A Thesis

Entitled

Assessing Relationships between Social Context, Knowledge and Student Perspective in a College Course on Environmental Science

By

Michael Mathis

Submitted as partial fulfillment of the requirements for

Masters of Science Degree in Biology: Ecology

___________________________________
Committee Chair: Daryl Moorhead

___________________________________
Committee Member: Christine Mayer

___________________________________
Committee Member: Michael Weintraub

___________________________________
Amanda Bryant-Friedrich, Dr. rer Nat.,
Dean College of Graduate Studies

The University of Toledo

May 2017
An Abstract of

Assessing Relationships between Social Context, Knowledge and Student Perspective in a College Course on Environmental Science

by

Michael Mathis

Submitted to the Graduate Faculty as partial fulfillment of the requirements for Masters of Science Degree in Biology: Ecology

The University of Toledo

May 2017

Environmental perspectives influence how people view the world and so evaluating the influence of knowledge and social context on perspectives may lead to more effective environmental education. I assessed the influence of social context and knowledge on the perspectives of college students by utilizing the New Ecological Paradigm Survey in a University environmental science course. Over four semesters and two years, students completed 1030 paired NEP surveys at the start and end of the course. An overall significant change in score was identified due to the course. Significant relationships also existed between change in NEP and initial score, college of study, and course attendance, suggesting an influence of social context on perspective. Although few studies have identified overall significant influences on perspective due to a course, no study has used course grades as a representation of knowledge to evaluate the influence of knowledge on perspective. No relationship was found between change in NEP and any course achievement or service learning, suggesting no connection between course content and perspective. Additional analysis found possible contradictions in ecocentric and anthropocentric question responses as shown by differences in mean scores greater than
could be explained by question phrasing or confidence intervals. Contradictions may exist because of the conflicting influence of social context and knowledge. Thus, social context may be a more important factor influencing perspective than knowledge, consistent with explanations for many of the partisan divides on scientific issues such as climate change.
# Table of Contents

Abstract i

Table of Contents iii

List of Tables v

List of Figures vi

I. Chapter 1 - Background 1
   A. Introduction 1
   B. Evaluating Perspectives 2
   C. College Students 3
   D. Setting and Goals 5

II. Chapter 2 – Methods 6
   A. Data Collection 6
   B. Change in NEP 6
   C. NEP and Achievement 6
   D. NEP and Service Learning 7
   E. Influence of College 7
   F. Themes and Phrasing 8
   G. Contradictions in Perspective 8

III. Chapter 3 – Results 8
   A. Overall NEP Change 8
   B. NEP and Achievement 9
   C. NEP and Service Learning 10
   D. Influence of College 10
List of Tables

Table 1  Student enrollments, number completing both surveys, percent completing both surveys, change in NEP score, and results of paired t-tests.  26

Table 2  Results of analyses of change in NEP score with respect to individual course performance indicators and initial score and regression of change in score and attendance.  27

Table 3  Student enrollment and percent representation of total enrollment by college, initial survey score, and change in score (mean±standard deviation).  28

Table 4  Summary of survey scores by theme, question, and phrasing, initial survey score, second survey score and change in score (mean±95% confidence interval).  29

Table 5  Results of ANOVA testing the effects of theme and question phrasing on initial and second survey scores.  30

Table 6  Initial and second survey scores by theme and phrasing (means±standard deviations). Means with different letters within a survey are significantly different (P≤0.05).  31
List of Figures

Figure 1  Change in survey score plotted against a student’s initial survey score ($R^2=0.10$, $P\leq0.05$).

Figure 2  Observed versus predicted change in survey score based on initial score and attendance ($R^2=0.11$, $P\leq0.001$)

Figure 3  Observed versus predicted changes in survey score based on initial survey score and college ($R^2=0.13$, $P\leq0.001$)
Chapter 1

Background

Introduction

Understanding scientific knowledge about contemporary environmental issues such as climate change, genetically modified crops, or human vaccinations, has surprisingly little impact on human perspectives about these topics (Armitage, 2005; Nyhan & Reifler, 2010; Broomell et al., 2015). In fact, social context may be a greater contributor to an individual’s environmental perspective than factual understanding (Kollmuss & Agyeman, 2002; McCright & Dunlap, 2011; Kahan et al., 2012). Thus, investigations of relationships between knowledge, social context, and perspectives may help us understand why these gaps exist and how to close them.

For example, many people deny the scientific evidence supporting anthropogenic climate change (Oreskes, 2004; Antonio & Brulle, 2011) and recent studies have shown that knowledge about this issue may not be as influential to individual perspective as social context, i.e., peer group identity (Kollmuss & Agyeman, 2010; McCright & Dunlap, 2011; Kahan et al., 2012). In addition, pedagogical research on constructivist and social cognitive theories have identified social context as an important contributor to learning (Bandura, 1986; Hodson & Hodson, 1998). Social learning also is supported by theories in sociobiology and human evolution. In particular group identity was thought to be important to evolution of early humans because an individual with perspectives contrary to those of the predominant social group could jeopardize his/her survival, social standing, and fitness (Wilson, 2000; Dusek, 2005). Although knowledge of scientific evidence does influence human perspectives of the world (Kollmuss & Agyeman, 2010; Kahan et al., 2012), the social context in which knowledge is gained is also important.
Herein I investigated the relationships between relevant knowledge, social context, and perspectives of college students by comparing results from an environmental perspectives survey (see below) with measures of relevant knowledge and indexes of social context within a university classroom setting.

