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The Impact of Environmental Biology Courses on the Human-Nature Relationship and Pro-Environmental Behavior of College Students

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Abstract: The relationship with nature and pro-environmental behaviors of community college students in introductory environmental biology courses were assessed using psychometric instruments and environmentally-themed Likert-based statements. Post-class, students demonstrated an increase in level of concern for non-human species and viewed themselves as closer to nature. Students' motivation for environmental concern for other people or themselves was not affected by completion of the course. As a result of the class, students demonstrated increased levels of pro-environmental behavior, such as thinking about the environment, recycling, and energy and water conservation. Changes in relationship with nature and pro-environmental behavior were moderated by professor, suggesting that the professor's teaching style and attitude may influence students' views and attitudes. Neither gender, age, student status (full- or part-time), nor type of class (with lab or without lab) influenced students' relationship with nature or pro-environmental behaviors. Substantially increasing the personal responsibility and degree of interaction with course content, as reflected by the comparison of an honors section to regular sections, did not result in significant changes in either relationship with nature or pro-environmental behavior. Applications to course instruction and environmental education at large are discussed.

Keywords: environmental biology, relationship with nature, pro-environmental behavior, psychometric instrument, environmental education

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Kelly Cartwright is a biology professor at the College of Lake County in Illinois. Her primary teaching responsibilities include Environmental Biology, General Botany, General Biology, and Sustainability. In addition, she works with graduate students at Prescott College in Arizona. Her research interests center around the human nature relationship, residential habitat, and curriculum design.

As a biology professor, my main goal is to have students learn and apply content. To be successful in a class, students need to become familiar with terminology, learn various skills, understand different concepts, and utilize this knowledge to examine complex situations. In some courses, specifically my general education courses, I hope that by learning said content students change how they think about environmental and sociological issues and the way they live; I hope that engagement with environmentally-themed content spurs actions or a change in attitude.

At the end of the semester, students often talk about how they have changed their behavior because they took environmental biology or how much they enjoyed the class and how it changed the way they think about environmental issues. While these anecdotal pieces are wonderful and reaffirming, they may represent isolated circumstances. I developed this study to determine what impact exposure to and engagement with environmental content has on students' pro-environmental behavior and relationship with the natural world. It is clear that we are facing ever-growing environmental threats in our world. Sadly, stories of air and water pollution, climate crisis, habitat loss, decline of pollinators, food insecurities, increasing rates of species extinctions, and related environmental issues plague us daily. Although not a panacea for all our issues, college-level biology classes may have the potential to address awareness of these issues and promote environmentally friendly attitudes and behaviors. In addition, the findings of this study relate to environmental and sustainability education occurring in realms outside of a formal biology class.

Environmental Knowledge, Nature Connectedness, and Pro-environmental Views and Behaviors

A person's relationship with the natural world and their pro-environmental behaviors and attitudes, or lack thereof, are complex issues. A logical idea is that a connection to nature and pro-environmental attitudes are determinants of pro-environmental behavior. While this holds true for many individuals, there are other factors at play in determining a person's environmental attitude and behavior (Amérigo, et al., 2017; Arcury, 1990; Bamberg & Möser, 2007; Bradley, et al., 1999; Gifford & Sussman, 2012; Schultz & Kaiser, 2012).

Although fascinating, a thorough discussion of all the different variables, models, and concepts related to environmental attitudes and pro-environmental behavior is outside the scope of this literature review. The central idea of this study and the focus of the literature review is exploring the link between level of environmental knowledge and a person's relationship with the environment and their pro-environmental behavior. Multiple studies on adolescents have demonstrated that learning about the environment, either in a direct (field experience) or indirect manner, results in a change in pro-environmental behaviors and views (Bradley, et al., 1999; Bogner, 2002; Dettmann-Easler & Pease, 1999; Neiman & Ades, 2014; Zelenzy, 1999). College-level environmental biology classes may have the potential to facilitate this change; however, these classes have not been studied as extensively as other populations or settings.

