. Through making its' participants more knowledgeable about the marine environment, the program also positively changes their outlook on nature, accomplishing one of the major goals of environmental education; to encourage enhanced stewardship and conservation of the natural environment.

Although the program has proven to provide a successful marine environmental learning experience, there are still some areas of concern. These are suggestions for future improvements, some of which are shared with Andrews (2003), which could help the *MarineQuest* program as well as other environmental education programs.

- **Clearly set educational goals for the program.** Each program needs to have a curriculum that reflects the academic goals for that age group. An understanding of attitudinal/behavioral, as well as intellectual abilities, needs to be used to help develop the lessons that will optimize learning. Reassessing current lessons and activities is needed as curriculum goals change.
- **Develop a thorough training program with re-evaluations.** One of the inevitable problems is high staff turnover, with the majority of staff being university students who move on after graduation. Developing a substantial training program ensures that instructors are aware of the goals of the programs and are prepared to educate in outdoor environments, which can be much more challenging than classroom lecturing.
- **Use assessment tools to constructively build knowledge.** As shown in this study a pretesting regime can have significant effects on overall knowledge gained. Concept maps or other pre-assessment tools should be used to establish a meaningful learning set for participants. Pre-assessments may also be useful tools for educators, formal and informal, to gain a perspective of the knowledge framework already present and how to best build knowledge from there.
- **Use of methods for future assessments.** A modified Solomon 4-group design has proven to be an effective way to assess environmental education programs like *MarineQuest*. Concept mapping has also proven to be an effective assessment tool for informal environmental education programs in which the exact material covered may change due to the environment (weather, tides, availability of species, seasonal conditions…etc.).

- **Future Areas for Assessment**
    - **Cross-age studies:** Looking at participants' abilities to develop and understand complex knowledge frameworks across age groups.
    - **Long term effects of interventions:** Follow sessions with participants to see how interventions affect retention of knowledge, and longevity of attitude changes. This may be difficult due to funding and willingness of participants to comply.
    - **Gender relationships:** Investigate differences in abilities to construct complex knowledge frameworks between sexes.

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Appendix A: Agenda of Activities during MarineQuest program

Coast Trek 2006

Day 1: Introduction to Coast Trek program (lecture)
- Overview of weeks activities
- Background of different marine habitats in coastal region

Journal set-up
- Why to keep a field/lab journal

Set-up group aquariums (activity)
- Basic fish tank configuration/maintenance
- Used to house specimens collected all week

Basic taxonomy (lecture)
- History of taxonomy
- Uses for taxonomy
- How to use guide books

Beach/Shallow Ocean Habitat (lecture/exploration)
- In-field description
- Personal journal entries
- Guided exploration
- Animal/plant collection

Classification of Animals (activity)
- Use field guides
- Enter findings in journals

Environmental Impacts on Coastal Habitats (lecture)
- Abiotic/Biotic factors
- Human impacts

Wrap-up discussion of day's activities and findings

Day 2: Masonboro Island Trip
- Introduction to Barrier Islands
- Boat Safety lesson
- Saltmarsh Habitat
    - In-field description
    - Overview of sampling techniques
    - Guided exploration
    - Animal/plant collection
- Beach Stations
    - Sea turtle lecture (N.C. species, nesting habits, human impact)
    - Guided exploration
    - Animal/plant collection

Classification/Identification of animals (activity)

- Use field guides
- Enter findings in journals

Wrap-up discussion of day's activities and findings

Day 3: Trip to Aquarium (activity)

- Guided Tour
- Scavenger Hunt
- Question Review with Prizes

Rocky Intertidal Community (lecture/exploration)

- In-field description
- Personal journal entries
- Guided exploration
- Animal/plant collection

Guided Kayak Tour (lecture/exploration)

- Blue crab fishery
- Coastal bird observation

Classification/Identification of animals (activity)

- Use field guides
- Enter findings in journals

Wrap-up discussion of day's activities and findings

Day 4: Fouling Community (lecture/exploration)

- In-field description
- Personal journal entries
- Guided exploration
- Animal/plant collection

Saltmarsh Habitat (lecture/exploration)

