DISSERTATION

ECOLOGICAL LITERACY IN A CONTEXT OF FIRST-YEAR COLLEGE STUDENTS

Submitted by
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In partial fulfillment of the requirements
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ECOLOGICAL LITERACY IN A CONTEXT OF FIRST-YEAR COLLEGE STUDENTS

ABSTRACT

This research focused on the knowledge and behavior components of ecological literacy as it pertains to a sample of first-year students at a large land grant university. Specifically, a four-point typology of environmentally responsible behaviors for first-year college students was identified that included dimensions related to consumer, disposal, reuse and conservation activities. The results of the typology were subsequently used to develop attitude and behavior scales to determine the viability of a value-attitude-behavior hierarchy as it relates to environmentally responsible behavior of first-year college students.

,Attitudes were strong predictors of environmental behaviors, especially in regards to behaviors pertaining to conservation and reuse. Conversely, value orientation had a significant albeit weak predictive relationship of attitudes about environmental behaviors. Conversely

In addition, a sample of the students in this study participated in a series of ecological lessons as part of their first-year seminar course. The effect of environmental education was subsequently analyzed to determine the extent to which knowledge of ecological principles, biological cycles and environmental services affected individual values, attitudes about environmental behaviors, and the frequency with which those behaviors were undertaken. The results indicated that knowledge gain had a positive impact on both attitudes and behavior, but minimal effect on values. The effect was strongest on attitudes about consumer

behaviors. In nearly all instances, participating in environmental education positively affected attitudes and environmental behaviors.

The results of this research equip university leaders with knowledge and tools to better integrate ecological literacy in the college curriculum and campus life. It provides a basis for ecological knowledge that should be taught in the classroom, as well as environmentally responsible behaviors to be promoted within the various advocacy and outreach efforts by campus organizations and student groups.

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Thanks to the friends, colleagues, family and faculty mentors who were there for the journey, all of it or parts thereof. May we will always fully appreciate the value of our natural world, and practice the ethics and choices to reflect it.

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CHAPTER ONE: INTRODUCTION

> The world does not need more rootless symbolic analysts. It needs instead hundreds of thousands of young people equipped with the vision, moral stamina, and intellectual depth necessary to rebuild neighborhoods, towns, and communities around the planet. . . We need an ecological concept of citizenship rooted in the understanding that activities that erode soils, waste resources, pollute, destroy biological diversity and degrade the beauty and integrity of its landscapes are forms of theft from the commonwealth as sure as is bank robbery.
>
> - David Orr
> *Earth in Mind (1994)*

Sustainability is identified in many environmental discussions as the most important goal that should be pursued by the world's 274 countries and 6 billion inhabitants (Chambers, 1998). It suggests that renewable resources should only be used at rates in which they can be replaced. For every evergreen tree that is harvested for timber, another is planted. For every salmon taken from the ocean, another is born. Or, in the case of non-renewable resources, sustainability suggests that a percent of non-renewable resource use should be directed toward developing viable alternatives (AtKisson, 1999). As crude oil is consumed, for example, part of its consumption should be invested toward further researching energy alternatives, such as hydrogen cells and wind turbines, so that the oil-dependent communities of the world have a means for continuing their business once crude oil is gone.

Ultimately, sustainability helps ensure that future generations will have the resources available to maintain or enhance the quality of life and standard of living

experienced by previous generations. Such a value of passing on "a better world" is embraced by many cultures, such as is commonplace in the United States (Roper, 1992). If nothing else, however, passing on an environment that cannot sufficiently provide future generations with the resources necessary to ensure security and peace is grossly inconsiderate.

There are very pragmatic reasons to pursue sustainability, as well. Namely, stable economies and communities depend on it. Sustainable use of resources ensures the indefinite viability of jobs and markets. It ensures a steady source of food and medicine. It goes hand in hand with a world that is largely at peace (Orr, 1994). Ultimately, sustainability serves the world in multiple ways, via multiple disciplines.

Despite the critical nature of sustainability to a peaceful and healthy world, however, it appears that the global citizenry is causing more harm than benefit to the world's natural resources, and therefore, to its own well-being. Our long term interests rest in the preservation of the planet's biological diversity, yet we are losing an estimated 27,000 species a year – including species that have remained unknown, unexamined and unnamed, that may have provided valuable and critical information (Hawken, 1993). The cure for any disease, for example, will originate, as everything must, from plant, animal or mineral. Yet the world loses plants, animals and minerals before they are fully understood.

Natural evolutionary processes account for an unspecified percent of species loss, but not all of it. The world lost 2.2 percent of its forests in the period 1990-2000, largely from the planet's species-rich tropical regions, and largely to support human consumption (United Nations Food and Agricultural Organization, 2000). When scientists from the

multi-nation Intergovernmental Panel on Climate Change (2001) concluded that most of the global warming of the past 50 years is attributable to human activities, the world became forced with the sobering fact that its own people, not the natural cycles of Mother Nature, were largely responsible. And as a consequence of human-induced global warming, global annual average temperature is projected to increase as much as 5.8 degrees Celsius by 2010 from 1990 levels, contributing to rising seas, severe droughts and other climatic disasters (Dunn and Flavin, 2002). The irony is stark; the long-term health and peace of the world depends on sustainable use of natural resources, yet practices and behaviors of the world's people fail to reflect it.

As the challenge of achieving a sustainable planet looms, there are questions to consider regarding how individuals of the world, in their respectively diverse lifestyles, can contribute to a healthier planet. What is the role of rural citizens in Africa who depend on forests for fuel wood? Or the Ecuadorian fisherman reliant on sea cucumber harvests for income to provide food for his family? Or the U.S. university student who will have one of the world's highest standards of living? Are each of them knowledgeable about how they can contribute to sustainability ? If not, how will they learn? How can individuals acquire environmental skills and knowledge, and how do those skills become integrated into daily and lifelong prescriptions for living?

The answer to these questions can be drawn in part from discussions by David Orr (1992) suggesting that educators and leaders should facilitate opportunities to help people become ecologically literate. Ecological literacy, or eco-literacy, implies a fundamental understanding about ecosystems and biological cycles, proficiency in skills and behaviors that protect them, and ultimately, a genuine personal concern and value for a healthy

planet (Disinger and Roth, 1992). For post-industrial counties such as the United States, nurturing ecological literacy might occur within the standard regime of formal schooling where gaining knowledge and acquiring skills is the standard student protocol. Schools at the primary, secondary, and university level would seem to be appropriate venues for teaching about ecological principles and biological cycles, and possibly the skills to protect them. Concerned and impassioned individuals must lead the charge, then, in creating the opportunities for students to acquire the skills and knowledge pursuant to ecological literacy.

But education personnel need information about how and what to do in order to effectively facilitate ecological literacy. University leaders, professors and administrators, for example, must have an understanding about what to ask their students to do, from a standpoint of relevant and reasonable behavior, and the appropriate approach for asking them to do undertake it. Certainly in an institution of learning, such as a university, a cognitive approach in the classroom would be at least one part of a strategy. If students are taught about ecosystems, the natural origins of goods, and other ecological principles, will they be inclined to change their behavior? If so, what behaviors in their everyday lives might they change?

The research focus for this dissertation addresses such questions about the environmental behaviors of college students, and the effect of an environmental education program on changing that behavior. The practical value of this research is perhaps best realized by university leaders and professors who aspire to integrate sustainability and ecological literacy in curricula, campus events, or campus administration and maintenance, such as the growing number of university leaders who

publicly acknowledged a university commitment to campus ecology via their signature to the Tallories Declaration. The Tallories Declaration is a commitment to raise awareness, create programs and revise curricula to reflect the need for environmental change. The research for this dissertation identifies a typology of behaviors which campus leaders can advocate and encourage the student population to undertake, and studies how knowledge can affect the likelihood that first-year college students undertake those behaviors. Ultimately, it provides leaders with the empirical data needed to design university programs and curriculum that motivate first-year college students to contribute more greatly to a goal of sustainability.

CHAPTER TWO:
MANUSCRIPT #1

A typology of environmentally responsible behavior for first-year college students

A typology of environmentally responsible behavior for first-year college students

Brett L. Bruyere, M.S.

Abstract: This article identifies a typology of environmentally responsible behaviors for first-year college students at a large land grant university. Using a mixed-method research design of focus groups, interviews and quantitative surveys, the author identifies 18 environmental behaviors distributed among a four-level typology for first-year college students. The study also describes how environmental behaviors are an integral part of an ecologically literate individual, and how higher education can integrate the results of this study into its teaching pedagogy and campus life.

Keywords: *environment, first-year seminar, environmentally responsible behavior*

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Introduction

Issue of Concern

When the United States' financial and job markets are ailing, public officials and government leaders often speak about the need for an "economic recovery." They examine trends and indicators such as unemployment rates and consumer confidence to help determine a package of interventions that can redirect the economy in a healthier direction. It can be argued that the country – and therefore, the planet – needs a similar approach when it comes to the sustainability of our natural resources. Namely, the country needs an "environmental recovery." Indicators of the need for that kind of recovery – energy consumption, biodiversity loss, global average temperature, among others – clearly point to a world population that is using its renewable resources faster than they can replenished, and consuming its non-renewable resources faster than affordable and suitable alternatives are being developed and implemented (AtKisson, 1999).

Consider the following: the world lost 2.2 percent of its forests in the ten year period of 1990-2000. These same forests provide habitat to a diversity of plant and wildlife that support the human existence with food and medicine (United Nations Food and Agricultural Organization, 2000). In the past year, scientists from the multi-nation Intergovernmental Panel on Climate Change (2001) concluded that most of the global warming of the past 50 years is attributable to human activities, which is especially relevant to the United States, where more than 25 percent of the world's carbon output occurs. As a consequence of global warming, global annual average temperature is projected to increase as much as 5.8 degrees Celsius by 2010 from 1990 levels,

contributing to rising seas, severe droughts and other climatic disasters (Dunn and Flavin, 2002). Clearly, an environmental recovery is needed as much as an economic recovery. Perhaps it is needed even more than an economic recovery, given that a sustainable supply of natural resources precedes a healthy economy (Orr, 1992).