A handful of studies shed light on different variables related to college students' view of nature and pro-environmental behaviors. Bradley, et al., (1999) demonstrated that high school students' knowledge and pro-environmental attitude increased as a result of a 10-day environmental course and that there was a significant correlation between knowledge and attitude. Duerden and Witt (2010) examined the impact of direct and indirect experience on adolescents' environmental knowledge and attitude and environmental behavior. They determined that indirect experience, such as course instruction, is related to an increase in environmental knowledge compared to environmental attitude, and that the direct experience,

such as field excursions, allowed for a connection between knowledge and behavior. Consistent findings were found by Nieman and Ades (2014); the authors determined that direct experience with nature led to increases in pro-environmental knowledge, intentions, and attitudes.

To evaluate how different factors relate to environmental issues and behavior, Levine & Strube (2012) examined intention (implicit and explicit), attitude (implicit and explicit), knowledge, and behaviors in college students. They determined multiple relationships amongst the identified variables. Implicit and explicit intentions and knowledge all related to pro-environmental behavior; however, knowledge was not related to environmental attitude. In addition, the authors concluded that explicit attitudes were related to intentions. They inferred that there may be multiple pathways that determine a person's behavior.

Kukkonen, et al., (2018) examined environmental behavior in college students in Finland; in particular, the authors modeled how sensitivity, awareness, enjoyment, and knowledge of the environment related to each other and to global concerns, environmental attitudes, and behavior. They determined several relationships applicable to the current study. Sensitivity and awareness to the environment was linked to enjoyment of nature, and enjoyment of nature was related to ecological knowledge and the intent to support environmental behaviors. In addition, the authors determined that ecological knowledge was linked to global concern and students described as having global concern did not agree with human dominance of the natural world. The study identified key relationships between the influencing factors of a person's view of the natural world and demonstrated the complex nature of these variables.

While some researchers have examined what factors influence our relationship with nature, others have been striving to quantify different facets of the human-nature relationship. Psychometric instruments have been developed by researchers in the fields of environmental/conservation psychology over several decades with the purpose of better understanding the dimensionality of the relationship people have with nature and the factors which influence said relationship (Clayton, 2003; Dunlap & Van Liere, 1978; Kals, et al., 1999; Mayer & Frantz, 2004; Nisbet, et al., 2009; Schultz, 2001). These scales allow for the measurement of different facets of the human-nature relationship. In addition, these instruments have been used to determine how experiences and demographic variables may influence the relationship between people and nature and their motivation for environmental concern (Cartwright & Mitten, 2017a, 2017b; Clayton, 2003; Frantz & Mayer, 2014; Geng, et al., 2015; Nisbet et al., 2009; Schultz, et al., 2004). For example, the New Ecological Paradigm (Dunlap & Van Liere, 1978), one of the first and most widely used indicators, measures a person's overall beliefs and views in respect to the environment.

The indicators selected for use in this study include the Environmental Motives Scale, the Nature Relatedness Scale, and the Inclusion of Nature in Self Scale, which are outlined in Table 1. The Environmental Motives Scale (EMS) allows for the evaluation of a person's motivation for environmental concern across three dimensions: Biospheric (species-oriented), Altruistic (other people-oriented), Egoistic (self-oriented) (Schultz, 2000; Schultz, 2001). The Nature Relatedness Scale (NR), which consists of an overall score and three subscales, quantifies how a person views nature and its use by humans, how they see themselves in connection to nature, and their overall comfort in large-scale nature (Nisbet, et al., 2009). The Inclusion of Nature in Self scale (INS) is a visual instrument, which represents the physical closeness or oneness of nature and self and evaluates how separate or inclusive a person feels to nature (Schultz, 2001). For a full review of instruments that have been developed, see Cartwright and Mitten (2018).

Table 1. Description of human-nature relationship instruments employed in the study of environmental biology students.