**Evaluating Perspectives**

The New Ecological Paradigm (NEP) survey (Appendix C) is based on two underlying conceptual theories: first, that the traditional societal perspective demonstrates an anthropocentric, ecologically ambivalent worldview and second, that this perspective is becoming more ecocentric over time, reflecting a more ecologically oriented worldview (Dunlap et al., 2000). Together these two viewpoints define a continuum for ranking an individual’s perspectives about the environment on a scale between anthropocentric and ecocentric. Survey questions alternate between ecocentric phrasing and anthropocentric phrasing with responses ranging from 1 (strongly disagree) to 5 (strongly agree). Anthropocentric questions are reversed scored and added to ecocentric question scores. An accumulative score defines were an individual falls on the continuum from a low score of 15 (completely anthropocentric) to a high score of 75 (completely ecocentric).

The validity of this survey has been tested repeatedly by comparing the perspectives of identified environmentalists to those of the general public (Dunlap, 2008). Other studies have verified that the survey assesses a single environmental belief system with its five independent topical themes (Hunter & Rinner, 2004; Milfont & Duckitt, 2004; Hawcroft & Milfont, 2009). Initially the purpose of the survey was to evaluate broad societal perspectives and changes in
perspective over time. However, the NEP has shown much broader utility as an investigative and comparative tool (Dunlap et al., 2000; Rauwald & Moore, 2002; Van Petegem & Blieck, 2006).

A search of the Web of Science online database for the title, *Measuring Endorsement of the New Ecological Paradigm: A Revised NEP Scale*, yielded 1119 citations in the academic literature. Thus, the NEP is possibly the most widely used measure of environmental concern in the world (Dunlap, 2008; Hawcroft & Milfont, 2009; Pienaar et al., 2015). For example, the NEP has been used to survey children (Van Petegem & Blieck, 2006; Manoli et al., 2007; Kopnina, 2011), assess the environmental beliefs of a wide range of influence groups from farmers to businessmen (Greiner, 2015; Shafer, 2006), and evaluate perspectives of people in different countries (Hawcroft & Milfont, 2009). It has also been used to evaluate perspectives among college students taking courses focused on environmental topics (Anderson et al., 2007; Packer, 2009; Harraway et al., 2012; Dagiliute & Niaura, 2014; Kuo & Jackson, 2014; Shephard et al., 2015). Measuring environmental perspectives in different settings like college courses or communities may inform future education practices and/or environmental policies.

**College Students**

Compared with other audiences and study settings, college classrooms represent a unique opportunity to explore the relationships between knowledge, social context, and perspective in a microcosm of society. The classroom provides a specific learning environment focused on a single topic. Moreover, classes in environmental science provide a clear opportunity to evaluate changes in environmental perspective with growing knowledge about the topic. The college classroom also provides a semi-controlled environment because students are committed to the class for a semester and their individual perspectives and knowledge can be measured at the
beginning and end of this time period. Few other opportunities exist where knowledge is evaluated as rigorously as in the academic classroom or is as focused on one topic, over such a definite period of time. Other studies have identified these same, convenient aspects of working with college students (Anderson et al., 2007; Packer, 2009; Shephard et al., 2015). However, no study has used course achievement as a measure of knowledge. Thus college courses likely provide the best opportunity to explore relationships between knowledge, social context, and environmental perspective.

Most previous studies of college students did not find a significant change in overall environmental perspective during courses (Packer, 2009; Harraway et al., 2012; Dagiliute & Niaura, 2014; Shephard et al., 2015) although significant changes were sometimes found within specific focal themes or for particular questions of the NEP survey (Anderson et al., 2007; Packer, 2009). Other factors like social context, political orientation, gender, or race can influence student perspective to a greater degree than knowledge (Kollmuss & Agyeman, 2010; McCright & Dunlap, 2011; Kahan et al., 2012). For example, earlier studies have investigated the impact of social context on students by comparing NEP scores of different study majors (Hodgkinson & Innes, 2001; Anderson et al., 2007; Harraway et al., 2012; Shephard et al., 2015), and relationships between survey responses and environmentally friendly behaviors (Dagiliute & Niaura, 2014). Interestingly, significant differences between genders have been reported, with females generally being more ecocentric (Harraway et al., 2012; Kuo & Jackson, 2014). Although few studies have identified overall significant influences on perspective due to a course, no study has used course grades as a representation of knowledge to evaluate the influence of knowledge on perspective. Herein I used assessments of knowledge mastery within an environmental course (below) to evaluate this relationship.
Setting and Goals

The University of Toledo offers an introductory course in environmental sciences for general education credit for students who are not science majors. The course explicitly explores scientific knowledge, social context, and human perspectives with regard to a broad range of environmental topics. Knowledge is presented to students through various pedagogical methods, including traditional lecture, assigned textbook readings, textbook based homework assignments, in-class discussions, and service-learning opportunities. Assessments of student performance measure knowledge gained, whereas attendance, participation in service learning, and choice of college are indexes of social context. Student environmental perspective is evaluated by voluntary completion of the New Ecological Paradigm survey at both the start and end of the course (Dunlap et al., 2000). Thus, these data can be used to evaluate relationships between perspectives, knowledge, and social context in a more rigorous manner than any previous study.