Purpose of Study

Human behavior change can be an important piece to achieving sustainability and embarking on an environmental recovery. The purpose of this article is to identify the salient environmentally responsible behaviors for a population of first-year college students. By identifying specific behaviors for this cohort, appropriate educational strategies can then be developed for and integrated within university curricula and other campus learning opportunities to which students are exposed.

The importance of the contribution of university students to achieving sustainability cannot be underestimated. First, the efforts and actions of every individual, group and culture are valuable in contributing to the tipping point of sustainability. Second, college students represent the population of individuals from which future legislators, policy developers and world leaders will be drawn. They will make decisions in their organizations, corporations and other workplaces that affect the health of our environment, and consequently, the health of our economy. Therefore, college students should be provided opportunities and encouragement to engage in meaningful environmental stewardship within the routine of their everyday lives, so that a positive environmental value transcends their subsequent years of policy-making and leadership. But, this encouragement of environmental behavior during college years must take into

account their life reality of residence halls, limited discretionary income and other unique situational factors of the lives of first-year college students. This study addresses such parameters.

Theoretical Background

Environmental challenges exist despite legislative efforts by many countries, including the United States, to improve the cleanliness of air and water, to assess environmental impacts prior to making decisions that affect the public domain, and despite a paradigm shift in U.S. public environmental values that indicate a more biocentric attitude toward natural resources (Dunlap and Van Liere, 1992). Certainly such policy and change in attitude has generated improvement in some areas of environmental quality – the air and water quality in many U.S. cities has steadily improved since passage of key legislation in the 1970s – but many scientists and others concur that environmental recovery efforts of the past 20 years have been too small or too slow (Gardner, 2002). Despite the volumes of environmental policy, regulatory codes and international treaties debated and developed over the course of the past 40 years, the world remains faced with compelling environmental challenges that are already adversely affecting the health and welfare of the world's population.

Perhaps the next wave of meaningful environmental change must originate from a sector other than manufacturing, industry, or any one of many other commercial or business entities that have become highly regulated and monitored by government, at least in the United States. Perhaps the next frontier of environmental progress must come from a sector that is difficult or perhaps inappropriate for government to regulate at all: individual behavior. The outcome of collective individual action to make

environmentally responsible choices of consuming less, driving less, or planting more, might have the positive impact that is needed to trigger an environmental recovery of far-reaching magnitude.

Behavior change is argued by some advocates as a critical piece to an effective overall strategy for moving the world more closely to a goal of sustainability (McDonough and Braungart, 2002). But "behavior change" is a vague term, as far as serving as the goal of educational and public awareness campaigns. It must be clearly defined in terms of what individuals actually need to do differently. Such specific behaviors may vary depending on the life stage and circumstance of the individual. It makes little sense, for example, to encourage less driving to someone without a driver's license, or to advocate to adolescents about purchasing energy-efficient appliances. In contrast, there may a need for a carefully-planned strategy that identifies the environmentally responsible behaviors which are appropriate and reasonable for a given audience and their given situation.

Ecological literacy.

Furthermore, environmental behavior is one of three parts requisite to becoming an ecologically literate individual (Orr, 1992). The terms "ecological literacy" and "environmental literacy" have varied definitions since they have received the attention of many researchers and environmental advocates, but there are commonalities among those definitions that imply three components: knowledge, concern and behavior. David Orr (1992) described ecological literacy as an informed affinity for the living world, driven by a sense of wonder, but tempered with a pragmatic understanding of ecological systems

and numbers. Disinger and Roth (1992) elaborated on that concept to suggest that the term should be defined by observable behaviors, that ecological literacy includes a component of *active involvement* that is based on environmental knowledge and concern. This study addresses this contention of involvement, or the *behavioral* component. Ultimately, Orr (1992) believed that it is widespread changes in how individuals live their lives that will be a primary force behind an ecological revolution in which resources are used wisely, and future generations will be assured a quality of life similar to or better than our own. In other words, people need to change what they do.

Behavior theory.

Environmentally responsible behavior has been the focus of considerable research with varying degrees of specificity. Much of this research examined the extent to which environmental behaviors follow a value-attitude-behavior hierarchy that has been extrapolated from and evidenced in other natural resource research, such as public attitudes toward wildlife management alternatives (Bright and Manfredo, 1998; Manfredo, Fulton and Pierce, 1997) and renewable energy (Bang, et al. 2000). Research by Homer and Kahle (1988) supported the value-attitude-behavior hierarchy within a context of organic food consumer choices, and other research has supported the hierarchy within the context of recycling behavior (Arbuthnot, 1977; Ebreo and Vining, 2001; Simmons & Widmar, 1990).

In addition to values and attitudes, environmental behavior studies have examined a number of additional antecedents. This includes Hines, Hungerford and Volk's (1986) meta-analysis of 128 studies in which they identified knowledge of an issue, desire to act,

and knowledge of courses of action, as key variables. Their conclusions were preceded by Sia, Hungerford and Tomera's (1985/86) research in which skills and knowledge of environmental action strategies emerged as strong predictors of environmental behavior. Sivek and Hungerford (1989/90) also concluded that instruction and use of environmental action strategies were salient predictors of environmental behavior. Other researchers have reached similar conclusions about the importance of knowledge of action strategies as a predictor of environmental behavior, including the work of Newhouse (1990) and Hwang, Kim and Jeng (2000). As the cumulative results of these studies indicated, knowledge of behavioral strategies is an important prerequisite to environmentally responsible behavior. In other words, one has to know what to do before he or she can do it.

One limitation of the current literature, however, is a lack of specific definition for "environmentally responsible behavior." The discipline of environmental education would benefit from additional research that identifies what such behavior looks like for specific groups of interest. For example, Linn, Vining and Feeley (1994) studied consumer choices of shoppers in specific grocery stores. Ebreo and Vining (2001) researched waste reduction and recycling behaviors of residents of three specific towns. Gigliotti (1994) researched the willingness of college undergraduates to make voluntary lifestyle changes. Arbuthnot (1977) examined recycling behaviors of an Ohio town, and Kearney and DeYoung (1995) studied carpooling behavior of employees of specific organizations. In these instances, the value and utility of research conclusions were especially high since they identified specific environmental behaviors for specific populations. While the work of other environmental behavior researchers has been

unquestionably valuable, especially in identifying antecedents to environmental behavior, additional research about specific behaviors is needed, particularly since specific behavior change is often the goal for public environmental education efforts.

The research presented in this article identifies a typology of behaviors that can be adopted by college freshmen at a large land grant university to contribute to conservation and sustainability of natural resources. College freshmen, many of whom are between 18-22 years of age, are typically in a life stage of early adulthood and commonly live in non-household residences such as university residence halls where options for environmentally responsible behavior are much different than in a residential dwelling. Some environmental behaviors such as curbside recycling may not be relevant to a student in a residence hall where such an amenity is unavailable. In addition, the consumption trends and preferences of college freshmen may also be distinctive from the rest of the population, such that a unique environmental education strategy to encourage them to undertake specific types of consumer behaviors is merited.

The research conducted for this study targeted first-year students at the main campus of Colorado State University (CSU) in Fort Collins, Colorado. CSU is a land grant university of more than 24,000 students. The university-wide graduation requirements for incoming freshmen at CSU include successful completion of a first-year seminar (FYS). The FYS is taken during the student's first year on campus. While each of the seven colleges within CSU has developed the FYS to fulfill its own needs and expectations, the common thread among all FYS's is to provide a small class atmosphere that encourages peer interaction and provides support during the first-year transition to university life.

Methods

This study utilized a mixed research strategy of qualitative and quantitative methods. The initial research was exploratory in nature, and included a series of focus groups, semi-structured interviews, and statistical analysis using principle components analysis (PCA). The results of the exploratory analysis were then statistically analyzed for further validation using reliability analysis and confirmatory factor analysis (CFA).

Qualitative Methods

In order to identify a set of reasonable and realistic environmental behaviors for first-year college students, three focus groups were conducted with upperclassmen in CSU's College of Natural Resources who lived on campus during their freshmen year of college. This population was selected for two reasons. One, they had experience living in the residence halls within the last two to three years. Therefore, they were familiar with freshmen year perspectives, and the environmental behavior options on campus, in residence halls, and in the surrounding community. Second, the upperclassmen had two to three years of coursework and exposure to natural resource content in the classroom, and environmental advocacy via campus and community environmental events. Therefore, they had greater awareness of the various options for environmental behavior compared to a freshmen population, that typically has less campus and life experience, and less exposure to environmental issues and advocacy.

Participants were self-selected individuals who responded to an announced solicitation in natural resource courses during the Fall, 2001 and Spring, 2002 semesters. The three focus groups had 12, 10 and 9 participants, respectively. Sufficient repetition of

results regarding the identification of specific environmental behaviors was achieved in the third focus group.

In addition, three semi-structured telephone interviews were conducted with representatives of the university's facilities management and residence life departments. These departments are responsible for implementation and administration of campus-based conservation programs. The interviews were conducted to identify the campus amenities available to students related to conservation behavior. Repetition of results was evident during the third interview.