Instrument	Composition and Examples	Scoring
Environmental Motives Scale (Schultz, 2000)	15 entities (e.g., plants, me, birds, my health, my lifestyle, future generations) to be valued by motivation for environmental concern	Subscales: each 1-7 • Biospheric • Altruistic • Egoistic
Nature Relatedness Scale (Nisbet, et al., 2009)	21 statements: • Humans have the right to use natural resources any way we want. • I don't often go out in nature. • I enjoy being outdoors, even in unpleasant weather. • The state of non-human species is an indicator of the future for humans.	Overall: 1-5 Subscales: each 1-5 • Self • Perspective • Experience
Inclusion of Nature in Self Scale (Schultz, 2001)	7 Venn-style diagrams of separate, touching, and overlapping circles identified as 'self' and 'nature'	Single score: 1-7

Methods - Study One

Population Description

The College of Lake County is a large two-year institution in northeastern Illinois, serving over 15,000 students each year. Full-time faculty teaching Environmental Biology courses were asked to participate in the study. Five professors participated with five sections in fall 2017 and four sections in spring 2018. Seven sections of Environmental Biology (Bio 120) and two sections of Environmental Biology without Lab (Bio 140) were included in the study. A total of 204 students completed the pre-class questionnaire and 180 completed the post-class portion. The average age of students in the study was 21.3; 25% of students were 19 or younger, and 75% of students were 21 or younger. Over 75% of the participants were attending college full-time, and 50.5% percent of students identified as female.

Course Descriptions

The courses studied included Environmental Biology (Bio 120) and Environmental Biology without Lab (Bio 140). Both courses are general education life-science electives, and the majority of students enrolled are non-science majors; less than 8% of the participants identified that their major was related to the environment. Lecture content for the two courses is similar: environmental literacy, science literacy, ecology, biodiversity, evolution, forestry, fisheries, food systems, air and water pollution, energy, and climate change. Environmental Biology includes one 2-hour lab each week; lab topics include field labs on a variety of habitats (prairies, forests, dune succession, wetlands), hands-on labs on scientific method and species diversity, wet labs on water chemistry and solid waste, and computer simulation labs on air and water pollution.

Questionnaire Development

The questionnaire was designed to capture demographic variables of interest in conjunction with established human-nature instruments and behavioral statements. Demographic variables assessed were age, gender (female, male, transgender), major (environmentally-related), enrollment status (full- or part-time), and expected grade. Three human-nature connection instruments were selected for use in the study allowing for evaluation of eight parameters related to the human-nature relationship. Ten Likert-based statements were developed to gauge pro-environmental behaviors and are listed in Table 2. The questionnaire took less than 15 minutes to complete.

Table 2. Likert statements used to evaluate pro-environmental behaviors. Items 3, 7, and 9 were reverse scored.

Item	
1	I recycle items such as glass, cans, and paper.
2	I conserve energy in the house.
3	I litter.
4	I use reusable canvas bags at the store.
5	I think about my impact on the environment.
6	I carpool.
7	I leave the TV or computer on when I leave the house.
8	I conserve water.
9	I buy disposable water bottles.
10	I buy organic items at the store.

Analysis

Class data were analyzed using SPSS (SPSS Inc., Chicago IL). ANOVA determined that there was no difference due to class type (with or without lab) and the classes were pooled; this is a significant finding on its own and is examined further in the discussion. Cronbach's Alpha was used to determine the internal validity of the EMS and NR subscales. A value of $\alpha = 0.70$ is a suggested cutoff for acceptance of data (source); all scales were over 0.70 with the exception of the NR-Perspective subscale, $\alpha = 0.56$. The NR-Perspective data are presented in the data tables and associated discussion, but inferences based on the NR-Perspective subscale should be treated as tenuous. Pre-class and post-class means were compared using *t*-tests. Independent t-tests were used to determine differences between populations (gender, class, enrollment status, semester, professor); Levene's test was used to test equality of variances within the populations.