- In-field description
- Overview of sampling techniques
- Guided exploration
- Animal/plant collection

Classification/Identification of animals (activity)

- Use field guides
- Enter findings in journals

Wrap-up discussion of day's activities and findings

Day 5: UNCW Center for Marine Science (activity)

- Guided Tour
- Squid Dissections

Prepare class/parent presentation (activity)

Awards/presentations

Appendix B: Human Subjects Compliance Documents

Contents:

1) **Approved Copy of UNCW application to Institutional Review Board**
2) **IRB approved Permission Slip**
3) **NIH Certificate**

Appendix B. 1: Approved Copy of UNCW application to Institutional Review Board

IRB Human Subjects Protocol Form
Revised February 10, 2006

RECEIVED
MAY 23 '06
SPONSORED PROGRAMS

For IRB Use Only
Protocol #: 2006-550
Approval Date: 5/25/06
Expiration Date: 5/25/07

University of North Carolina Wilmington
Institutional Review Board
Human Subjects Protocol Form

PART A: GENERAL PROJECT INFORMATION

1. **Title of Project** (use same title as grant proposal, if applicable):

Assessing Marine Quest: Effects of a Summer Marine Science Education Program on Knowledge and Attitudes of Participants

2. **Project Type:**
   - ☐ **Research** **Proposal #** _____ ***Attach a copy of the proposal**
     - ☐ **Funded** **Account #** _____ ☐ **Under Review**
     - **Funding Agency*:** ☐DOE ☐NIH ☐Other _____
   - ☒ **Student Research (if checked, provide student name at #7 below)**
   - ☐ **Teaching** **Course Number:** _____

3. **Proposed Start Date:** June 2006 **Proposed End Date:** August 2006

IRB Use ONLY:
Type of IRB Review: ☐**Full Review** ☒**Expedited #** 7 ☐**Exempt**
Results: ☒**Approved** ☐**Approved Pending Revisions** ☐**Deferred** ☐**Disapproved**

C Dau Rieu ____________ 5/25/06
Signature of the IRB Chairperson **Date**

☐ **If necessary, revisions/clarification received:** ____________
Results: ☐**Approved** ☐**Approved Pending Revisions** ☐ **Disapproved**

____________ ____________
Signature of the IRB Chairperson **Date**

4. **Principal Investigator:** (If student research, PI should be Faculty Advisor)

Name: Joel Mintzes	**Date of IRB Training:** 11/18/03
Title: Professor	**Phone:**962-3437
Department: Marine Biology	**Fax:**
Campus Address: Dobo Hall	**E-mail:**mintzes@uncw.edu
Mailing Address: Dept. of Marine Biology, UNCW	

A copy of this page, signed by the IRB Chair, serves as formal notice of the approval of, disapproval of, or the need to revise this protocol. The protocol and consent form or assent/permission form are effective for ONE year from the date of approval. Any changes to this study, no matter how small, are subject to approval by the IRB. UNCW policy requires the submission of a Closure Report upon completion of a study. *Please note: If this study will continue beyond the expiration date specified upon approval, it is the responsibility of the Principal Investigator to file an Annual Renewal Form prior to the expiration date. IRB forms are available at* http://www.uncw.edu/ora/.

1

Appendix B.2: IRB Approved Permission Slip

Permission Slip:

Assessing Marine Quest- Follow-up Study: Effects of a Summer Marine Science Program on the Knowledge and Attitudes Towards Marine Life

The purpose of this study is to assess changes in knowledge and attitudes of participants in the 2006 Coast Trek program run through the University of North Carolina Wilmington. During the course of the study, participants will be asked to complete attitude inventories, multiple choice tests, and concept maps. All participants will remain anonymous and participation in this study is completely voluntary. This testing will not interfere with the camp's normal routines. If there are ANY questions regarding this assessment, please feel free to contact Kurt Tressler at (910) 431-6511.

I agree to participate in this study and recognize that I may withdraw at any time from the assessment with no penalty to me.

Please sign and date.