Quantitative Methods

Results of the three focus groups and three telephone interviews allowed for development of an initial list of 20 conservation-related behaviors that current CSU freshmen living on-campus had a reasonable option to undertake. This list of behaviors served as the basis for a quantitative survey of seven freshmen samples, six of which were drawn from the university's FYS sections in Spring, 2002. Of the six FYS sections, two were selected from the university's College of Natural Resources and four were drawn from other colleges and departments on campus. Class sections were selected based on the willingness of the instructor to allow sampling to be conducted during course meeting times. The seventh sample of first-year students was comprised of self-selected students who responded to an outdoor clean up project as part of a campus wide volunteer service day. Each group had between 17 and 20 participants. The total sample size was 136 respondents.

During the fourth and fifth weeks of the Spring, 2002 semester, the 136 students completed a survey of the 20 environmental behavior items identified during the

qualitative research. Respondents indicated to what degree they participated in a specific environmental behavior when the opportunity arose, on a scale of one (1) (never) to seven (7) (always). Scale length was based on Kline's (1986) assertion that seven-point scales provide the most robust and statistically sound results. A "not applicable" option was also included for each of the 20 items.

Survey results were analyzed using SPSS Version 10.0. A principal component analysis with varimax rotation was conducted to first extrapolate factors from within the 20 behaviors. Missing data was excluded listwise. Based on factor loadings and judgment of the research team, reliability analyses were then conducted to assess further validity of the factors. Variables for the identified factors were then analyzed in Amos Version 4.0 for a confirmatory factor analysis of the model suggested in the preceding exploratory and reliability analyses.

Results

The focus groups and telephone interviews resulted in an initial list of 20 identified behaviors that freshmen at CSU could potentially and reasonably undertake. Eighteen of the 20 behaviors were identified in all three focus groups, and the remaining two were identified in two of the three focus groups. Behaviors identified in only one of the focus groups were not retained. In terms of the phone interviews with university personnel, eight of the initial 20 behaviors were identified in each of three interviews, six were identified in two of the interviews, four were identified once, and two were not identified at all. The phone interviews did not result in new behaviors which were not

previously identified in the focus groups. Collectively, these 20 behaviors served as the basis for the survey administered to the sample of 136 first-year students (see Table 1).

Table 1 about here

The principle components analysis resulted in identification of five factors with Eigenvalues greater than a value of 1.0 that cumulatively explained 73 percent of variance. While the general rule of thumb is to retain all factors with Eigenvalues greater than 1.0, it is not always the best solution (Norusis, 1994), and the fifth factor was dropped from further analysis. Its Eigenvalue marginally exceeded a value of 1.0 (1.18). Further, only two variables loaded on the fifth factor, and those two variables either were reassigned to another factor where it had an acceptable loading (> .40) and theoretically had a better fit, or was dropped from further analysis entirely. After dropping the fifth factor, the remaining four factors accounted for 67 percent of variance. Results for all five factors are presented in Table 2.

Table 2 about here

The subsequent reliability analysis deviated from the PCA results for statistical rigor and theoretical fit. The variable *take unwanted CDs to buy-back stores* was added with the variables on Factor 4, which appeared to have a theme of *throwaway* or *disposal.* This variable loaded highest on Factor 1 (.52), and its loading on Factor 4 was .02 lower (.50). In addition, the variable *recycle plastic bottles* was also added with the variables on Factor 4 in which the disposal theme seemed more theoretically appropriate, despite its highest loading on Factor 5 (.77). While the value of the loading of this variable on

Factor 4 (.33) was not as strong as would be preferred, the researchers decided, on a theoretical basis, that the variable fit best with Factor 4.

Due to the adjustment of *recycle plastic bottles* to Factor 4, only one variable remained loaded on Factor 5, *volunteer for conservation projects*. According to Kline (1986), one-item scales should be avoided, and the variable did not have an acceptable loading (< .28) on any remaining factors. Consequently, *volunteer for conservation projects* was eliminated from further analysis.

The final adjustment involved the variable "assess environmental records of candidates for public office." It loaded on Factor 1 with a value of .53. However, the remaining four variables on Factor 1 had loading which were considerably higher, ranging from .67 to .82. Further, the variable did not seem to coincide with the consumer theme to which the other variables appeared to be related. The variable *assess environmental records of candidates for public office* did not have a statistically acceptable loading on any other factor (< .31), and was therefore dropped from further analysis.

After dropping Factor 5 from further study and making the adjustments previously described, reliability analyses were completed on the four remaining factors. Reliability analysis indicated a Cronbach alpha of .83 for Factor 1, .82 for Factor 2, .80 for Factor 3, and .85 for Factor 4 (see Table 3).

Table 3 about here

The CFA conducted to test the model suggested by the PCA and reliability analyses was analyzed with uncorrelated error terms. Further, although PCA theoretically

extrapolates factors which are orthogonal to one another, the researchers correlated the four factors to one another in the CFA model based on the argument that in reality, all four factors positively relate to a bigger construct of concern for the environment. Consequently, it was concluded that the factors should not be included in the model as independent, since they are in fact related to a similar orientation or value regarding the environment.

Goodness of fit results of the CFA indicated a χ^2 / df value of 4.74 and a normed non-central fit index (CFI) of .91 (see Table 3).

Discussion

Typology of Results

Results of the PCA, reliability and CFA analyses suggest that a four-level typology of environmental behaviors for first-year college students exists that includes: 1) consumer, 2) disposal, 3) reuse, and 4) conservation (see Figure 1). This typology is supported by the PCA, Cronbach alpha values in the reliability analysis, and the goodness of fit statistics in the CFA. The four components of the typology are not necessarily exclusive to this sample; the non-college student population should consider its consumer, disposal, reuse and conservation behaviors, as well. However, the specific behaviors which comprise these four components, as identified in this study, are perhaps unique.

Figure 1 about here

The consumer choice behaviors included items which can be considered distinct to a college student population. *Buy paper products made from recycled material*, for example, would include notebooks, paper and folders as needed for academic endeavors, of which there are generally recycled product options. *Purchase beverages packaged in recyclable containers* are common among many population cohorts, but perhaps more so for a campus population that has frequent access to vending machines and a number of convenience stores located on or near campus. *Avoid food purchases that come in excess packaging* can be especially relevant to a college student population in which convenience can be a key variable in food choices, and oftentimes "convenient" food comes in single-serving sizes that use a disproportionately high amount of natural resources in their packaging. Finally, *buy a used CD* is highly relevant, as music is a common interest among college students.

Disposal behavior represents the second element of the typology. How students discard of trash and unwanted possessions had a number of specific behaviors associated with it. First, students are able to *recycle plastic* and *recycle paper* using a variety of on-campus amenities, including mixed container recycling bins located in individual residence hall rooms and recycling receptacles located in most campus buildings. Second, first-year college students at CSU typically live on campus, and must move out at the end of the school year. This provides an opportunity to discard unwanted possessions, such as articles of clothing and small appliances. The residence hall departments provide donation bins at the end of each semester, to encourage *donating unwanted clothing or small appliances*. Additionally, compact discs can often be sold to stores that sell used

music. Therefore, with a population that traditionally has minimal discretionary income, *retuning compact discs to buy back stores* may be preferable to throwing them away.

The three variables that loaded on Factor 3 had a theme of reuse, including *buy a used appliance*, *repair a backpack* and *repair a CD player*. Factor 3 partially accounts for the tendency of students who reside in residence halls to purchase microwaves, warming plates and other small appliances that create convenience when residing in small spaces. In addition, backpacks and compact disc players are common belongings among college students, and were also identified in focus groups as possessions which often become in need of repair.

The fourth element of the typology addressed conservation of energy, water and paper. Mainstream conservation behaviors such as *taking shorter showers, foregoing a shopping bag, turning off lights* and *turning off water while brushing* are relevant, but not exclusively, to the sample of college students addressed for this study. *Printing on both sides of paper* may be more salient to them since they are often responsible for computer-printed assignments and term papers. Overall, using less, or conservation, clearly emerged as one dynamic of the typology.

The two variables which did not emerge as particularly significant in this study – *volunteering for conservation projects*, and *assessing environmental records of candidates for public office* – are perhaps indicative of the apathy generally associated with the 18-24 year old age group when it comes to volunteerism and voting. Although they were identified in earlier focus groups of upperclassmen as viable environmental behaviors, the quantitative survey administered to first-year students did not support their inclusion in the final typology.

In the end, environmental behaviors for first-year college students involve largely what they buy, options for buying it, if it becomes reused, and how they eventually dispose of it. Behaviors such as carpooling and composting that serve as the basis for some public education campaigns are not as relevant to this population which commonly has no commute and resides predominantly in a campus residence hall with limited living space. Of more relevance to college men and women are buying compact discs, securing small appliances for their residence hall rooms, and printing term papers on both sides of the sheet.

Implications

The results of this study have clear implications for leaders in higher education who support the integration of ecological literacy in the university teaching pedagogy and overall campus life. As David Orr (1992, 1994) advocated, a mission of higher education should focus on the development of balanced and whole persons, in which the analytic, intellect, feelings and manual competence are integrated. From a standpoint of ecological literacy, this integration insinuates that such a person be knowledgeable about ecological principles, feel concern for ecological health, and employ the skills and behaviors to act responsibly. It is the latter of these that has been addressed in this study.

As university leaders, such as those who made a commitment to integrate sustainable practices by signing the Tallories Declaration, consider how to encourage its students to adopt environmental responsible behaviors, they must know which behaviors to target. Based on the results of this study, a clear list of behaviors is provided which is relevant and salient to a population of first-year college students. In freshmen and

perhaps higher level courses of environmental studies, environmental ethics, conservation, or similar classes, this typology can be integrated and discussed, with a greater likelihood of engaging the students because the behaviors are *relevant*. In addition, campus organizations which generate awareness and educate students about the need for sustainability can also use the typology as a means for encouraging student action.

The environmental recovery needed on a global level will require broad-based contributions: more efficient fuel-wood stoves in rural areas of developing countries, advances in alternative energies by developed countries, and behavior changes by the world's biggest consumers, to name a few. This research outlines the contributions that can be made by first-year college students. As they get older and their life circumstances inevitably change, those contributions will change. Part of the environmental recovery, then, is for individuals to consider and reconsider what they can do at a given time in their life, to help propel the planet's natural resources to a sustainable level.