Results

Analysis yielded several key findings. As outlined in Table 3, there were positive changes in students' relationship to the environment as a result of taking an environmental biology class, but the changes were not consistent across all instruments or professors. Of the EMS subscales, the Biospheric subscale showed significant increase whereas the Altruistic and Egoistic subscales did not change. Within the NR scale/subscale, all but the NR Experience subscale increased significantly. Of note, post-class scores on the indicators increased across the board. However, changes were influenced by professor; some professors' scores were statistically different from others. The results of the professor-sorted indicator data demonstrate the nuances of the impact that professors (either content or approach) have on their students'

learning. For example, Professor A had the highest averages on five indicators yet was the lowest on the EMS Egoistic subscale. In comparison, Professor D had the highest EMS Egoistic average but was significantly lower on most other scales. There was limited variability on the EMS Altruistic and NR Self scores, which may suggest that course content and activities do not strongly relate to the ideas measured by these instruments.

Table 3. Comparison of pre- (pooled) and post- (pooled and sorted by professor) scores on pro-environmental behavior and human-nature indicators. An * in the Post – Pooled row represents a significant change from the pre-class pooled score ($p < 0.05$). The post-scores were sorted by professor; the highest post-class average for each instrument is in bold; an * identifies groups who scored significantly lower than the highest average ($p < 0.05$).

		Bio	Alt	Ego	NR	Self	Pers	Exp	INS
Pre - Pooled	*M* *SD* *n*	5.53 (1.37) 189	5.91 (1.17) 189	5.47 (1.68) 189	3.45 (0.58) 204	3.24 (0.83) 204	3.76 (0.61) 204	3.39 (0.85) 204	3.45 (1.29) 198
Post – Pooled		5.86* (1.30) 169	6.05 (1.08) 169	5.72 (1.45) 169	3.67* (0.58) 180	3.57* (0.81) 180	3.93* (0.58) 180	3.51 (0.78) 180	3.99* (1.53) 179
Post – by Professor									
A	*M* *SD* *n*	**6.14** (1.11) 61	6.07 (1.10) 61	5.22* (1.73) 61	**3.80** (0.56) 64	3.64 (0.77) 64	**4.10** (0.55) 64	**3.66** (0.75) 64	4.14 (1.34) 64
B		5.64* (1.43) 43	5.92 (1.16) 43	5.73* (1.30) 43	3.55 (0.77) 43	3.47 (0.79) 43	3.80 (0.53) 43	3.63 (0.81) 43	4.05 (1.45) 42
C		6.09 (0.90) 36	**6.24** (0.97) 36	6.05 (1.16) 36	3.77 (0.52) 39	**3.74** (0.82) 39	4.01 (0.52) 39	3.50 (0.78) 39	**4.23** (1.63) 39
D		5.26* (2.00) 17	5.97 (1.32) 17	**6.36** (0.87) 17	3.43* (0.70) 20	3.30 (0.91) 20	3.71* (0.63) 20	3.28 (0.91) 20	3.30* (1.56) 20
E		5.41* (1.20) 12	5.87 (0.66) 12	6.31 (1.05) 12	3.53 (0.50) 12	3.39 (0.77) 14	3.66* (0.67) 14	3.56 (0.56) 14	3.43* (2.03) 14

As demonstrated in Table 4, students' pro-environmental behavior increased as a result of the class experience; however, not all individual behaviors showed significant change. Recycling, energy conservation, thinking about the environment, and conserving water were individual behaviors that demonstrated significant improvement. Although the overall average of behaviors reflected significant improvement, the degree of change was rather small. Differences due to professor were also noted across the behaviors (Table 5).

Table 4. Comparison of individual behavior scores from students in environmental biology classes. Categories in bold represent a significant change ($p < 0.05$) in pro-environmental behavior post-class.

Category	Pre-Class Score *M* (*SD*) *n*	Post-Class Score *M* (*SD*) *n*
Combined Average	**3.29 (0.45) 202**	**3.49 (0.46) 179**
Recycling	**3.87 (0.95) 202**	**4.12 (0.83) 179**
Energy Conservation	**3.23 (0.84) 202**	**3.61 (0.83) 179**
Littering	4.41 (0.71) 201	4.43 (0.80) 178
Reusable Bags	2.27 (1.26) 202	2.45 (1.30) 179
Thinking About Environment	**3.12 (0.98) 202**	**3.69 (0.93) 179**
Carpool	2.92 (1.10) 202	2.96 (1.63) 179
TV/Computer Use	4.26 (1.11) 202	4.36 (0.93) 179
Conserve Water	**3.13 (0.88) 202**	**3.34 (0.97) 179**
Disposable Bottles	2.89 (1.19) 202	2.97 (1.21) 179
Buy Organic	2.82 (1.10) 202	2.98 (1.71) 179

Table 5. Comparison of post-class pro-environmental behaviors sorted by professor. Values in bold represent the highest average; values with * are significantly lower ($p < 0.05$) than the highest average.