________________ Parent   _____ Date   ________________ Participant   _____ Date

UNCW IRB
Protocol 2006-550
Approved CG
Expires 5/25/07

Appendix B. 3: U. S. National Institutes of Health- Human Participant Protections Education for Research Teams online course completion certificate.

Human Participant Protections Education for Research Teams — Page 1 of 1

National Cancer Institute
U.S. National Institutes of Health | www.cancer.gov

NCI Home | Cancer Topics | Clinical Trials | Cancer Statistics | Research & Funding | News

Human Participant Protections Education for Research T

Completion Certificate

This is to certify that

kurt tressler

has completed the **Human Participants Protection Education for Research Teams** online course, sponsored by the National Institutes of Health (NIH), on 05/07/2006.

This course included the following:

- key historical events and current issues that impact guidelines and legislation on human participant protection in research.
- ethical principles and guidelines that should assist in resolving the ethical issues inherent in the conduct of research with human participants.
- the use of key ethical principles and federal regulations to protect human participants at various stages in the research process.
- a description of guidelines for the protection of special populations in research.
- a definition of informed consent and components necessary for a valid consent.
- a description of the role of the IRB in the research process.
- the roles, responsibilities, and interactions of federal agencies, institutions, and researchers in conducting research with human participants.

National Institutes of Health
http://www.nih.gov

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http://cme.cancer.gov/cgi-bin/cms/cts-cert5.pl — 5/7/2006

Appendix C: Testing Instruments

Contents:

Appendix C. 1: Concept Map Instructions

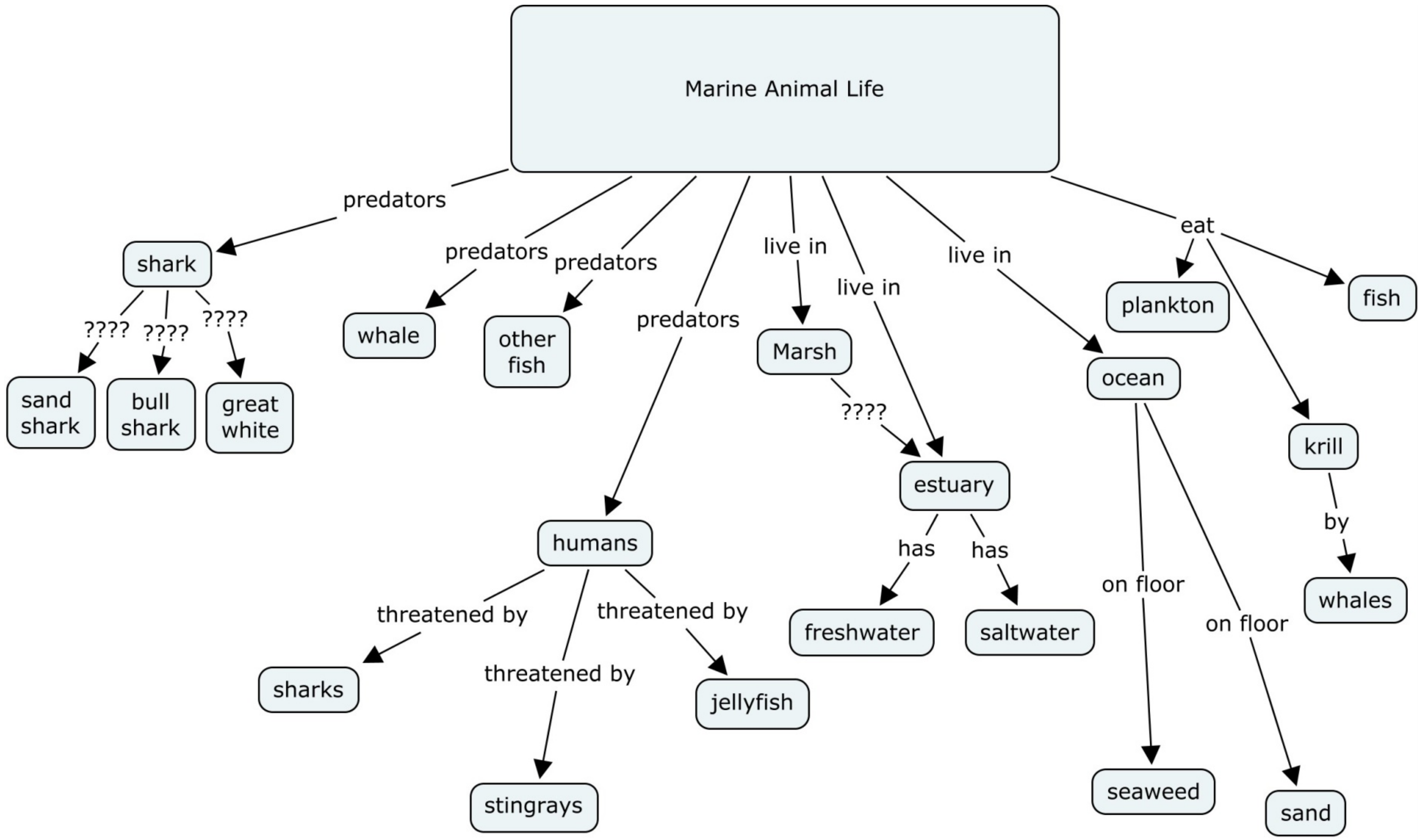
The following are a few of Novak and Gowin's (1984) age-appropriate sample strategies used to introduce concept maps.