The overall goal of my study was to evaluate relationships between knowledge, social context and environmental perspectives of college students enrolled in this course. More specifically, my two main objectives were to determine if either (1) knowledge gained from the course and/or (2) the social context of students enrolled in the course, influenced their environmental perspectives. Moreover, these objectives were evaluated with one of the largest datasets of paired NEP surveys ever obtained in a study of this kind.
Chapter 2

Methods

Data Collection

The NEP Survey was administered to multiple sections of the environmental science course at the beginning and end of each of four academic semesters over two years with responses to individual questions and overall scores recorded for each student. During this time five different instructors taught the course. Additional information recorded for each student included total course grade, grades for each homework assignment, grades for each exam, attendance, and hours participating in service learning. Additional data included the student’s declared college, major, and degree of study.

Change in NEP

A paired t-test compared final survey scores to initial scores; tests were performed for all classes combined, and by semester. Only data from students completing both surveys, and only those giving permission to evaluate their responses (as per IRB protocol #2000179), were included in the analysis. A linear regression found a significant relationship between initial survey score and change in score between surveys, and so initial score was included as a covariate in all analyses exploring relationships between change in score and both student achievement and social context.

NEP and Achievement

Linear regressions evaluated relationships between initial NEP scores and four measures of student achievement: overall grade (percentage), total exam grade (percentage), overall
homework grade (percentage), and attendance (percent of classes attended). Linear regressions also assessed the relationship between change in NEP score and these same assessments with initial NEP score included as an explanatory factor.

NEP and Service Learning

Two analyses were performed to assess the relationships between service learning and NEP scores. First, participation was defined as a categorical variable, i.e., either a student participated in service learning or not. A one-way ANOVA assessed whether initial survey score (indicative of beginning student perspective) was related to subsequent participation in service learning. An ANCOVA assessed whether change in NEP score was influenced by participation in service learning and initial score. Second, participation was also defined as a continuous variable represented by the number of service hours completed for only those students who participated. A linear regression explored the relationship between initial survey score and the number of service learning hours performed by those who participated. Another linear regression examined the relationships between change in score and both the number of service hours and initial score.

Influence of College

An ANCOVA explored the relationship between change in NEP and student’s declared college, including initial score as a covariate. Post hoc tests were used to identify significant differences between specific colleges. Because many colleges had small enrollments, a second ANCOVA examined only the two colleges with highest student representation in a similar analysis.
Themes and Phrasing

A two-way ANOVA was used to examine relationships between initial survey scores and both question phrasing (anthropocentric vs. ecocentric) and theme (Appendix C). A second ANOVA similarly examined the relationship between the second survey scores and both phrasing and theme. A significant interaction between phrasing and theme in both analyses led to separate one-way ANOVA for each phrasing examining relationships between survey scores and theme. Post-hoc tests identified which themes were significantly different from one another. A t-test determined if survey scores differed between anthropocentric and ecocentric questions, on both initial and final surveys, pooling all themes.

Contradictions in Perspective

Possible contradictions in perspective were identified in two ways from these results. Differences between pairs of similarly phrased questions within themes were considered to be potentially contradictory if the 95% confidence intervals for their means did not overlap. For questions with opposite phrasing they were considered potentially contradictory if the difference between the 95% confidence intervals for their means was greater than the overall difference between phrasings for the particular survey (above).

Chapter 3

Results

Overall NEP Change

Over four semesters from spring 2014 through fall 2015, 1916 students had taken the course (Table 1), generating 1030 paired pre- and post-course surveys from students who agreed
that their results could be analyzed (as per IRB protocol #2000179). The average return rate for both surveys was 54%. A paired t-test revealed a significant increase in overall NEP score of 1.05±5.81 (mean±standard deviation) points for students completing both surveys (Table 1), for all semesters combined. During springs 2014 and 2015 paired t-tests also showed significant NEP increases of 1.23±5.20 and 2.08±5.66, respectively. Fall 2014 had an increase of 0.50±6.06, approaching significant (0.5≤P≤0.10) but there was no change in NEP scores during fall 2015. A linear regression revealed a significant overall, negative relationship between the initial survey score (x) and change (y) in survey score (y = -0.2586x + 14.902, N=1030, F=124, R²=0.11, P≤0.001). For this reason, all subsequent analyses of change in NEP included initial score as a covariate.

NEP and Achievement

Linear regressions evaluated relationships between NEP scores and four measures of course achievement: overall grade (percentage), total exam grade (percentage), overall homework grade (percentage), and attendance (percent of classes attended). Only attendance had a significant relationship to initial NEP score, but it was very weak (Table 2; N=1030, F=3.72, R²=0.004, P≤0.05). As for the relationships between change in NEP score and course metrics, only course attendance added a significant albeit small contribution to change in score over initial survey score (Table 2; N=1030, R²=0.11, P≤0.001) little changed from that of initial score, alone (above).
**NEP and Service Learning**

Results of a one-way ANOVA revealed that the initial scores for students who did not perform service (54.06±7.33, N=658) were significantly greater (F=9.05, P≤0.001) than for students who did (52.63±7.39, N=372). In addition, a regression showed no relationship between initial score and number of service hours for participants (N=372, F=0.75, P≤0.39). An ANCOVA including initial score as a covariate showed no difference (F=0.18, P≤0.67) in scores for students who did not perform service (N=658, 0.97±5.80) and students who did (N=372, 1.19±5.83). Multiple regression analysis including initial score as an explanatory factor also found no significant relationship between change in score and hours of service for those who participated in service learning (N=372, F=0.08, P≤0.78).