	Prof A	Prof B	Prof C	Prof D	Prof E
Category	*M* (*SD*) *n*				
All Behaviors	**3.67** (0.44) 64	3.40* (0.42) 43	3.47* (0.47) 39	3.33* (0.50) 19	3.18*(0.41) 14
Recycling	4.23 (0.77) 64	4.05 (0.69) 43	**4.33** (0.70) 39	3.95 (0.97) 19	3.43* (1.22) 14
Energy Conservation	**3.69** (0.83) 64	3.56 (0.76) 43	3.67 (0.92) 39	3.58 (0.90) 19	3.36 (0.75) 14
Littering	4.46 (0.71) 63	4.28 (0.90) 43	4.51 (0.75) 39	4.37 (1.06) 19	**4.57** (0.65) 14
Reusable Bags	**2.84** (1.35) 64	2.21* (1.28) 43	2.21* (1.21) 39	2.26 (1.05) 19	2.29 (1.43) 14
Thinking About Environment	**3.95** (0.88) 64	3.49* (0.98) 43	3.74 (0.88) 39	3.47* (0.96) 19	3.21* (0.80) 14
Carpool	**3.30** (1.02) 64	2.95 (1.25) 43	2.87 (1.20) 39	2.53* (1.07) 19	2.29* (1.14) 14
TV/Computer Use	4.47 (0.85) 64	4.14 (1.12) 43	4.46 (0.79) 39	4.21 (1.08) 19	**4.50** (0.65) 14
Conserve Water	**3.63** (0.92) 64	3.16* (0.87) 43	3.36 (0.99) 39	3.37 (1.01) 19	2.50* (0.85) 14
Disposable Bottles	3.02 (1.15) 64	3.05 (1.21) 43	2.74 (1.35) 39	2.79 (1.35) 19	**3.36** (1.08) 14
Buy Organic	3.09 (1.00) 64	**3.19** (1.44) 43	2.85 (1.06) 39	2.84 (1.67) 19	2.36* (1.15) 14

Overall, the pre-class population did not vary in their relationship to nature or pro-environmental behaviors in conjunction to gender, enrollment status (part- vs. full-time), professor, semester, or class (lab vs. non-lab). This suggests that changes observed in behavior or pro-environmental attitude are a result of in-class experiences and not outside a-priori factors, such as certain students selecting a specific professor or a specific gender having a bias toward certain behaviors/views. No significant differences in post-class pro-environmental behavior or relationship with nature were noted due to the following variables: gender, age, enrollment status, class, or semester (due to weather constraints, the order of outdoor/indoor labs is different from fall to spring semesters and was thought to be of potential influence).

Methods - Study Two

Population and Course Description

The questionnaire developed for the initial study was employed in an honors environmental biology (Bio 120) class fall semester, 2018. The course hours and content are similar to the regular sections; however, the manner through which both the material is taught

and students are assessed is substantially different. For example, the honors course included instructor-led and peer-led discussions from *A World of Health: Connecting People, Place and Planet* (Northwest Earth Institute, 2010); a student-generated and organized public presentation on Human Health and the Environment; in-depth research-based essays for each unit; an environmental quality report for their residential area; a creative assignment reflecting knowledge gained from field labs; and a self-evaluation project on how they could apply environmental biology principles to their daily life, which were associated with the Bring It Home pieces within their textbook, *Environmental Science for a Changing World* (Karr, Interlandi, & Houtman, 2018). The questionnaire was employed in the honors class to test whether the different activities and greater degree of personal responsibility for content and class participation had an impact on pro-environmental behavior or relationship with nature.