A. Activities to prepare for concept mapping (grades three to seven):

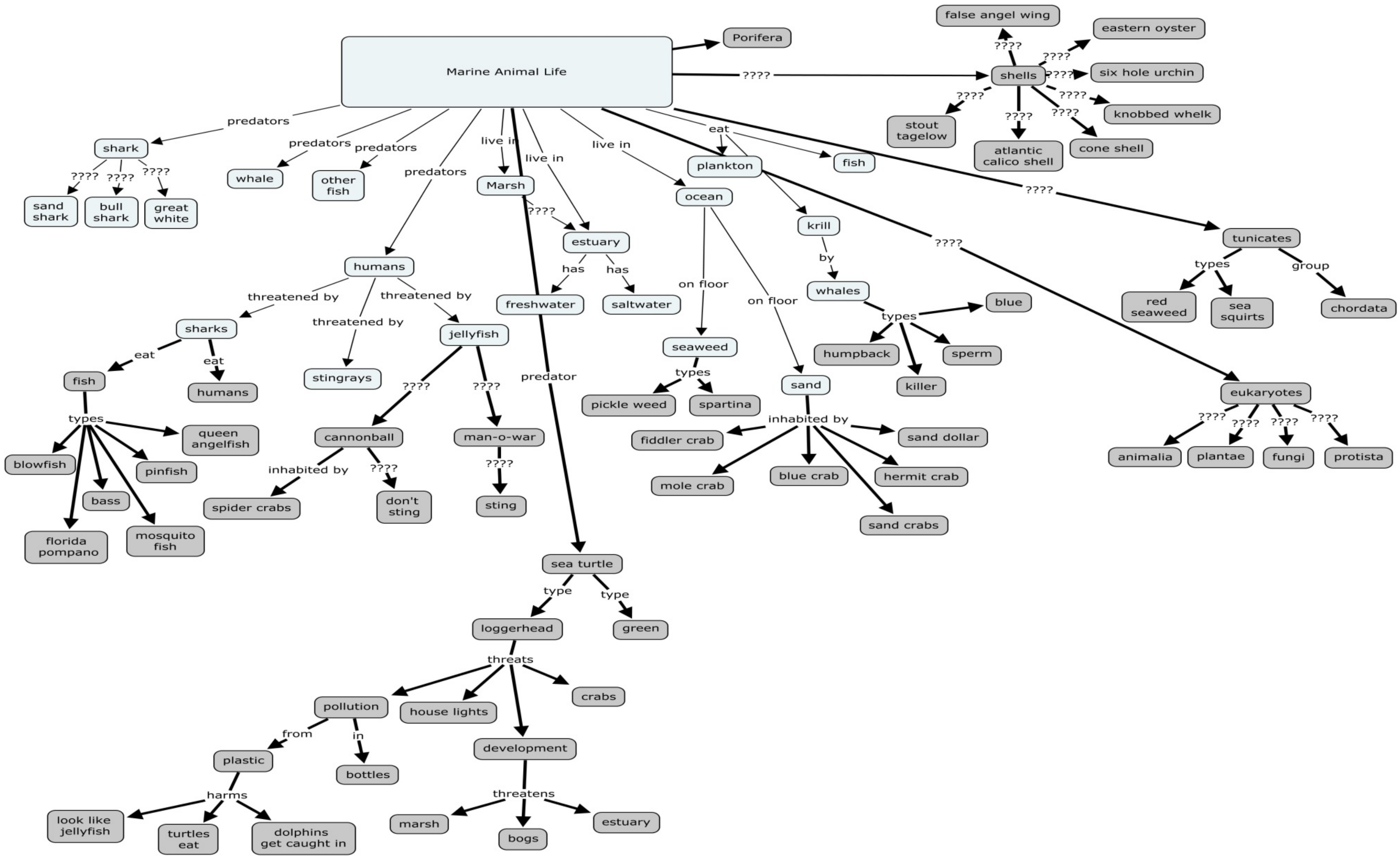
- "Make two lists of words on the blackboard or overhead projector using a list of familiar words for objects and another list for events. For example, object words might be car, dog, chair, tree, cloud, book; and event words could be raining, playing, washing, thinking, thunder, birthday party. Ask children if they can describe how the lists differ." (29)
- "Ask the children to describe what they think of when they hear the word car, dog, etc. These mental images we have for words are our *concepts*; introduce the word concept". (29)
- "Repeat the activities in step 2, using the event words". (29)
- "Now list the words such as are, where, the, is, then, with. These are not concept words; we call them *linking* words…Linking words are used together with concept words to construct sentences that have meaning". (29)