**Influence of College**

Twelve colleges were represented by students enrolled in the course, with the largest accounting for 35.92% of all students (College of Business), and several other colleges each representing less than 1% (Table 3). ANOVA revealed significant differences between the initial scores for the 12 colleges (N=1030, F=3.58, P≤0.001) but post hoc tests identified no significant differences between any pair of colleges. An ANCOVA including initial score as a covariate found a significant relationship between change in NEP and college (N=1030, F=1.86, P≤0.04) but again, post hoc tests identified no significant differences between any pair of colleges. The relationship between the observed changes in score and predictions based on this ANCOVA (N=1030, R²=0.13, P≤0.001) explained slightly more variation than the simple regression of change in NEP against initial score (above). An ANCOVA including only the two colleges with highest enrollments (College of Business N=370, College of Education N=176, Table 3)
including initial score as a covariate, showed that changes in score were significantly different between these colleges (F=8.68, P≤0.001). Initial scores also were significantly different between these two colleges (F=43.69, P≤0.001).

**Themes and Phrasing**

A two-way ANOVA examining the relationship between initial survey scores and both question phrasing and theme, revealed significant main effects of both independent factors, as well as a significant interaction between them (Table 5). A similar ANOVA examining the relationship between the second survey scores and both question phrasing and theme also revealed significant main effects as well as a significant interaction (Table 5).

Subsequent one-way ANOVA for each phrasing identified significant differences in initial scores between themes (Anthropocentric: N=7210, F=289.95, P≤0.001; Ecocentric: N=8240, F=94.98, P≤0.001). Post hoc tests showed that most themes were different from one another (Table 6). Additional one-way ANOVA for each phrasing identified significant difference in second survey scores between themes (Anthropocentric: N=7210, F=283.71, P≤0.001; Ecocentric: N=8240, F=59.96, P≤0.001). Post hoc tests again showed that most themes were significantly different from one another (Table 6).

Overall, questions phrased anthropocentrically (N=7208, 3.12±1.25) on the initial survey had a significantly lower score (t=44.15, P≤0.001) than ecocentric questions (N=8240, 3.96±1.08), for a minimal difference of 0.84 points between the 95% confidence intervals of their means. Anthropocentrically phrased questions (N=7208, 3.18±1.28) on the second survey also had a significantly lower score (t=46.70, P≤0.001) than ecocentric questions (N=8240, 4.07±1.05), for a minimal difference between their 95% confidence intervals of 0.89 points.
Contradictions within Themes

In the initial survey, ecocentric questions in theme 1, anthropocentric questions in theme 2, and anthropocentric questions in theme 4 are likely contradictory because the differences between the mean scores of pairs of questions with the same phrasing is greater than their 95% confidence intervals (Table 4). Differences between both pairs of anthropocentric and ecocentric questions in theme 1 (questions 1 vs. 6 and 6 vs. 11) were greater than the overall difference in responses due to phrasing in this survey (0.84 points, above). The same was true for both pairs of questions in theme 4. In theme 2, only the difference between question 2 (anthropocentric) and 7 (ecocentric) was greater than could be explained by phrasing (Table 4).

In the second survey, pairs of ecocentric questions in theme 1, anthropocentric questions in theme 2, and anthropocentric questions in theme 4 are likely contradictory because the differences between their mean scores is greater than their 95% confidence intervals (Table 4). Differences between both pairs of anthropocentric and ecocentric questions in theme 1 (questions 1 vs. 6 and 6 vs. 11) were greater than the overall difference in responses due to phrasing in this survey (0.89 points, above). The same was true for both pairs of questions in theme 4. In theme 2, the differences between the two pairs of differently phrased questions (questions 2 vs. 7, questions 7 vs. 12) were not greater than could be explained by phrasing (Table 4).

Chapter 4
Discussion

My research provided a more rigorous exploration of the relationships between knowledge, social context, and environmental perspective for students enrolled in a college
course than any previous study. In particular, no other study utilized such a large set of paired surveys or used categories of student achievements as quantitative measures of knowledge. In brief, I found (1) a small overall increase in NEP with taking the course; (2) no relationship between any metric of knowledge and NEP; (3) significant effects of social context (attendance and college) on NEP; (4) differences between both themes and question phrasings; and (5) possible contradictions in perspective.

Unlike most previous studies, I found a small but significant change in perspective with students becoming more ecocentric by taking the course (cf. Anderson et al., 2007; Packer, 2009; Shephard et al., 2015). However, all former studies aggregated mean pretest scores and mean posttest scores to quantify an average overall change. My study ensured that each individual’s pretest and posttest were paired, improving statistical rigor. In addition, my sample size was much greater than any other study and represented four semesters during two years, including 14 sections of the course. I also found that preexisting perspectives were important to understanding future perspectives, whereas no other study explored the relationship between initial score and change in score. I found that students who had high initial scores generally changed less than students with low initial survey scores. This is logical because students with high initial scores have less room for increasing their survey scores. This relationship raises questions about conclusions drawn from earlier studies because previous studies investigating change in NEP score over time might have found significant changes if they had accounted for initial score (Anderson et al., 2007; Packer, 2009; Kuo & Jackson, 2014; Shephard et al., 2015).