The honors class had 13 students, 12 of whom were female. The average age of students was 21.0; however, 11 students were 20 or younger. There are obvious limitations to this study. A strong gender bias was exhibited, and the sample size was small (honors classes are run with lower enrollment levels). This honors section is offered every other year, so the potential for replication is severely limited. Due to the limitations, conclusions from the second study should be taken with caution.

Analysis

Data were analyzed in a similar fashion to Study One. Cronbach's Alpha was used to evaluate internal validity of the EMS and NR subscales. All scales/subscales were deemed viable with the exception of the NR-Perspective, $\alpha = 0.49$. Pre-class and post-class indicator and behavior data were analyzed using paired *t*-tests. Due to the small class size and lack of heterogeneity in age, gender, and enrollment status, the data were not analyzed by subpopulations.

Results

As outlined in Table 6, the students' scores on the indicators demonstrated a change in their relationship with nature. The EMS Biospheric, NR, NR Self, and INS demonstrated significant growth as a result of the class. There was an opposite trend on the EMS Egoistic subscale; the average was lower post-class compared to pre-class, suggesting that students were less motivated by self-focused concerns, but the change was not significant.

Table 6. Comparison of pre- and post-class human-nature indicator scores for the environmental biology honors section. An * indicates a significant change ($p < 0.05$) in post-class scores.

Time		Bio	Alt	Ego	NR	Self	Pers	Exp	INS
Pre	*M*	5.90	6.46	6.15	3.96	3.97	4.11	3.79	4.25
	SD	(1.01)	(0.71)	(0.75)	(0.34)	(0.50)	(0.60)	(0.56)	(1.22)
	n	13	13	13	12	12	12	12	12
Post		6.48*	6.76	6.04	4.25*	4.37*	4.35	3.94	5.00*
		(0.54)	(0.61)	(1.52)	(0.44)	(0.44)	(0.46)	(0.69)	(0.73)
		13	13	13	12	12	12	12	12

In addition, as presented in Table 7, students increased their post-class pro-environmental behavior. The overall behavior score demonstrated growth in pro-environmental behavior;

however, only two individual behaviors (Not Littering and Thinking About the Environment) were significant.

Table 7. Comparison of individual behavior scores from the environmental biology honors class (n = 13). Categories in bold represent a significant change ($p < 0.05$) in pro-environmental behavior post-class.

Category	Pre-Score *M* (*SD*)	Post-Score *M* (*SD*)
Combined Average	**3.48 (0.50)**	**3.82 (0.50)**
Recycling	3.85 (1.28)	4.15 (0.90)
Energy Conservation	3.69 (1.03)	3.85 (0.80)
Littering	**4.23 (0.83)**	**4.85 (0.37)**
Reusable Bags	2.77 (1.45)	3.08 (1.26)
Thinking About Environment	**3.77 (0.72)**	**4.46 (0.52)**
Carpool	3.08 (1.11)	3.62 (0.88)
TV/Computer Use	4.31 (1.18)	4.62 (0.65)
Conserve Water	3.15 (1.14)	3.38 (0.77)
Disposable Bottles	3.15 (1.07)	3.31 (1.50)
Buy Organic	2.85 (0.80)	3.38 (0.87)

Discussion

Relationship with Nature

The ranking of motivation for environmental concern was consistent pre- and post-class, highest to lowest: Altruistic, Biospheric, Egoistic. Of the three EMS subscales, significant change occurred in only the Biospheric subscale, suggesting that students developed a greater concern for non-human species as a result of the course. The Egoistic subscale, which demonstrates concern for self, did not change significantly, but this may be due to variation across classes; some sections reflected a decrease in concern for self while others reflected an increase. This variation is likely due to influence from the professor's viewpoint or approach. Surprisingly, the Altruistic subscale did not change significantly. In prior studies the Altruistic and Biospheric subscales have reflected convergence (Cartwright & Mitten, 2017a, 2017b; Schultz, 2001). The lack of significant change in the Altruistic subscale may be due to the non-human species-centric content of the course compared to human-focused topics and an associated increase in non-human species knowledge. The lack of change may also reflect that students enter with and retain a concern for other people and future generations.