B. Activities to prepare for concept mapping (grades seven through college):

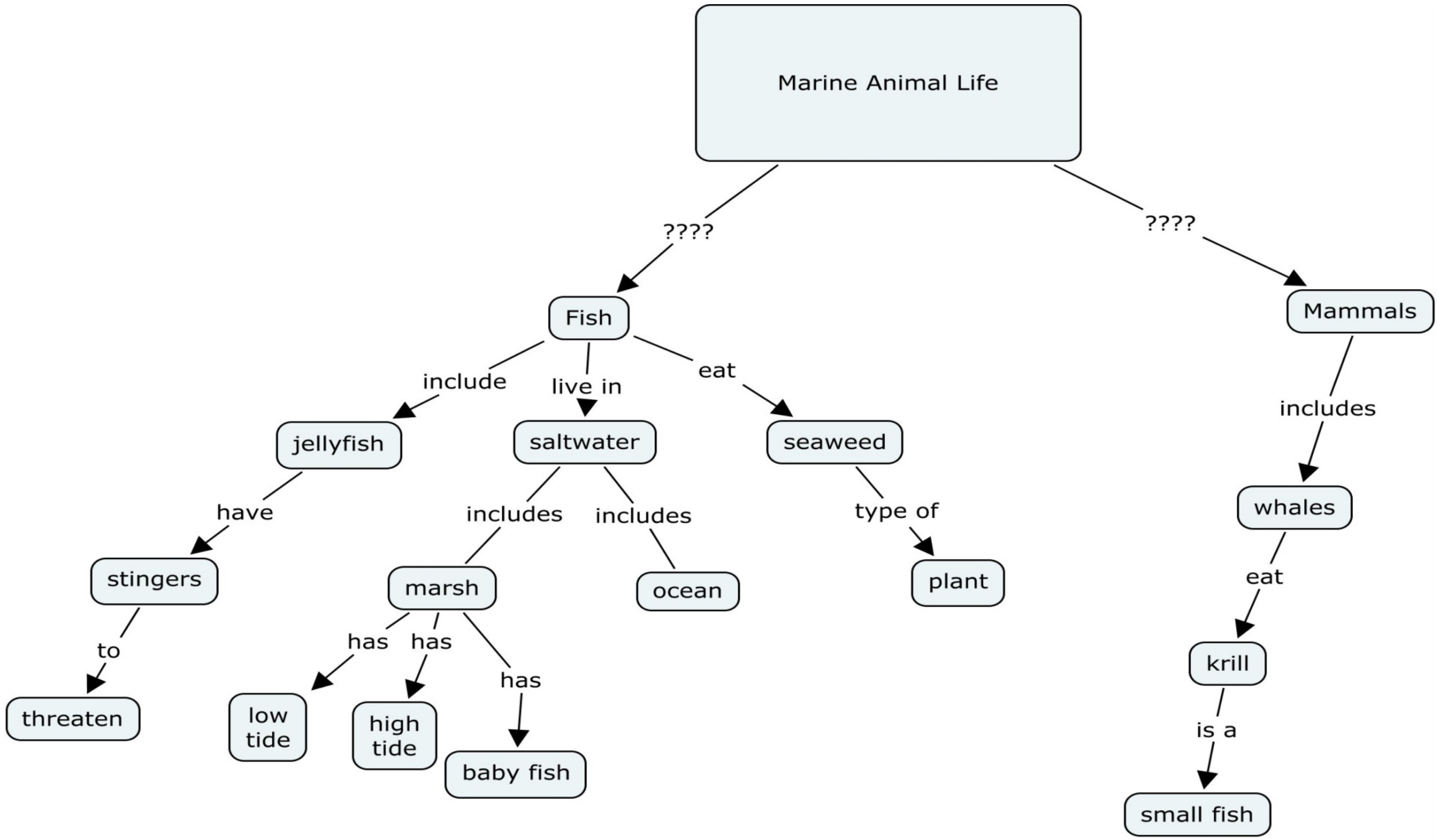
- "Make two lists of words on the blackboard or overhead projector using a list of familiar words for objects and another list for events… Ask the students if they can describe how they differ." (32)
- "Ask the students to describe what they think of when they hear the word car, dog, etc. Help them recognize that even though we use the same words, each of us may think of something a little different. These mental images we have for words are our concepts; introduce the word concept." (32)
- "Repeat the activities in step 2, using event words." (32)
- "Have students construct a few short sentences of their own, identify the concept words and tell whether each is an object or event, and also identify the linking words." (32)
- "Introduce some short but unfamiliar words to the class such as dire, terse, or *canis*. These are words that stand for concepts they already know, but have somewhat special meaning. Help students see that meanings of concepts are not rigid and fixed, but can grow and change as we learn more." (33)