Generalizability and Limitations

It should be noted that this study focused exclusively on students at Colorado State University, and the typology of environmental behaviors is based largely in part on the campus and community resources available to those students for recycling, conservation, and similar behaviors. The generalizability of the study is therefore limited to campuses and communities with similar opportunities and programs. Future research might assess and evaluate how to integrate the findings from this research into the educational and awareness programs that are typical of most campuses, such as lecture

series, course curricula, residence hall programs and similar outlets. While this study has provided a basis from which to build an educational and environmental message, it does not address how that message should be crafted and delivered.

Conclusion

There are numerous indicators that resources on our planet are not being used prudently: biodiversity loss, carbon output, global annual average temperature are only a few. If the world's population values its future generations as well as a healthy environment, then it must consider its behaviors and consumption of resources. It must become knowledgeable about the relationship of sustainability to economic stability and physical health. It must acquire skills in applying stewardship to their daily behaviors. In other words, they must become *ecologically literate*. It is critical element to averting a global environmental crisis. This study addresses how one population can make their contribution.

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Table 1. List of environmental behaviors for freshmen at Colorado State University.

Recycle plastic bottles
Recycle paper
Donate unwanted clothing
Donate unwanted small appliances
Print on both sides of paper
Repair a backpack
Repair a CD player
Purchase beverages packaged in recyclable containers
Buy a used CD
Avoid food purchases that come in excess packaging
Buy paper products made from recycled material
Buy used small appliances
Take short showers
Turn off water while brushing teeth
Turn off lights when leaving my room
Turn off personal computer when finished
Volunteer for conservation projects
Forego shopping bags for 1- or 2- item purchases
Assess environmental records of candidates for public office
Take unwanted CDs to buy-back stores

Table 2. PCA factor loading results of 20 environmental behaviors of college freshmen[a]

Survey item	Factor 1 ϵ =8.15	Factor 2 ϵ =2.21	Factor 3 ϵ =1.63	Factor 4 ϵ =1.40	Factor 5 ϵ =1.17
Purchase beverages packaged in recyclable containers	.80				
Buy a used CD	.70				
Avoid food purchases that come in excess packaging	.82				
Buy paper products made from recycled material	.67				
Assess environmental records of candidates for public office	.53				
Take short showers		.52			
Turn off water while brushing teeth		.66			
Turn off lights when leaving my room		.70			
Print on both sides of paper		.61			
Forego shopping bags for 1- or 2- item purchases		.83			
Turn off personal computer when finished		.63			
Repair a backpack			.57		
Repair a CD player			.85		
Buy used small appliances			.82		
Recycle paper				.64	
Donate unwanted clothing				.83	
Take unwanted CDs to buy-back stores	(.52)			.50	
Donate unwanted small appliances				.80	
Recycle plastic bottles				(.33)	.77
Volunteer for conservation projects					.64

a – (n=136)

Table 3. Reliability and confirmatory factor analysis of environmental behaviors [1,2]

	Factor Loading	Cronbach α
Consumer Index		**.83**
Purchase beverages packaged in recyclable containers	.94	
Buy a used CD	.51	
Avoid purchasing food that comes in excess packaging	.80	
Buy paper products made from recycled materials	.67	
Conservation Index		**.82**
Take short showers	.63	
Turn off water while brushing teeth	.84	
Turn off lights when leaving a room	.90	
Turn off personal computer when finished	.68	
Forego shopping bags for 1- or 2- item purchases	.48	
Print on both sides of the paper	.41	
Reuse Index		**.80**
Repair a backpack	.77	
Repair a CD player	.68	
Buy a used small appliance	.77	
Disposal Index		**.85**
Recycle plastic bottles	.72	
Recycle paper	.82	
Donate unwanted clothing	.68	
Take unwanted CDs to buy-back stores	.58	
Donate unwanted small appliances	.68	

1 -- (n=136)
2 -- goodness of fit indices from structural equation analysis using Amos 4.0 found the data to be a good fit of the model (X^2/df = 4.74; NFI = .89; CFI = .91; GFI =.88).

Figure 1. Typology of environmental behaviors for first-year college students

CONSUMER BEHAVIORS *Purchase beverages in recycled containers, buy used CDs, avoid products in excessive packaging, buy paper products made from recycled material*
CONSERVATION BEHAVIORS *Take short showers, turn off water while brushing, turn off lights, turn off computers, forego shopping bags, print double-sided*
DISPOSAL BEHAVIORS *Recycle plastic bottles, recycle paper, donate unwanted clothing, donate unwanted small appliances, return CDs to buy-back stores*
REUSE BEHAVIORS *Repair a backpack, repair a CD player, buy used appliances for residence hall room*

CHAPTER THREE:
MANUSCRIPT #2

Assessing ecological literacy within a context of environmental values, attitudes and behaviors of first-year college students, and the effect of environmental education.

Assessing ecological literacy within a context of environmental values, attitudes and behaviors of first-year college students, and the effect of environmental education.

Brett L. Bruyere, M.S.

Abstract: This article assesses the viability of a value-attitude-behavior hierarchy within the context of four environmentally responsible behavior types of first-year college students. In addition, the research studies the effect of knowledge on attitude and behavior, and ultimately has implications for further understanding of ecological literacy.

Keywords: *environment, ecological literacy, eco-literacy, environmentally responsible behavior*

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Introduction

Ecological literacy, or eco-literacy, has received the attention of environmental scientists, philosophers, advocates, and others. Consequently, the term has varied definitions, but with compelling commonalities among those definitions that imply three components: *knowledge, affect* and *behavior*. To achieve ecological literacy, there must be acquired *knowledge* about ecological principles and biological cycles, a personal *affinity* or *concern* for the natural environment, and *behavior practice* that contributes to healthy ecosystems and communities (Disinger and Roth, 1992; Orr, 1992).

Education is critical to achieve ecological literacy. Knowledge of biological cycles and options for environmental behaviors, for example, must be gained through some type of formal or informal education, either initiated by an individual on their own accord, or perhaps by an institution or organization with environmental education as part of its mission. However, environmental education has been frequently criticized as not being education at all, but rather, advocacy (Gigliotti, 1990; Knapp, 2000; Salmon, 2000). Such criticism of environmental education is problematic given the frequency with which education is acknowledged as a desirable method for encouraging responsible behavior. This presents a critical question: how can environmental education remain knowledge-based, and therefore mitigate the attention of critics, but also achieve its goal of inspiring change in behavior?

The purpose of this study is to clarify the *knowledge* and *behavior* components of ecological literacy for a population of first-year college students. The study assesses the extent to which knowledge of ecological principles, biological cycles and environmental systems impacts specific environmental attitudes and behaviors, and if environmental

education can positively affect environmental behavior change. In addition, the study assesses the relationship defined by the value-attitude-behavior hierarchy as they relate to environmental behaviors, to assess if such a hierarchy exists in this context, as it has in other natural resource studies.

First-Year Seminars and Ecological Literacy

The focus for this study is first-year college students at a large land grant university. A majority of the participants were enrolled in a three-credit first-year seminar (FYS) course. Taken during the first year of college, the course is intended to assist students in achieving a successful transition to the campus life and academic rigor of a four-year university. Barefoot and Fidler (1994) discovered that more than 71% of college and universities offered such a course in some format. Further, of schools which offered the FYS as an academic credit course, societal issues and values clarification were among the top four most frequently reported topics covered in the class. This is apropos for a population of college students, many of whom are in a life stage in which clarifying values and confronting social issues is common (Erikson, 1968), and whom also reside at a time in which global environmental issues are in imminent need of attention. Today's college students will inherit a number of environmentally-related challenges: the world will have to develop viable alternatives to fossil fuels, profoundly consider the importance of maintaining biodiversity, and respond to the increased potential for natural disasters associated with global warming (Starke, 2002). Ecological literacy will be imperative in order to effectively address such complex and potentially daunting issues.

David Orr (1992) described ecological literacy as an informed affinity for the living world, driven by a sense of wonder but tempered with a pragmatic understanding of ecological systems. In his discussion, he asserted that one must have an understanding of ecological principles, laws of thermodynamics, carrying capacity, and steady state economics, in order to successfully achieve ecological literacy. Such knowledge, he argued, is imperative to becoming a responsible citizen and environmental steward.

Roth (1968) and Disinger and Roth (1992) shared many of Orr's principles in their discussion of ecological literacy. In addition to a concern for the environment, and knowledge about the environment, they emphasized a component of *active involvement* and observable behaviors. While this is discussed and implied in Orr's work, as well, the argument that one must act responsibly and adopt positive environmental behaviors is especially prevalent in their work.

McClaren's (1990) discussions of ecological literacy included similar elements. He spoke of the importance of values clarification and the need for individuals to integrate healthy and sustainable environments into personal value systems. This is comparable to Orr's assertion that people must adopt a personal affinity and concern for the natural environment. And similar to the other ecological literacy advocates and philosophers, McClaren also argued for greater knowledge about biological cycles and alternatives for engaging in meaningful environmental action.

Collectively, these various discussions and definitions of ecological literacy imply that an individual have knowledge of ecological principles, concern for a healthy natural environment, and skills to engage in environmentally responsible behaviors, to be

ecologically literate. Together, these three parts represent a unique and dynamic model of eco-literacy suggested in Figure 1.

Figure 1 about here

This study assesses the relationship between environmental values and attitudes, as well as the effect of attitude on four specific environmental behavior groups derived from the typology of environmentally responsible behaviors for first-year college students identified by Bruyere (2002): consumer, disposal, reuse and conservation. This typology was generated based on a study on college students, and identified the types of behaviors that are relevant and reasonable for a population of first-year college students at a large public university (see Figure 2).