Despite finding a significant increase in NEP scores among students taking this class, I found no relationship between either a student’s initial NEP score, or change in NEP score, and most aspects of course achievement, including overall student grade, exam grades, and
homework grades as measures of environmental knowledge. Thus initial perspective did not influence how a student performed in the class nor did course performance influence subsequent change in NEP. Earlier studies in environmental perspective identified knowledge as a major contributor to perspective (Burgess et al., 1998; Kollmuss & Agyeman, 2002; Sturgis & Allum, 2004) but several recent studies found that knowledge only partially contributes to environmental perspective (Kollmuss & Agyeman, 2002; Allum, 2008; Kellstedt et al., 2008; Kahan et al., 2012), and other studies found that knowledge had little or no effect on perspective (Kahan et al., 2010; McCright & Dunlap, 2011; Dunlap, 2016). I also found no relationship between change in survey score and course achievement when initial score was included as a covariate. If a student performed well in the course (i.e., gained knowledge) there was no connection to change in score. It appears counterintuitive that knowledge showed no contribution to environmental perspective in this study.

Recent research on climate change denial can help explain the lack of relationships between measures of environmental knowledge and change in NEP. Several studies have shown that individuals may possess knowledge of the science behind climate change or have observed the effects of climate change but still state a disbelief in climate change (McCright & Dunlap, 2011; Kahan et al., 2012; Marquart-Pyatt, 2014). Peers, family, culture, and political affiliations all contribute to environmental perspective and appear to be more important than knowledge (Kollmuss & Agyeman, 2002; Kahan, 2010; Kahan et al., 2012; Dunlap, 2013; Dunlap et al., 2016; Litina et al., 2016). A dilemma occurs when evidence in support of climate change contradicts the dominant social paradigm of a group. Those who experience this contradiction engage in culture and identity protective cognition to maintain their worldview and alignment with their social networks (Kahan et al., 2007; Kahan et al., 2011; Kahan et al., 2012).
means individuals develop a mental framework to justify their current perspective despite evidence opposing it. Research in sociobiology and psychology point to individuals avoiding contradiction with their peer groups, families, or cultures for fear of alienation even if this requires rejecting scientific consensus (Wilson, 2000; Kahan et al., 2007; Kahan et al., 2012). Social context is important to environmental perspective.

Within this study, course attendance, student self-selection of college, and service learning were indexes of social context. I found a significant relationship between change in score and attendance, perhaps because students were required to complete an in-class discussion with other students during every class period. Discussion groups possibly introduced students to peers with different perspectives and established a social network that may explain the modest relationship between attendance and overall change in NEP score. Social learning theory reveals that humans learn in social contexts (Bandura, 1986) and many studies on environmental perspectives (see above) acknowledge the influence of social networks on perspective. Thus, social networks may have affected perspectives within the course.

A student’s self-selection of college before entering the course is an example of previous social context, perhaps analogous to peer identification. Many studies using the NEP survey with college students have found significant differences between the self-selected study majors of students (Hodgkinson & Innes, 2001; Anderson et al., 2007; Shephard et al., 2015). Generally, students in business, engineering, or technical fields score lower on the NEP than students in natural sciences, education, or social sciences. I found an overall relationship between college and NEP, but differences between particular colleges could not be identified. However, an analysis of the two most commonly represented colleges showed that College of Business
students had significantly lower NEP scores than College of Education students. Thus, effects of
college, although significant, were neither large nor particularly insightful in this study.

Finally, a large body of research supports experiential learning as a successful teaching
practice (Bouillion & Gomez, 2001; Brewer, 2002; Krajcik & Czerniak, 2014), and service
learning provided another social context in this study that could influence student perspective. I
identified no relationship between initial NEP score and subsequent number of service hours a
student completed, so that an ecocentric perspective did not lead students to participate in service
learning. This is interesting because Dunlap & Van Liere (1978) found that individuals with
higher NEP scores were more likely to participate in environmental organizations. However,
other aspects of perspective could explain the lack of participation by high scoring individuals
such as a lack of incentive or motivation (Kollmuss & Agyeman, 2002), although extra credit
usually motivates participation. There was also no difference between change in score for
students who participated and those who did not. Only one other study using the NEP
investigated service learning and it found a significant positive change in score for theme four
but no change in overall score (Packer, 2009).

Several studies explored changes in scores on individual themes of the survey or for
individual questions (Harraway et al., 2012; Dagiliute & Niaura, 2014; Kuo & Jackson, 2014).
However, I found significant differences between themes, question phrasing, and interaction
between themes and phrasing. To my knowledge, no other study identified this potential
interaction nor evaluated their results accordingly. Nonetheless, previous research with the NEP
survey indicated that the themes are independent components of an environmental perspective
(Dunlap et al., 2000; Amburgey & Thoman, 2012). My analysis of themes confirmed that NEP
responses for most themes were significantly different from one another on both surveys. Thus,
the themes appear to represent largely distinct aspects of environmental perspective. I also identified significant differences in responses between ecocentric and anthropocentric phrasing on both the initial and second survey. Students responded more ecocentrically to ecocentric questions (higher scores) and more anthropocentrically to anthropocentric questions (lower scores). No other study using the NEP has explored the impact of phrasing on student responses, which is important when comparing responses between questions.