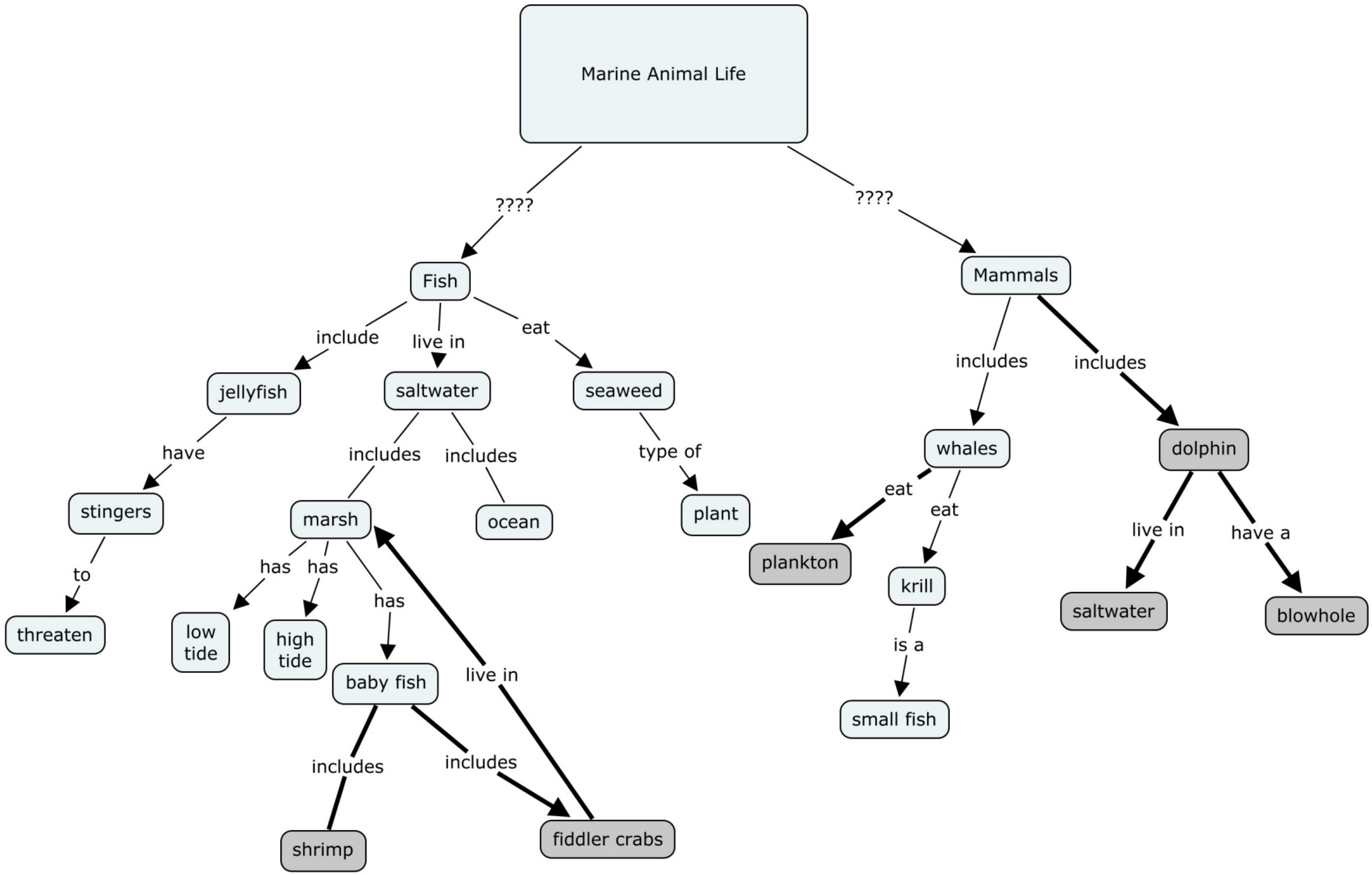
Appendix C. 2: Example of Group I (Experimental) Concept Map – Pretest



Appendix C. 3: Example of Group I (Experimental) Concept Map – Posttest. Concepts added to posttest are shaded.



Appendix C. 4: Example of Group III (Control) Concept Map – Pretest



Appendix C. 5: Example of Group III (Control) Concept Map – Posttest. Concepts added to posttest are shaded.

Appendix C. 6: Multiple Choice Questionnaire

Marine Life Multiple Choice Questions

Please answer the following questions on the bubble sheet provided.

1. Choose the answer that shows the correct phyla and example
- **a.** Cnidaria – clam
- **b.** Porifera – sponge
- **c.** Arthropoda – sea squirt
- **d.** Chordata – anemone
- **e.** Chordata – sea star

2. How sure are you about your answer to question 1?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

3. A common animal that lives in the fouling community would be:
- **a.** Barnacle
- **b.** Fiddler Crab
- **c.** Sea Bass
- **d.** Sea Gull
- **e.** Turtle

4. How sure are you about your answer to question 3?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

5. What problem does NOT face animals that live in the fouling community:
- **a.** Competition for space
- **b.** Periods of inundation and exposure
- **c.** Burial by sediments
- **d.** Competition for food
- **e.** Predation

6. How sure are you about your answer to question 5?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

7. Identify the body part that a fish does NOT have
- **a.** Gills
- **b.** Lateral Line
- **c.** Blowhole
- **d.** Eyes
- **e.** Dorsal Fin

8. How sure are you about your answer to question 7?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

9. Which of the following is NOT a fish:
- **a.** Stingray
- **b.** Eel
- **c.** Dolphin
- **d.** Sea Robin
- **e.** Sturgeon