Figure 2 about here

In addition, this study assesses the impact of environmental education on values, attitudes and behaviors related to the natural environment. A sample in this study participated in a series of cognitive-based presentations about topics drawn from Orr's (1994) discussion of the knowledge component of ecological literacy. The impact of that approach on values, attitudes and behaviors is subsequently assessed.

Hypotheses

Given that ecological literacy addresses environmental values and behaviors, previous research on the relationships between values, behaviors and attitudes is valuable. As consistently shown in previous research on the value-attitude-behavior hierarchy, the orientation of one's fundamental values predicts attitudes related to

specific issues, and those attitudes predict behaviors related to the issue. These relationships have been positively supported in natural resource research related to public support of wildlife management alternatives (Bright and Manfredo, 1998; Manfredo, Fulton and Pierce, 1997), renewable energy (Bang, et al. 2000), organic food choices (Homer and Kahle,1988) and recycling (Arbuthnot, 1977; Ebreo and Vining, 2001; Simmons and Widmar, 1990). The attitude-behavior relationship is also replicated in other well-established behavior models, such as Ajzen and Fishbein's (1980) Theory of Reasoned Action. Based on its application and consistent support in previous natural resource and environmentally related research, the value-attitude-behavior hierarchy is expected to hold in this study for each of the four behavior types identified in the typology. The hypotheses for this research, therefore, include the following (see Figure 3):

H_1: value orientation toward the environment will be a significant predictor of attitudes toward environmental behaviors

H_2: attitude toward environmental behaviors will be a significant predictor of the extent to which environmental behaviors are practiced.

Figure 3 about here

Previous research regarding the role of knowledge on environmental attitudes and behaviors has varied. In some previous studies, researchers identified no effect of knowledge on environmental concern or behavior (Borden and Schettino, 1979; Kearney and DeYoung, 1995). However, other studies have identified a positive effect of knowledge associated with specific behaviors such as recycling (Junquera, del Brio and

Muniz, 2001), as well as general environmental behavior (Bradley, Waliczek, and Zajicek, 1999; Hwang, Kim, and Jang, 2000; Pooley and O'Connor, 2000; Simmons, 1998). Further, the implication of Petty and Cacioppo's (1986) Elaboration Likelihood Model suggests that as knowledge, or cognitive structure, about an issue is enhanced, attitudes related to that issue become more stable and difficult to change. Overall, the cumulative analysis of previous research indicates that knowledge has a stabilizing affect on and positive correlation with both environmental attitudes and environmental behaviors. Consequently, additional hypotheses for this study are as follows:

H_3: knowledge will partially mediate the attitude-behavior relationship (see Figure 4)

H_4: attitudes toward environmental behaviors will significantly change following participation in an environmental education program

H_5: environmental behaviors will significantly change following participation in an environmental education program

Finally, values have been extensively studied in previous research and in many contexts. Rokeach (1973) defined values as singular beliefs about what is personally and socially preferable, used as standards to evaluate actions and attitudes, and that remain with an individual throughout a lifetime. Heberlein (1981) described values as central to an individual's belief system, and therefore, difficult to change without a major cognitive reorganization. The information presented in the treatments in this study was not considered sufficient to trigger a major cognitive reorganization. Therefore, a change in value orientation toward the environment was not predicted, resulting in the following hypothesis:

H_6: value orientations will not change following a gain in knowledge

Methods

Sampling

The sample for this study was 136 first-year students at the main campus of Colorado State University (CSU) in Fort Collins. The sample was drawn from six FYS courses from multiple departments on campus. These sections were selected based on the willingness of the instructor to allow surveys and presentations to be conducted during course meeting times. In addition, 17 additional first-year students participated who were a part of a campus-sponsored outdoor clean-up project. Of the 136 respondents, two first-year seminars (n=34) received a series of lessons drawn in part from Orr's (1992) ecological literacy discussions regarding ecological principles, biological cycles, and environmental services.

Survey Development

During the fourth and fifth weeks of the Spring, 2002 semester, all 136 participants completed a pre-survey related to environmental values, attitudes and behaviors. Values were measured using Dunlap and Van Liere's (1978) New Environmental Paradigm (NEP) scale. The NEP has been used in other environmental value research applications, including Gigliotti's (1994) research on college students and Scott and Willits' (1994) research of Pennsylvania residents. The survey also included 18 attitude assessments about specific environmental behaviors. Respondents were asked to indicate on a seven-point scale ("not at all to important" to "very important") the extent

to which they felt an environmental behavior is important to college students. The seven point scale was selected to maximize statistical rigor (Kline, 1986). The 18 items were drawn from the list of behaviors drawn from the typology developed and validated previously (Bruyere, 2002) that identified viable and reasonable environmental behavior alternatives for first-year college students (see Figure 2).

In addition to their perceived importance for each of the 18 behaviors, respondents were also asked to indicate the frequency with which they actually engage in those behaviors, on a scale of 1 ("never") to 7 ("always"). This provided a means to assess the frequency of the actual environmental behaviors in the typology.

An additional section of the survey included nine environmental knowledge questions about ecological principles and cycles, local sources of energy and waste disposal, sustainability, natural resource origins of plastic, and others. It included five multiple choice and four true-false items (see Table 1). The questions were developed and selected based in part on Orr (1992) and McClaren's (1990) ecological literacy reviews that suggested a need for proficiency in biological cycles, ecological principles, and familiarity with local environmental services. The nine knowledge questions were developed and reviewed by academic faculty and two student focus groups to ensure construct validity.

Table 1 about here

Following the pre-test, 34 students were presented with an environmental education program. This included lecture-style presentations about ecological principles, biological cycles, and the natural resource origins of common consumer goods.

Participants were also informed of the local environmental systems related to energy, water and municipal solid waste. The information was carefully presented to remain objective and factual; discussion regarding the merits of different options for energy and solid waste disposal, for example, was avoided. Overall, the lectures were intended to enhance the *knowledge* element of ecological literacy. The presentation of environmental knowledge occurred during the ninth and tenth weeks of the semester. The post- test was administered to all participants during the fourteenth and fifteenth weeks.

Analyses

Results were statistically analyzed in SPSS Version 10.0. Scales were calculated using reliability analysis. Mean pre and post test results were compared using paired sample t-tests, and prediction and model tests were completed by linear regression analyses.

Viability of the value-attitude-behavior hierarchy (hypotheses 1 and 2) was determined by a series of linear regressions for each of the four behavior group types. Specific attitude scales (i.e. *consumer attitudes*) were regressed on environmental value orientation. The respective behavior scales (i.e. *consumer behaviors*) were then regressed on the corresponding attitude scales. For the value-attitude-behavior hierarchy to hold, environmental value orientation was required to be a significant variable in the *value-attitude* regression model, and attitude scales were required to be significant in the *attitude-behavior* regression model.

To test for hypotheses 3 related to the mediation of knowledge in the attitude-behavior relationship, three regression analyses were conducted for each of the behavior types suggested in the typology: attitudes regressed on knowledge, behavior regressed on attitudes, and behavior regressed on both attitudes and knowledge. To substantiate mediation, the independent variables in each of the three models needed to show significance, and the contribution of *attitude* in the full model (with *knowledge* as an additional independent variable) needed to be lower than in the simple model of behavior regressed on attitudes.

To address the effect of knowledge gain on environmental values, attitudes and behaviors, a series of paired t-tests were conducted on the sample (n=34) of students who

participated in the lessons about ecological principles, biological cycles, and environmental services.

Results

Scale reliability

The Cronbach's alpha for reliability of the nine scales related to environmental values, and the attitudes and behaviors associated with each of the four components of the behavior typology, varied between .68 and .85 (see Table 2). Given that all scales were greater than .60, use of these indices for hypothesis testing was considered appropriate.

Table 2 about here

Value-Attitude-Behavior Hierarchy

Hypothesis 1 stated that value orientation would predict attitudes toward environmental behaviors, and hypothesis 2 stated that attitude would predict environmental behavior. Regression analysis for the *consumer* behavior group indicated that value orientation accounted for 5% of variation in consumer attitudes, with a significance of ($p<.01$) and a standardized Beta coefficient of .23. Consumer attitudes accounted for 30% of variation in consumer behaviors, with a significance of ($p<.01$) and a standardized Beta coefficient of .56.

Regression results for the *disposal* behavior group indicated that value orientation accounted for 7% of variation in disposal attitudes, with a significance of ($p<.01$) and a

standardized Beta coefficient of .27. Disposal attitudes accounted for 37% of variation in behaviors, with a significance of ($p<.01$) and a standardized Beta coefficient of .61.

For the *reuse* component, value orientation accounted for zero percent of variation in reuse attitudes, with a significance of ($p=.91$) and a standardized Beta coefficient of -.01. Reuse attitudes accounted for 48% of reuse behaviors variance, with a significance of ($p<.01$) and a standardized Beta coefficient of .70.

Finally, the *conservation* scales indicated that value orientation accounted for 5% of the variance in conservation attitudes, with a significance of ($p<.01$) and a standardized Beta coefficient of .23. In the attitude-behavior regression, conservation attitudes accounted for 49% of the variance, with a significance value of ($p<.01$) and a standardized Beta coefficient of .70. Due to the insignificance of value orientation on *reuse* attitudes, hypothesis 1 was partially supported. Based on the significance of the attitude-behavior regression for all four behavior types, hypothesis 2 was fully supported (see Tables 3 and 4).

Tables 3 and 4 about here

Knowledge Mediation of Attitude-Behavior Relationship

Hypothesis 3 stated that knowledge would mediate the attitude-behavior relationship. The mean knowledge score was 5.59 and the mode was 6, out of 9, indicating that most respondents correctly answered 62-65% of the knowledge questions on the pre-test.