A number of studies have explored changes in specific question responses and/or correlations between different questions (Lee, 2008; Harraway et al., 2012; Dagiluite & Niaura, 2014; Kuo & Jackson, 2014). However, I found no studies using the NEP that explored whether responses to specific sets of questions could represent contradictions in perspective. Van Liere & Dunlap (1983) suggest that failure to organize environmental perspectives as a part of overall worldview leads to inconsistencies in attitude and behavior related to the environment. My analysis compared possible contradictions between perspectives by comparing responses to questions within each theme, adjusted by phrasing, and found several possible contradictions.

For example, questions 1 and 11 on the first survey, both a part of the same theme and both with ecocentric phrasing, had significantly different responses that may suggest contradictory or inconsistent views. Question 1 was, “We are approaching the limit of the number of people the earth can support.” (NEP score 3.37±1.18). Question 11 was, “The earth has only limited room and resources” (NEP score 3.96±1.21). The third question in this theme was phrased anthropocentric, “The earth has plenty of natural resources if we just learn how to develop them”, and was more different from the other two (NEP score 2.05±1.12) than differences between phrasing (0.84 points on the first survey). It appears that students may not understand the relationships between a growing human population and the constraints of limited resources.
Such contradictions are interesting in part because several studies have identified a gap between knowledge and perspective (Kollmuss & Agyeman, 2002; Kahan et al., 2012). In some instances, more education was negatively correlated with assessing environmental risks (Kahan et al., 2012). More knowledge about environmental issues also does not necessarily lead to a more ecocentric perspective. Clearly, it is possible for individuals to simultaneously hold conflicting perspectives about the environment.

In summary, the NEP was developed and implemented to determine where the general public falls on a spectrum of anthropocentric to ecocentric perspectives (Dunlap & Van Liere, 1978). Use of the revised NEP survey attempted to clearly define an individual’s perspectives in many different situations and has been applied to children (Van Petegem & Blieck, 2006) and explored how perspectives are established (Kopnina, 2011). Others have assessed the environmental perspectives of a wide range of groups from farmers to businessmen (Shafer, 2006; Greiner, 2015) or evaluated people in different countries on topics ranging from tourism to conservation to political policy (Rauwald & Moore 2002; Imran et al., 2013). College students were the focus of many studies because of the benefits of using a classroom setting to control possible variables influencing perspective (Hodgkinson & Innes, 2001; Kilbourne et al., 2001; Rideout et al., 2005; Anderson et al., 2007; Lee, 2008; Packer, 2009; Harraway et al., 2012; Dagiliute & Niaura, 2014; Jowett et al., 2014; Kuo & Jackson, 2014; Shepard et al., 2015). A limitation of my study as well as others in the past is that accounting for all influences on perspective is difficult. However, several aspects of my study were unique when compared to other studies of college students. Most studies used one application of the NEP survey whereas I could include the initial score in analyses of change in NEP, as well as paired pre- and posttest results. I also had a very large sample size that included multiple sections over semesters and
years, which yielded a much more powerful analysis. Finally, I was able to identify possible contradictions in perspective held by individuals.

In conclusion, I found a significant albeit modest increase in New Ecological Paradigm (NEP) score in students taking an environmental science class. I also found a significant, negative relationship between initial score and subsequent change in score that should be considered in future studies. I found no relationship between any assessment of environmental knowledge and perspective, nor did participation in service learning activities (experiential learning) appear to influence perspective. However, I found a significant relationship between class attendance and change in NEP score as well as the self-selection of college (peer identification) and change in NEP score. I also identified apparent contradictions in student responses to individual questions indicating that students may simultaneously possess conflicting views about human relationships with the environment. Thus, the social context of learning and cultural cognition in this class appears to be influencing environmental perspective more than acquisition of relevant knowledge.


Packer, A. (2009). Service learning in a non-majors biology course promotes changes in students’ attitudes and values about the environment. *International Journal for the Scholarship of Teaching and Learning, 3*(1), 17.


Appendix A

Tables

Table 1: Student enrollments, number completing both surveys, percent completing both surveys, change in NEP score, and results of paired t-tests.

<table>
<thead>
<tr>
<th>Semester</th>
<th>Students</th>
<th>Surveys*</th>
<th>Response</th>
<th>Change</th>
<th>P ≤</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spring 2014</td>
<td>344</td>
<td>147</td>
<td>42%</td>
<td>1.23±5.20</td>
<td>0.01</td>
</tr>
<tr>
<td>Fall 2014</td>
<td>613</td>
<td>434</td>
<td>70%</td>
<td>0.50±6.06</td>
<td>0.08</td>
</tr>
<tr>
<td>Spring 2015</td>
<td>504</td>
<td>272</td>
<td>54%</td>
<td>2.08±5.66</td>
<td>0.01</td>
</tr>
<tr>
<td>Fall 2015</td>
<td>452</td>
<td>177</td>
<td>39%</td>
<td>0.67±5.71</td>
<td>0.11</td>
</tr>
<tr>
<td>Total</td>
<td>1916</td>
<td>1030</td>
<td>54%</td>
<td>1.05±5.81</td>
<td>0.01</td>
</tr>
</tbody>
</table>

*Only those students who gave permission to use survey results
Table 2: Results of analyses of change in NEP score with respect to individual course performance indicators and initial score and regression of change in score and attendance.