10. How sure are you about your answer to question 9?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

11. Choose the answer that identifies the two types of zooplankton:
- **a.** Meroplankton, phytoplankton
- **b.** Nekton, holoplankton
- **c.** Phytoplankton, holoplankton
- **d.** Pelagic, Benthic
- **e.** Meroplankton, holoplankton

12. How sure are you about your answer to question 11?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

PLEASE TURN THE PAGE OVER

13. Zooplankton is an important part of the food web because it:
- **a.** creates most of the oxygen in the oceans
- **b.** uses light in photosynthesis
- **c.** provides dense ground cover in the saltmarsh
- **d.** is a source of food for larger animals and other zooplankton
- **e.** eats large, sick animals

14. How sure are you about your answer to question 13?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

15. The five types of sea turtles that nest in North Carolina are the Kemp's Ridley, Loggerhead, Flatback, Hawk's Bill and:
- **a.** Snapping Turtle
- **b.** Green Turtle
- **c.** Box Turtle
- **d.** Sargasso Turtle
- **e.** Calinectes Turtle

16. How sure are you about your answer to question 15?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

17. Choose the answer that is NOT a threat to sea turtle hatchlings
- **a.** Lights in beach hotels
- **b.** Raccoons, ghost crabs, and sea gulls
- **c.** Poachers
- **d.** Seaweed
- **e.** Beach Renourishment

18. How sure are you about your answer to question 17?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

19. A common animal that lives in the salt marsh is the:
- **a.** Ghost Crab
- **b.** Fiddler Crab
- **c.** Bear
- **d.** Great White Shark
- **e.** Dolphin

20. How sure are you about your answer to question 19?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

21. Animals that live in salt marsh grasses or mud must deal with:
- **a.** Inundation by water <u>and</u> exposure to air
- **b.** Competition for limited space
- **c.** Constant temperature
- **d.** High wave energy
- **e.** Limited food availability

22. How sure are you about your answer to question 21?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

23. Which of the following is true about sharks:
- **a.** Sharks hunt people
- **b.** All sharks eat large animals
- **c.** Sharks do not have bones
- **d.** Sharks only have one set of teeth
- **e.** Sharks reproduce quickly

24. How sure are you about your answer to question 23?
- **a.** Very sure
- **b.** Sure
- **c.** Unsure
- **d.** Very Unsure

Appendix C. 7: Final Randomized Marine Animal Life Attitude Inventory

Please respond to each of the following on the bubble sheet by indicating whether you:

(A) Strongly Disagree
(B) Disagree
(C) No Opinion
(D) Agree
(E) Strongly Agree

Strongly Disagree----	Disagree----	No Opinion----	Agree ----	Strongly Agree
(A)	(B)	(C)	(D)	(E)

1. I would rather read a book about dolphins than see them in the wild
2. Sea gulls should be killed to keep them from bothering people at the beach
3. It is terrible that fishermen hurt turtles with their nets
4. I would be excited if I saw a manatee
5. I think that fiddler crabs are interesting creatures
6. The only good fish is a dead fish
7. All marine animals that live on the bottom of the ocean are gruesome
8. I would be excited to go on a whale-watching trip
9. Dolphins should have legal rights
10. I would like to have a dolphin for a pet
11. I am not interested in anything about sharks
12. I feel that the all jellyfish should be killed
13. If you have seen one dolphin, you’ve seen them all
14. People should be able to catch more sharks to keep the price of shark fin soup cheap
15. It is important to protect places where young fish and birds live
16. I would love to swim with a sea turtle
17. Poking jellyfish with a stick is wrong
18. Fishermen should never try to rescue a turtle that is caught in their nets
19. I would like to read books about the relationship between sea turtles and humans
20. Stingrays are not graceful animals
21. I would not go out of my way to see a sea turtle
22. It’s not a human’s job to keep sharks from becoming extinct
23. It is important for aquarium dolphins to be taught tricks
24. Seagulls that dive for your food aren’t trying to be annoying; they are just trying to eat
25. I don’t think that capturing crabs is a challenging activity
26. I would like to watch a sea bird make a nest on the beach