Results of two sets of regression analyses – 1) attitude regressed on knowledge and 2) behavior regressed on attitudes – were required to initially analyze hypothesis 3. Attitude-behavior regression results were previously reported (see Table 4).

In the attitude-knowledge regression, *consumer* attitude accounted for .5% of the variance in knowledge, with a significance of (p=.44) and a standardized Beta coefficient of .07. In the analysis of *disposal* behaviors, attitude accounted for .3% of the variance in knowledge, with a significance level of (p=.56) and a standardized Beta coefficient of .05. In the regression models related to *reuse*, attitudes were not a significant predictor of knowledge (p=.72), explaining .01% of the variance with a standardized Beta coefficient of -.03. In the analysis of *conservation* behaviors, attitude was not a significant (p=.22) predictor of knowledge, with a standardized Beta coefficient of -.11 and an explained variance of less than 1%.

Due to the insignificance of attitude as a predictor of knowledge for all four behavior types, knowledge was determined not to be a mediator of the attitude-behavior relationship. Hypothesis 3 was rejected (see Table 5). Consequently, the full regression model of behaviors regressed on attitude and knowledge was not necessary.

Table 5 about here

Effect of Environmental Education on Values, Attitudes and Behaviors

In assessing the impact of participation in environmental education, a paired independent sample t-test was first conducted to determine if the 34 participants actually gained knowledge about environmental cycles and services. In the analysis, the pre-test

knowledge mean of 5.84 was significantly less ($p<.03$) than the post-test mean of 8.10 (see Table 6).

Hypothesis 4 stated that attitudes about environmental behaviors would change following participation in environmental education. Attitudes about *consumer* behaviors shifted positively from 3.70 to 4.61 and the difference was statistically significant ($p<.01$). Attitudes related to *conservation* behaviors changed significantly ($p<.01$) from 4.58 to 5.15. Attitudes toward *disposal* behaviors also changed, from 4.90 to 5.47 ($p<.01$), and attitudes about *reuse* behaviors became more positive, from 3.78 to 4.33 ($p<.01$). Hypothesis 4 was supported.

Hypothesis 5 stated that environmental behaviors would become more frequent following an environmental education lesson. Differences in behavior were indicated as an increase from 3.20 to 4.50 for *consumer* behaviors ($p<.01$), 4.82 to 5.15 for *conservation* behaviors ($p<.01$), a gain from 4.08 to 4.71 for *disposal* behaviors ($p<.01$) and a change from 4.18 to 4.25 for *reuse* behaviors ($p=.52$). Hypothesis 5 was partially rejected (see Table 6).

Hypothesis 6 suggested that value orientation would not change following knowledge gain. The pre-test value orientation for respondents was 4.95 on a scale of 1 (negative orientation) to 7 (positive orientation). The post-test value was 4.7, and the difference was considered significant ($p <.01$) (see Table 6). Hypothesis 6 was rejected.

Table 6 about here

Discussion

Reliability results for the nine scales measuring values, attitudes and behaviors were considerably high, providing strong statistical support for the scales, as well as the overall four-point typology of behaviors for first-year college students presented in Figure 2. University educators and leaders should consider this typology when developing efforts toward campus ecology and student awareness of environmental issues. Bruyere (2002) discussed the implications of this typology in greater detail.

Value-Attitude-Behavior Models

Hypotheses 1 and 2 addressed the viability of the value-attitude-behavior hierarchy with the four specific behavior types: consumer, disposal, reuse and conservation. For the hierarchy to hold, the respective *value-attitude* and *attitude-behavior* regression models for each of the four types needed to be significant.

Most of the hypotheses related to value-attitude-behaviors were supported, but with relative weakness on the *value-attitude* link. The value-attitude regression for the *reuse* behavior type was not significant, and therefore, hypothesis 2 was partially rejected. While acceptable statistics emerged for the other three behavior types in the value-attitude relationship, those respective models were weak. Values did not explain a great deal of the variance in consumer, disposal and conservation attitudes. Overall, the results of this study indicate that value orientation may be only one of several factors influencing environmental attitudes with a sample of first-year college students.

These findings raise a question of why environmental value orientation fails to accurately estimate environmental attitudes for a sample of first-year college students.

The mean results of the value orientation scales were favorable in terms of being positively oriented toward environmental protection. Attitudes about environmental behaviors were also positively oriented toward the pro-environment end of the scale. Yet a positive environmental value orientation failed to predict positive attitudes toward environmental behaviors.

One point to consider is the effectiveness of the 1978 NEP as an effective instrument for measuring environmental value orientations of today's college student population. Perhaps the items that comprise that scale are of less relevance to today's young adults. Since development of the NEP, global warming has become an unquestionable and serious environmental issue. Ozone depletion emerged as a new challenge. The world surpassed the six billion population milestone in 1999. It may be that such events have contributed to a dimension of environmental value orientation that is not accurately reflected in the 1978 NEP. Further investigation into the construct validity of the NEP for first-year college students, as a measure of environmental value orientation, is needed.

In addition, as Fishbein and Ajzen (1975) reported, value orientation may not provide sufficient specificity to measure attitudes. Attitudes are directed toward specific attitude objects, while value orientation is a construct applied more generally and that transcends multiple dimensions of one's life. Consequently, it may not be probable in all scenarios for a measure of general environmental value orientation to accurately predict a specific environmental attitude. While one may have a positive environmental orientation, that does not mean the individual has a positive attitude for everything specific to the environment.

Contrary to the *value-attitude* regression results in which the relationships were consistently weak, the *attitude-behavior* analyses regularly indicated a strong regression model for each of the four behavior types. These findings indicate that the *attitude-behavior* relationship is consistent with previous research: how one feels about a particular type of environmental behavior is a strong predictor as to whether or not they actually engage in such behaviors. Unlike the *value-attitude* relationship, the variables in the *attitude-behavior* relationship are specific, in this case, to an environmental action. One's attitude about a specific environmental behavior would seem to be a reasonable predictor as to whether an individual engages in that same specific environmental behavior. Consequently, affecting attitudes of first-year college students is a reasonable approach for affecting their behavior.

The attitude-behavior results were especially strong for the *conservation* and *reuse* behaviors. One common thread between these two behavior types is the low intensity of effort needed to engage in the behaviors associated with each. *Turning off lights* and *printing on both side of paper* (conservation behaviors) requires minimal or no additional effort or cost compared to the alternatives, in most cases. Similar conclusions can be said about *buying a used appliance* or *repairing a CD player* (reuse behaviors). Consumer behaviors, however, sometimes result in added cost -- the "environmental" choice is often times, although not every time, more expensive. Given the limited means of many college students, one conclusion drawn from this study is environmental behaviors that incur no additional cost more closely follow environmental attitudes than behaviors which create an additional cost. The issue of cost as a barrier to environmental behavior needs to be studied further.

Environmentally responsible behaviors regarding disposal alternatives may also require additional time. Donating unwanted clothing can require a trip to a second hand store or charity drop-off point. Recycling plastic containers or office paper can require additional effort for seeking out the appropriate receptacle. While the additional effort may appear minimal, throwing away a plastic soda bottle in a garbage can that is in the residence hall room requires unquestionable less effort than seeking out a recycling bin located in the lobby or down the hall.

Knowledge Mediation

Given the amount of resources dedicated by environmental organizations to educate about and advocate for the need of the public to make environmentally responsible choices, the effect of knowledge is a valuable topic to consider. As previously discussed, the Elaboration Likelihood Model (Petty and Cacioppo, 1981) suggested that as one holds greater knowledge relative to a particular attitude, the attitude is less likely to change with subsequent attempts at persuasion. From a standpoint of environmental education, then, the assumption and hope may be that as one acquires greater knowledge about ecological principles and systems, their environmental attitudes will become more strongly pro-environment and less likely to change. Conversely, favorable environmental attitudes which are not supported by a depth of cognitive structure are more vulnerable to persuasion and change. Therefore, a strong cognitive structure would be the preferable option if sustained behavior change is the goal.

Knowledge did not mediate attitudes and behaviors in this study. Only a quarter of respondents were able to correctly answer more than six of nine questions (the passing

score by most traditional grading methods). Consequently, there did not appear to be "enough" knowledge to successfully mediate the attitude-behavior relationship. In fact, in some instances, as environmental knowledge increased, their attitudes about some environmental behaviors became less favorable toward the environment. This is not surprising: it would be likely for knowledge to have minimal or no mediation on environmental attitudes and behaviors when students did not have a great deal of environmental knowledge to begin with. If this lack of knowledge can be equated to a weak cognitive structure, then according to the Elaboration Likelihood Model, the respondents' pro-environmental attitudes and behaviors are vulnerable to change. To prevent a change toward less favorable environmental attitudes and behaviors, the cognitive structure behind those attitudes and behaviors must be enhanced.

While six out of nine correct responses is modest, it is not entirely abysmal. This raises a question of how much and what kind of knowledge is necessary to stabilize favorable environmental attitudes and behaviors. At what point does knowledge have an impact?

Effect of Environmental Education on Values, Attitudes and Behaviors

Students who participated in the presentations about ecological principles, biological cycles and local environmental services demonstrated a significant gain in knowledge, with an average gain of more than 2 correct responses. In total, 30 of 34 students in this sample answered 8 or 9 questions on the post-test, representing a near perfect score.

The mean value orientation scores decreased between the pre-test and the post-test. Therefore, hypothesis 6, suggesting that values would remain stable, was rejected. However, the difference was minimal and represented a change of less than 3%. Consequently, despite the statistically significant change, value orientations appeared to remain relatively stable overall, with both the pre and post test scores indicting a positive value orientation toward the environment. In this regard, environmental values of first-year college students in this study were consistent with previous research and theory; values did not change.