<table>
<thead>
<tr>
<th>Analysis</th>
<th>Independent Factors</th>
<th>df</th>
<th>F-ratio</th>
<th>P ≤</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANCOVA</td>
<td>Total Grade (%)</td>
<td>1</td>
<td>0.15</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td>Initial Score</td>
<td>1</td>
<td>124.28</td>
<td>0.001</td>
</tr>
<tr>
<td>ANCOVA</td>
<td>All Exams (%)</td>
<td>1</td>
<td>0.7</td>
<td>0.4</td>
</tr>
<tr>
<td></td>
<td>Initial Score</td>
<td>1</td>
<td>124.93</td>
<td>0.001</td>
</tr>
<tr>
<td>ANCOVA</td>
<td>All Homework (%)</td>
<td>1</td>
<td>2.13</td>
<td>0.14</td>
</tr>
<tr>
<td></td>
<td>Initial Score</td>
<td>1</td>
<td>125.11</td>
<td>0.001</td>
</tr>
<tr>
<td>ANCOVA</td>
<td>Class Attendance (%)</td>
<td>1</td>
<td>3.82</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Initial Score</td>
<td>1</td>
<td>127.01</td>
<td>0.001</td>
</tr>
<tr>
<td>Regression</td>
<td>Attendance</td>
<td></td>
<td>-1.95</td>
<td>0.05</td>
</tr>
<tr>
<td></td>
<td>Initial Score</td>
<td></td>
<td>-11.27</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Table 3: Student enrollment by college, percent representation of total enrollment, initial survey score, and change in score (mean±standard deviation).

<table>
<thead>
<tr>
<th>College</th>
<th>Count</th>
<th>Percent</th>
<th>Survey 1</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>370</td>
<td>35.92</td>
<td>51.98±7.50</td>
<td>0.90±5.79</td>
</tr>
<tr>
<td>Education</td>
<td>156</td>
<td>15.15</td>
<td>54.31±6.29</td>
<td>1.94±5.37</td>
</tr>
<tr>
<td>Communications and the Arts</td>
<td>117</td>
<td>11.36</td>
<td>54.22±7.31</td>
<td>0.90±5.48</td>
</tr>
<tr>
<td>Literature, Languages, Social Sciences</td>
<td>116</td>
<td>11.26</td>
<td>55.41±7.74</td>
<td>0.66±0.66</td>
</tr>
<tr>
<td>Social Justice - Human Services</td>
<td>102</td>
<td>9.90</td>
<td>54.32±7.33</td>
<td>0.74±5.91</td>
</tr>
<tr>
<td>YouCollege (undecided)</td>
<td>90</td>
<td>8.74</td>
<td>53.11±6.67</td>
<td>1.50±6.63</td>
</tr>
<tr>
<td>Adult and Lifelong Learning</td>
<td>39</td>
<td>3.79</td>
<td>56.69±7.79</td>
<td>1.10±6.83</td>
</tr>
<tr>
<td>Health Sciences</td>
<td>15</td>
<td>1.46</td>
<td>51.07±6.77</td>
<td>0.20±5.40</td>
</tr>
<tr>
<td>Engineering</td>
<td>14</td>
<td>1.36</td>
<td>54.43±8.63</td>
<td>-1.29±7.00</td>
</tr>
<tr>
<td>Natural Science and Mathematics</td>
<td>9</td>
<td>0.87</td>
<td>55.67±9.64</td>
<td>2.67±7.31</td>
</tr>
<tr>
<td>Nursing</td>
<td>1</td>
<td>0.10</td>
<td>57.00±0.00</td>
<td>-11.00±0.00</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>1</td>
<td>0.10</td>
<td>58.00±0.00</td>
<td>0.00±0.00</td>
</tr>
</tbody>
</table>
Table 4: Summary of survey scores by theme, question, and phrasing, initial survey score, second survey score, and change in score (mean±95% confidence interval).

<table>
<thead>
<tr>
<th>Theme*</th>
<th>Question</th>
<th>Phrasing</th>
<th>Survey 1</th>
<th>Survey 2</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>Ecocentric</td>
<td>3.37±0.06</td>
<td>3.56±0.06</td>
<td>0.19</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>Anthropocentric</td>
<td>2.05±0.07</td>
<td>2.16±0.07</td>
<td>0.11</td>
</tr>
<tr>
<td>1</td>
<td>11</td>
<td>Ecocentric</td>
<td>3.96±0.07</td>
<td>4.15±0.07</td>
<td>0.19</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>Anthropocentric</td>
<td>3.10±0.06</td>
<td>3.29±0.06</td>
<td>0.19</td>
</tr>
<tr>
<td>2</td>
<td>7</td>
<td>Ecocentric</td>
<td>4.30±0.06</td>
<td>4.34±0.06</td>
<td>0.04</td>
</tr>
<tr>
<td>2</td>
<td>12</td>
<td>Anthropocentric</td>
<td>3.44±0.07</td>
<td>3.52±0.07</td>
<td>0.08</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>Ecocentric</td>
<td>3.85±0.07</td>
<td>3.94±0.07</td>
<td>0.09</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Anthropocentric</td>
<td>3.52±0.07</td>
<td>3.54±0.06</td>
<td>0.02</td>
</tr>
<tr>
<td>3</td>
<td>13</td>
<td>Ecocentric</td>
<td>3.80±0.06</td>
<td>3.95±0.05</td>
<td>0.15</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>Anthropocentric</td>
<td>3.07±0.07</td>
<td>2.97±0.07</td>
<td>-0.10</td>
</tr>
<tr>
<td>4</td>
<td>9</td>
<td>Ecocentric</td>
<td>4.15±0.06</td>
<td>4.24±0.06</td>
<td>0.09</td>
</tr>
<tr>
<td>4</td>
<td>14</td>
<td>Anthropocentric</td>
<td>3.10±0.06</td>
<td>3.10±0.06</td>
<td>0.00</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>Ecocentric</td>
<td>4.16±0.07</td>
<td>4.21±0.07</td>
<td>0.05</td>
</tr>
<tr>
<td>5</td>
<td>10</td>
<td>Anthropocentric</td>
<td>3.54±0.07</td>
<td>3.68±0.07</td>
<td>0.14</td>
</tr>
<tr>
<td>5</td>
<td>15</td>
<td>Ecocentric</td>
<td>4.06±0.08</td>
<td>4.13±0.08</td>
<td>0.07</td>
</tr>
</tbody>
</table>