Of the NR scale/subscales, all but the NR Experience subscale demonstrated positive significant change. These results suggest that students see humans and themselves as close to nature and have a reduced view of using nature solely for human benefit. The Experience subscale reflects comfort in large-scale natural areas and although students in the Environmental Biology with Lab course have multiple field labs, the settings are in 'tame' areas (well maintained gravel or woodchip trails, close to residential areas, frequent interaction with other park users), so the lack of significant change in response to comfort with wilderness was not surprising.

The INS represented how students see themselves in juxtaposition to Nature and the results suggest that taking part in an environmental biology class decreases the view of

separation between people (self) and nature. A confusing outcome was that two sections had post-class scores that were similar or lower than the pre-class INS scores, suggesting that the students felt an increased level of separation from nature after taking the class. As with the EMS, these results suggest that a professor's approach/influence may have an impact on this relationship.

Pro-Environmental Behavior

Overall, students' pro-environmental behavior increased as a result of taking part in an environmental biology class. However, even though the change was significant for the combined average and for selected individual behaviors, the level of change was relatively small. The greatest change for both the regular sections and the honors section was the category of Thinking About the Environment. The lack of substantial change on other behaviors speaks to the multitude of factors that determine pro-environmental behavior. Some behaviors may have a higher difficulty level associated with them, either in time, convenience, or cost. Other behaviors may have a negative or positive stigma associated with them that could decrease or increase participation, e.g., littering is usually viewed as negative and many students self-reported a low frequency of littering. Although change was noted, learning about the environment may not be sufficient to cause dramatic behavior change, especially in behaviors that have a higher level of work or financial investment required.

The relative pre- and post-class rankings of the pro-environmental behaviors were compared between the regular sections and the honors section. This ranking does not reflect significant differences; it is included to identify which behaviors students already do regularly and where greater change could occur (Table 8). The rankings of individual behaviors were similar pre- and post-class and were similar between the regular sections and the honors section. The ranking of 'Thinking About the Environment' improved in both the regular and honors sections. Overall, students do not litter, they conserve energy inside their homes, and they recycle. Categories where greater change could occur would be in conserving water, purchasing habits (using reusable bags, buying organic, avoiding disposable bottles) and energy conservation, including carpooling. Educators may want to stress these behaviors as examples of where students could change. However, it is important to highlight that many students in this study live with their parents and are dependent on them for basic needs. Students tell me that they would like to change their purchasing habits after they learn about different topics, but they get push-back from their parents. In addition, the College of Lake County is a commuter campus, and many students work in addition to attending school, and their schedules may prevent carpooling. Although I (and other professors) talk about many pro-environmental options in class, we understand that students have limitations on what they can do at this stage in their lives.

Table 8. Relative ranking of pre- and post-class behaviors across the regular and honors sections. A lower number represents a higher level of pro-environmental behavior. Ranking does not represent significant differences. Items with the same number were too similar to assign a rank.

Category	Regular Sections Pre-Class Rank	Regular Sections Post-Class Rank	Honors Section Pre-Class Rank	Honors Section Post-Class Rank
Recycling	3	3	3	4
Energy Conservation	4	5	5	5
Littering	1	1	2	1
Reusable Bags	10	10	10	10
Thinking About Environment	6	4	4	3
Carpool	7	7	8	6
TV/Computer Use	2	2	1	2
Conserve Water	5	6	6	7
Disposable Bottles	8	7	6	9
Buy Organic	9	7	9	7