Conversely, knowledge gain did have an impact on attitudes toward each of the four types of environmental behaviors. The effect was especially strong on attitudes toward consumer and reuse behaviors, in which the attitudes shifted from slightly negative to positive. Attitude change for disposal and conservation also showed a favorable shift, becoming more positive in each instance.

The impact of environmental education on consumer attitudes was more than twice as strong as the others. This may be attributable to one part of the lesson that traced a leather shoe and its paper packaging to its natural resource origins of livestock, trees and plants, and the sources of energy required to expedite its production and delivery. Students during this lesson often noted, without prompting, their previous lack of knowledge about the natural resource origin of their possessions. The subsequent lesson drawn from this presentation could be strongly aligned with giving greater consideration to the things one purchases. Further analysis into the effect would be helpful, however, to assess exactly what type of knowledge contributed to the change in attitudes about consumer behaviors. Overall, knowledge gain related to nutrient cycles, sources of

energy, raw material origins of every day items, and municipal solid waste disposal had an across-the-board favorable impact on attitudes toward environmentally responsible behaviors.

Based on the strong attitude-behavior relationship identified in the analyses, the positive shift in attitudes following environmental education would seem likely to lead to an increase in the frequency of how often participants engaged in environmental behaviors. This trend was supported. Following environmental education, three of the four environmental behavior types also increased. Only *reuse* behaviors did not.

Unlike the attitude change results, in which the consumer attitude change was exceptional, there was no one type of behavior which changed a starkly greater amount than others. Environmental education had a near across-the-board impact on behavior, with the exception of *reuse* behaviors. One explanation that may explain the lack of gain in frequency of reuse behaviors is that students may not have had a need or opportunity to engage in that behavior between the pre and post tests. Opportunities to r*epair a backpack* or *repair a CD player* do not occur frequently, for example, and probably not during the three months between survey administrations for this study.

Overall, the results of this study present a very favorable scenario: as individuals learn about ecological principles, biological cycles, and environmental systems, their environmental attitudes become more favorable and their environmental behaviors become more frequent. Knowledge seems to become a greater influence in their decision-making, meaning the cognitive structure is enhanced, and they are therefore less likely to change their attitudes.

The results of this study provide instructors and leaders in higher education with empirical evidence to support a curricular requirement of basic ecology within the undergraduate degree program. As Orr (1994) suggested, it would be otherwise irresponsible if college students are able to graduate without knowing where energy comes from or how parts of an ecosystem affect each other. In addition, the implications of this study are relevant and valuable to environmental education providers and proponents who teach first-year college students. First, the arguments of Orr and others regarding the need for more instruction in ecological principles and related content had a positive effect. With no advocacy or suggestions that the planet is in need of saving, students changed their environmental attitudes and behaviors after acquiring fundamental knowledge about ecology, biological cycles, natural resource origins of everyday items, and related content. This was especially true for attitudes and behaviors related to consumer choices. Consider the impact if every college freshmen were required to learn the basics of ecology and other information presented to the participants in this study.

Limitations

The generalizability of this study is limited to a population that is similar to the one studied here, and with similar environmental amenities available to them. Students in this study are on a campus that provides recycling options in most of its facilities, live in residence halls with programs that encourage donating unwanted possessions at the end of each semester, and reside in a community and a state generally considered to be concerned with natural resources and environmental issues.

In addition, there was no effort to determine to what extent changes in environmental values, attitudes or behaviors were attributable to external influences, rather than the ecological information provided to the sample in this study. As individuals on the campus of a large university, there are regularly efforts in the classroom and on the campus to influence knowledge and attitudes. Students may have acquired knowledge in other classes, observed a provocative presentation or event, read articles in the media, or any one of many other means that affect what students know, how they feel, and the behaviors they choose to undertake.

Need for Future Research

As identified previously, as one knew more of the answers on the knowledge section, their environmental attitudes and behaviors related to *disposal* was less preferable in terms of it being the environmentally responsible choice. This raises questions about what type of content must be presented in order to affect one's decisions on how to discard of materials that can recycled, donated, or reused. The education approach in this study failed to do so.

Also, further research into the value-attitude relationship is needed. As mentioned previously, the viability of the NEP as a measure of the value orientation for today's college students must be addressed. More research into the weakness of the value-attitude relationship is needed, as the results of this study were not consistent with a great deal of previous research that supports the value-attitude relationship.

The time frame for this study was not sufficient to study the long term retention of knowledge, and the extent of its continued impact on environmental attitudes and

behaviors. While the initial results were favorable, there is no certainty that the acquired knowledge will be retained, or if attitudes and behaviors will remain favorable. A longitudinal component to research such as this would be valuable.

Finally, further investigation into the effect of knowledge is needed. There was no attempt in this study to understand the processing and reflection that occurred that linked acquisition of knowledge to more positive environmental attitudes and behaviors. After learning how trees contribute to nutrient cycles, there was no way to know if students connected those ecological principles to the need to conserve trees through printing double-sided or purchasing paper products made from recycled products. Through the use of focus groups or similar methods that allow an in-depth analysis, such connections should be researched.

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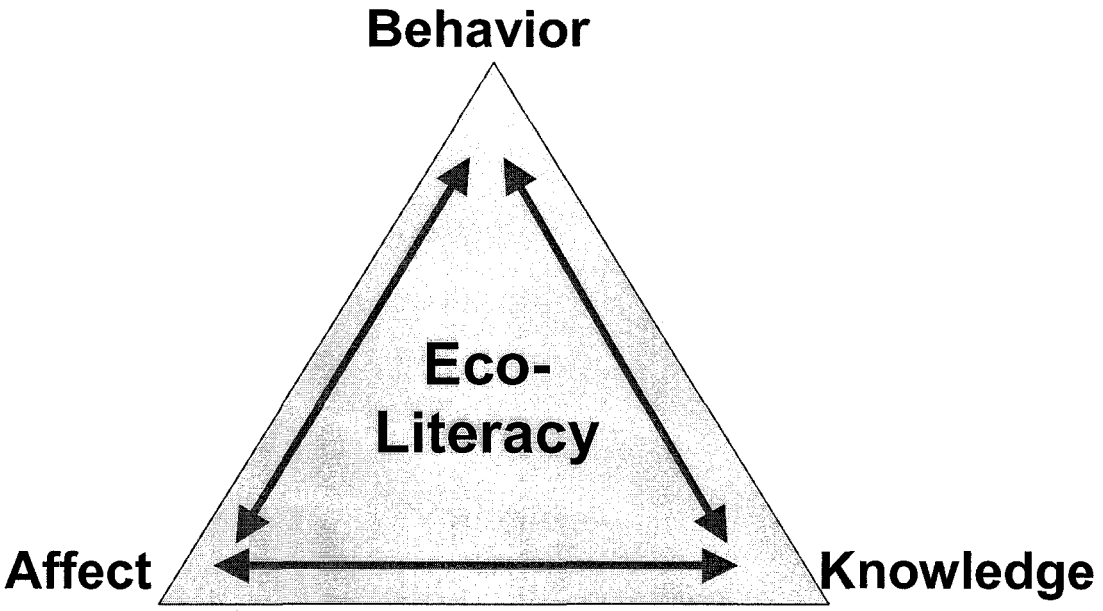
Figure 1. Model of eco-literacy

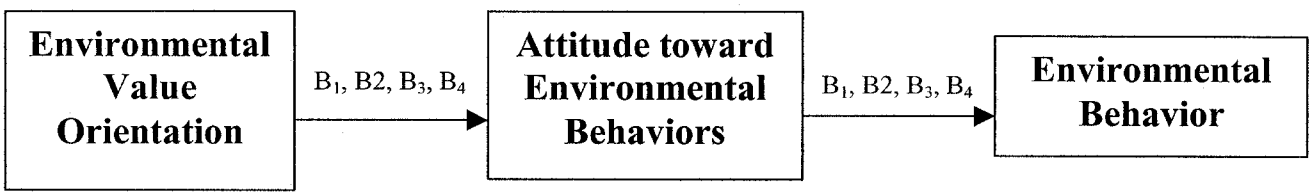


Bruyere, 2002

Figure 2. Typology of environmental behaviors for first-year college students

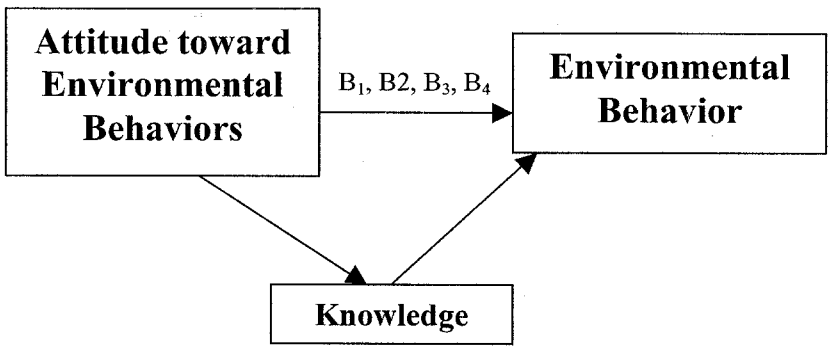
CONSUMER BEHAVIORS *Purchase beverages in recycled containers, buy used CDs, avoid products in excessive packaging, buy paper products made from recycled material*
CONSERVATION BEHAVIORS *Take short showers, turn off water while brushing, turn off lights, turn off computers, forego shopping bags, print double-sided*
DISPOSAL BEHAVIORS Recycle plastic bottles, recycle paper, donate unwanted clothing, *donate unwanted small appliances, return CDs to buy-back stores*
REUSE BEHAVIORS *Repair a backpack, repair a CD player, buy used appliances for residence hall room*