*Theme 1 – Limits to Growth, Theme 2 – Anti-Anthropocentrism, Theme 3 – The Fragility of Natures Balance, Theme 4 – Rejection of Exemptionalism. Theme 5 – The Possibility of Eco-crisis
Table 5: Results of ANOVA testing the effects of theme and question phrasing on initial and second survey scores.

<table>
<thead>
<tr>
<th>Factor</th>
<th>df</th>
<th>Survey 1</th>
<th></th>
<th>Survey 2</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>F-ratio</td>
<td>P ≤</td>
<td>F-ratio</td>
<td>P ≤</td>
</tr>
<tr>
<td>Phrasing</td>
<td>1</td>
<td>2195</td>
<td>0.001</td>
<td>2456</td>
<td>0.001</td>
</tr>
<tr>
<td>Theme</td>
<td>4</td>
<td>265</td>
<td>0.001</td>
<td>223</td>
<td>0.001</td>
</tr>
<tr>
<td>Phrasing x Theme</td>
<td>4</td>
<td>141</td>
<td>0.001</td>
<td>155</td>
<td>0.001</td>
</tr>
</tbody>
</table>
Table 6: Initial and second survey scores by theme and phrasing (means±standard deviations).

Means for themes with different letters within a survey and phrasing are significantly different (P≤0.05).

| Theme | Survey 1 | | | Survey 2 | |
|-------|----------|----------|----------|----------|
|       | Anthropocentric | Ecocentric | | Anthropocentric | Ecocentric |
| 1     | 2.05±1.12\textsuperscript{A} | 3.66±1.23\textsuperscript{A} | 2.16±1.17\textsuperscript{A} | 3.85±1.18\textsuperscript{A} |
| 2     | 3.27±1.28\textsuperscript{C} | 4.30±1.08\textsuperscript{D} | 3.41±1.29\textsuperscript{C} | 4.34±1.05\textsuperscript{C} |
| 3     | 3.52±1.14\textsuperscript{D} | 3.82±0.99\textsuperscript{B} | 3.54±1.14\textsuperscript{CD} | 3.95±1.01\textsuperscript{A} |
| 4     | 3.09±1.09\textsuperscript{B} | 4.15±0.92\textsuperscript{C} | 3.03±1.12\textsuperscript{B} | 4.24±0.89\textsuperscript{BC} |
| 5     | 3.54±1.15\textsuperscript{D} | 4.11±0.99\textsuperscript{C} | 3.68±1.17\textsuperscript{D} | 4.17±0.95\textsuperscript{B} |
Appendix B

Figures

Figure 1: Change in survey score plotted against a student’s initial survey score ($R^2=0.10$, $P \leq 0.05$).
Figure 2: Observed versus predicted change in survey score based on initial score and attendance

($R^2=0.11$, $P \leq 0.001$)
Figure 3: Observed versus predicted changes in survey score based on initial survey score and college ($R^2=0.13$, $P \leq 0.001$)
Appendix C

The New Ecological Paradigm Survey

Theme 1 - Limits to Growth

1. We are approaching the limit of the number of people the earth can support.
6. The earth has plenty of natural resources if we just learn how to develop them.
11. The earth has only limited room and resources.

Theme 2 - Anti-anthropocentism

2. Humans have the right to modify the natural environment to suit their needs.
7. Plants and animals have as much right as humans to exist.
12. Humans were meant to rule over the rest of nature.

Theme 3 - The Fragility of Natures’ Balance

3. When humans interfere with nature, it often produces disastrous consequences.
8. The balance of nature is strong enough to cope with the impacts of modern industrial nations.
13. The balance of nature is very delicate and easily upset.

Theme 4 - Rejection of Exemptionalism

4. Human ingenuity will ensure that we do NOT make the earth unlivable.
9. Despite our special abilities humans are still subject to the laws of nature.
14. Humans will eventually learn enough about how nature works to be able to control it.

Theme 5 - The Possibility of Eco-crisis

5. Humans are severely abusing the environment.
10. Human destruction of the natural environment has been greatly exaggerated.
15. If things continue on their present course, we will soon experience a major ecological disaster.