Influence of Professor

Transformation of behaviors and relationship to nature was modified through exposure to content; however, the degree of change was moderated by the professor or the approaches/activities used in class**.** It is important to note the impact of the individual professor because if changing students' relationships or behaviors is a goal of the class, then we as educators need to identify the disparity between sections. A logical follow-up study would be to examine faculty conceptions of what goals, outside of learning the content and becoming scientifically literate, faculty have for their students. In addition, we would need to examine what factors most influence student behavior and attitude: is it the specific content being taught, the exercises or activities a professor uses, or the professor's attitude? By extension, educators outside of the biology class can evaluate how their approach to teaching and learning reinforces or hinders students' interest and connection to the subject matter and associated change in behavior/attitude. Meltzer, et al., (2020) documented an influence of instructor on college students' biophilic orientations on the humanistic, scientific, and utilitarian subscales as measured by the Kellert-Shorb Biophilic Values Indicator (Shorb & Schnoeker-Shorb, 2010) during a 21-day outdoor orientation program. Their results and others (Bobilya, et al., 2005; Sibthorp, et al., 2011) lend support to the conclusions that the instructor's approach can influence students' views and behaviors.

Comparison to Honors Class

There were many similarities between the honors section and the regular sections. Shared significant changes (and lack of significant changes) were noted in the human-nature indicators. In addition, there were similarities in the change in behaviors between the classes. Both groups thought about the environment more as a result of the class, and their overall pro-environmental behavior increased. The degree of change for specific behaviors appeared equal to or greater than that of the regular sections; however, most were not significant. It is interesting to note that the

greater interaction and self-reflected learning of the honors course had minimal impact on behavior change, compared to the regular sections. This lack of substantial difference may suggest that exposure and interaction with content through a typical course fashion (lecture supported with activities) is enough to spur change in connection to nature and pro-environmental behaviors. The extra time and effort on the part of the student and the professor (activity development and grading time) in the honors section did not lead to significantly greater gains in terms of attitude or behavior. Greater interaction and responsibility for content may lead to slightly greater gains but not at a level congruous with effort. This may reflect that there is a limit to the amount of change, either in respect to connection with nature or pro-environmental behaviors that can be accomplished within a typical semester.

Lack of Difference Due to Lab

A logical assumption is that physical interaction with the natural world, though outdoor or indoor lab settings, leads to a greater connection to nature. This idea has been supported by multiple authors (Bogner, 2002; Bradley, et al., 1999; Duerden & Witt, 2010; Nieman & Ades, 2014); however, it did not hold true for this population. The post-class results for the two courses (with lab and without lab) were similar for the human-nature indicators and pro-environmental behavior. This result can be viewed in a beneficial way; it means that a person's relationship with nature and their associated behaviors can be influenced without physically interacting with nature. Many education programs, both formal and informal, are limited by their access to nature, either by location or in some cases safety issues. The results of this study suggest that change in attitude and behavior can occur, even if education takes place inside. I am by no means advocating for intentionally reducing people's interaction with nature. A wealth of studies have documented the profound benefits of being in nature and the connection people form through those experiences. The physical act of interacting with nature may develop changes in emotional resilience, empathy, and cognitive skills that are beyond what was measured in this study. In addition, more extensive interaction with nature, for example longer time periods or more wild habitats might have significant impact on the variables examined in this study. The lack of difference demonstrated in this study is an avenue for further examination.

Conclusions

There are several major conclusions that can be gleaned from this study. Exposure and interaction with environmental biology content has an impact on students' pro-environmental behaviors and their relationship with nature. Tied to this though, is that the strength of change is related to the individual professor, possibly influenced by the teaching style, the teacher's attitude, intrinsic goals, and/or the activities assigned. If educators wish for their students' behavior and views of the environment to change, then they need to incorporate those goals in their teaching and learning approach, either implicitly or explicitly. Contrary to previous studies, a difference was not noted in response to direct exposure to nature. However, the sample size was small and had potential confounding effects from influence of different professors; this concept merits further study. In addition, the extra level of self-reflection and responsibility with content, as demonstrated in the honors course, did not result in significantly higher levels of change in either the connection to nature or pro-environmental behaviors; however, this finding should be tested with a larger and more diverse population.

The potential for changing an individual's relationship with nature and pro-environmental behaviors exists in college-level environmental biology classes and by extension other avenues

of similar content exploration. Educators can work to identify and subsequently leverage experiences that facilitate these changes. Settings and courses that do not include content related to pro-environmental views and behaviors and do not facilitate associated changes are missed opportunities for growth.

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