Figure 3. Model of value-attitude-behavior hierarchy, and knowledge mediation



B_1= consumer behaviors
B_2= disposal behaviors
B_3= reuse behaviors
B_4= conservation behaviors

Figure 4. Model of knowledge mediation of attitude-behavior relationship



B_1= consumer behaviors
B_2= disposal behaviors
B_3= reuse behaviors
B_4= conservation behaviors

Table 1. Environmental knowledge questions

Plastics are most commonly processed from what raw material?

a. zinc
b. sand particulates
c. sub-tropical species of trees
d. crude oil

All of the following are non-renewable sources of energy EXCEPT:

a. crude oil
b. natural gas
c. wind
d. coal

The primary source of energy in northern Colorado is:

a. natural gas
b. wind
c. coal
d. solar

Trees help naturally recycle all of the following elements EXCEPT:

a. nitrogen
b. water
c. carbon
d. hydrogen

A majority of the garbage generated in Ft. Collins is disposed by which of the following methods?

a. landfill
b. incinerator
c. transported out-of-state
d. composted

True or False

___F__ Processing recycled aluminum requires more energy than manufacturing new aluminum from raw material.

___T_ Trees can consume carbon emissions from automobiles.

___T__ One consequence of sulfur dioxide emission is its contribution to acidic precipitation.

___F__ Sustainability refers to the long-term overuse of resources.

Table 2. Scale reliability for value orientation, environmentally responsible attitudes and behavior

Scale	Cronbach Alpha
Value orientation (NEP)	.70
Attitude Types	
Consumer attitudes	.77
Disposal attitudes	.72
Reuse attitudes	.68
Conservation attitudes	.85
Behavior Types	
Consumer behaviors	.83
Disposal behaviors	.85
Reuse behaviors	.80
Conservation behaviors	.82

Table 3. Regression analysis of *value-attitude* relationship for four behavior types[1]

	Dependent Variable: Attitude			
	Adjusted R^2	**Standardized Beta Coefficient**	**F**	**p-value**
Consumer Dimension				
Model	.05		7.24	.01
Value		.23		.01
Disposal Dimension				
Model	.07		9.74	.01
Value		.27		.01
Re-use Dimension				
Model	.000		.01	.91
Value		-.01		.91
Conservation Dimension				
Model	.05		7.10	.01
Value		.23		.01

1: n=134

Table 4. Regression analysis of *attitude-behavior* relationship for four behavior types[1]

	Dependent Variable: Behavior			
	Adjusted R^2	**Standardized Beta Coefficient**	**F**	**p-value**
Consumer Dimension				
Model	.30		56.1	.01
Attitude		.56		.01
Disposal Dimension				
Model	.37		75.3	.01
Attitude		.61		.01
Re-use Dimension				
Model	.48		110.66	.01
Attitude		.70		.01
Conservation Dimension				
Model	.49		124.10	.01
Attitude		.70		.01

1: n=134

Table 5. Regression analysis of *knowledge-attitude* relationship for four behavior types[1]

	Dependent Variable: Attitude			
	Adjusted R^2	**Standardized Beta Coefficient**	**F**	**p-value**
Consumer Dimension				
Model	.005		.60	.44
Knowledge		.07		.44
Disposal Dimension				
Model	.003		.34	.56
Knowledge		.05		.56
Re-use Dimension				
Model	.001		.13	.72
Knowledge		-.03		.72
Conservation Dimension				
Model	.01		1.52	.22
Knowledge		-.11		.22

1: n=134

Table 6. Effect of knowledge gain on value, attitude and behaviors[1]

Scale	N	Pre-test value	Post-test value	Change	t-value	p-value
Knowledge gain	34	5.84	8.10	+ 2.26	2.34	.03
Value orientation	34	4.95	4.70	- .15	7.23	.01
Consumer attitude	34	3.70	4.60	+ .90	6.20	.01
Consumer behavior	34	3.20	4.51	+ 1.31	6.60	.01
Disposal attitude	34	4.90	5.47	+ .57	7.97	.01
Disposal behavior	34	4.08	4.71	+ .63	6.05	.01
Reuse attitude	34	3.78	4.33	+ .55	7.13	.01
Reuse behavior	34	4.18	4.25	+ .07	4.65	.53
Conservation attitude	34	4.58	5.15	+ .57	6.96	.01
Conservation behavior	34	4.82	5.24	+ .42	6.51	.01

1: n=34

CHAPTER FOUR: CONCLUSION

In Gladwell's (2000) book "The Tipping Point," he argued that most of the trends that become mainstream in the United States – fashion trends, management style trends, and socio-political trends such as supporting civil rights – are the result of a fledgling idea or practice which gains sufficient momentum and magnitude that it becomes widely recognized, accepted and eventually embraced by a majority of the public. The resurgence of hush puppy shoes in the 1990s, for example, was traced to a small cohort of youth in Harlem who aspired to be different. The passage of the Civil Rights Act of 1964 was the culmination of decades of advocacy and mobilization started by small groups of equal rights proponents in geographic pockets throughout the United States. If Gladwell's assertion is true – that all ideas have a tipping point – then the contribution of every individual is valuable in creating a populace in the United States, including university students, that takes its environment and the need for sustainability seriously.

In fact, university students can perhaps contribute to the tipping point of sustainability more than others. As educated individuals, they will often be selected in the future to positions of leadership in private businesses, elected government offices, non-government organizations, and other realms. By virtue of such positions, they will have a potential to lead and influence dozens, hundreds, even thousands of people. Given the potential of college students to have a meaningful impact on so many people, and

therefore, the health of the world's environment, university leaders would be wise to ensure that this group achieve ecological literacy during their college experience.

The research completed for this dissertation addressed, in part, two components of ecological literacy: behavior and knowledge. Specifically, a four point typology of 18 behaviors was identified that fully defines the behavioral component of ecological literacy for first-year college students at universities with environmental amenities similar to those at Colorado State University. The typology suggests that what students buy (consumer), how they dispose of it (disposal), if they can reuse it (reuse), and how resource use can be lessened (conservation) are the most salient and prevalent dimensions to environmental behaviors for this population.

In regards to the knowledge component of ecological literacy, this study provided support for the positive effect of environmental education on one's attitude toward and frequency of adopting the specific environmental behaviors identified in the typology. Specifically, knowledge related to biological cycles, the natural resource origins of common possessions, and environmental sources of water, energy and municipal solid waste management had a significant impact on environmental attitudes and behaviors. This was especially true for consumer attitudes and behaviors.

Further, the positive shift in environmental attitudes and behaviors was the result of objective and empirical information. It was not the product of an advocacy effort, emotional appeal, or slogan-based campaign to save the world that so often has served as the basis for criticism in the past. Rather, the information presented to participants in this study was indisputable: there is no debating where local municipal solid waste is taken for disposal, or if there is a role for trees in the carbon and water cycles of ecosystems.

While the specific behaviors listed in the typology may lose their relevance as college students graduate and their life situations change, the results of this study remain valuable. The typology identified in this research can help college students adopt environmentally responsible behavior as a lifelong habit, in the same way that university leaders hope their graduates have acquired a lifelong habit to think critically and analytically throughout their lives. Perhaps students who engaged in environmentally responsible behaviors during college will deliberately consider how they can continue contributing to sustainability as their life circumstances change.

This research also highlights the need to develop an effective scale for measuring the environmental value orientation of young adults. The New Environmental Paradigm (NEP) has been widely applied in previous research, but may be less relevant to a population whose birthdates are after the development of the scale itself. The NEP has undergone revisions in the past, and it would appear necessary to revise it again in order to make it more relevant to a younger population. Or, perhaps an entirely new approach is necessary.

While the NEP failed to strongly substantiate value orientation as a predictor of attitudes about environmental behaviors, attitudes were conversely very strong predictors of environmental behavior. Especially in relation to behaviors which required minimal additional time or money, such as conservation and reuse behaviors, the attitude-behavior relationship was especially strong.

The behaviors identified in this study, and the subsequent value-attitude-behavior analyses, have a limited shelf-life, however. The typology represents 18 behaviors which were relevant and salient at a specific period in time. But society is dynamic. Consumer

trends change. Universities change policies affecting campus ecology and sustainability. New second hand stores open in communities, while other close. Any of these scenarios, and dozens more, can affect the viability of the typology, and therefore, the analyses subsequently based on it. The 18 behaviors should be revisited and edited, and new behaviors should be identified and considered as warranted by change.

This study does not completely address ecological literacy. In addition to *behavior* and *knowledge*, there is the third component of *affect*. Affect includes the dynamic that inspires one to care, to consider sustainability a personal value in the same way that one values health, family and freedom. However, teaching people to care can be difficult to accomplish in a classroom. To fully achieve ecological literacy, however, college students must somehow acquire a sense of personal concern for the natural environment.

The variable associated with environmental concern in previous research is referred to as *significant life experience*. This research identified meaningful experiences in the outdoors (significant life experience) as a common variable among individuals who pursued conservation-related careers (Tanner, 1980), members of environmental organizations (Palmer, 1993), individuals who engage in environmental behaviors (Chawla, 1998) and environmental leaders (Marcus, 1978). The cumulative implication of this research suggests that outdoor experiences during childhood and adolescence have an influence on environmental behavior later in life.

Consequently, in addition to integrating the results achieved in this study in the school curricula, university leaders should consider how its campus can provide meaningful outdoor experiences within the mission of the school. Imagine a university in

which first-year students participate in a multi-day backpacking or camping trip orientation prior to the beginning of their collegiate experience, followed by a university requirement to take an ecology course that presents biological cycles, local environmental services, ecological principles, and within a university administration that encourages environmentally responsible behavior through the provision of recycling options in every building, and campaigns to conserve electricity and water in residence halls. By doing so, the university will be a genuine leader in the development of ecologically literate individuals.

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1 Additional references are cited within the manuscripts of chapters two and three