

2009

The Effect of Environmental Service Learning on Empowerment for Responsible Environmental Behaviors in College Students

Derek W. Rosenberger

Follow this and additional works at: <https://pillars.taylor.edu/mahe>



Part of the [Higher Education Commons](#)

Recommended Citation

Rosenberger, Derek W., "The Effect of Environmental Service Learning on Empowerment for Responsible Environmental Behaviors in College Students" (2009). *Master of Arts in Higher Education Theses*. 131.
<https://pillars.taylor.edu/mahe/131>

This Thesis is brought to you for free and open access by the Graduate Theses at Pillars at Taylor University. It has been accepted for inclusion in Master of Arts in Higher Education Theses by an authorized administrator of Pillars at Taylor University. For more information, please contact pillars@taylor.edu.

THE EFFECT OF ENVIRONMENTAL SERVICE LEARNING ON EMPOWERMENT FOR
RESPONSIBLE ENVIRONMENTAL BEHAVIORS
IN COLLEGE STUDENTS

A thesis

Presented to

The School of Graduate Studies

Department of Higher Education and Student Development

Taylor University

Upland, Indiana

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts in Higher Education and Student Development

by

Derek W. Rosenberger

May 2009

© Derek W. Rosenberger 2009

COMMITTEE MEMBERS

Thesis Supervisor: Dr. Michael D. Guebert

Professor, Earth and Environmental Science

Taylor University

Hearing Committee Member: Dr. Skip Trudeau

Professor, Higher Education and Student Development

Taylor University

Hearing Committee Member: Dr. Randall Dodge

Professor, Higher Education and Student Development

Taylor University

ABSTRACT

The purpose of this study was to empirically test whether service learning pedagogy utilized in a general education science course is able to promote locus of control (LOC) for responsible environmental behavior (REB) and intent to act (ITA) upon REB. To measure this, two instruments, the Environmental Action Internal Control Inventory, developed by Smith-Sebasto and Fortner (1994) to test for LOC for REB, and Hsu's (1997) ITA construct, developed to test for ITA upon REB were administered to two sections of a general education science course for non-science majors utilizing a nonequivalent pretest posttest control group design. This study shows that after participating in a 6-week environmental service-learning project, in general, students with little or no college-level science background showed no significant change in their LOC for REB or ITA upon REB compared to students in a control group, which did not participate in service learning. However there was some positive change noted in students in the service-learning group who had low pretest ITA.

Limitations to the present study are considered with the intent to improve future studies relating to environmental service learning. In addition, implications for future research are discussed which include the need for further investigation of environmental service learning outcomes and the effects of service learning on different target groups.

ACKNOWLEDGMENTS

There are quite a few individuals who helped make this project possible. I would like to first thank my thesis advisor, Dr. Mike Guebert, for his willingness to add one more project to his plate, and help me to gain a better understanding of service learning. I would also like to thank Dr. Don Takehara for allowing me to work with him and his class, and putting in a lot of extra time in order to try an innovative approach to teaching. I thank Dr. Scott Moeschberger, for his help in my search for significance, and for his council through my regression depression. I thank Mary Rayburn, for her encouragement and for introducing me to service learning and for making possible my professional development in the area through involvement in conferences and committees. And finally, I would like to thank my wife, Ashley Rosenberger, for her inspiration, encouragement, and patience through the entire process, from project formation, to editing and completion. Many thanks to you Ashley.

TABLE OF CONTENTS

ABSTRACT.....	iii
ACKNOWLEDGEMENTS.....	iv
LIST OF TABLES.....	vii
LIST OF FIGURES.....	viii
INTRODUCTION AND LITERATURE REVIEW.....	9
Problem Statement.....	11
Responsible Environmental Behavior.....	11
Service Learning.....	15
Service Learning Outcomes and Empowerment.....	17
METHODS.....	22
Design.....	23
Participant Demographics.....	23
Course Description.....	24
Instrumentation.....	28
RESULTS.....	30
DISCUSSION.....	34
Limitations.....	36
Implications for Future Research	40
Conclusion.....	42
REFERENCES.....	44
FIGURES.....	51

APPENDIX: INSTRUMENT.....54

LIST OF TABLES

Table 1. Comparison of the t test scores on the effects of service learning on responsible environmental behavior affective empowerment variables.....	30
Table 2. Comparison of the t test scores for affective responsible environmental behavior on mean change between the service learning and control groups.....	32
Table 3. Regression analysis of pretest scores and change scores.....	32
Table 4. Percent change in LOC and ITA for students as a whole.....	33

LIST OF FIGURES

Figure 1. Grade point average frequencies of students in both experimental and control sections.....	51
Figure 2. Student frequencies for gender in both experimental and control sections.....	52
Figure 3. Student frequencies for year in college for both experimental and control sections.....	52
Figure 4. Student frequencies for science courses taken in college for both experimental and control sections.....	53
Figure 5. Experimental and control results for the ITAS. The experimental graph indicates a strong negative correlation between student pretest scores and change scores.....	53

CHAPTER 1

INTRODUCTION AND LITERATURE REVIEW

Higher education is well situated to address the need for a more environmentally literate society – one whose citizens possess knowledge, attitudes, and skills that result in responsible environmental behaviors (REB). Americans with a college degree are more likely to possess environmental knowledge than Americans with high school-level educations (Kaplowitz & Levine, 2005). Many colleges and universities already offer courses that are related to environmental topics, and some even require courses focused directly on these issues (Moody & Hartel, 2007). Yet there is still little focus on developing ways of empowering students to move beyond mere knowledge of environmental issues to behaviors that actually address them (Smith-Sebasto, 1995; Wilke, 1995). In other words, higher education too often does not address the fact that awareness of environmental issues does not necessarily equate to engaging in REBs (Thapa, 1999). A large majority of students who receive a college degree are environmentally illiterate, that is, they have little understanding of how their actions impact the natural world in which they live, despite knowing that significant environmental issues exist (Orr, 1992; Wilke, 1995).

Service learning may be one of the most effective pedagogies in bridging the gap between knowledge and behavior (Astin & Sax, 1998; Astin, Vogelgesang, Ikeda, & Yee, 2000; Carver, 1997; Evangelopoulos, Sidorova, & Riolli, 2003; Eyler & Giles, 1999). Service learning engages students in issues relevant to the local community, and empowers them to utilize

knowledge and skills gained in the classroom to leverage positive change. Indeed, *environmental* service learning may be an effective method of instilling environmental literacy and REBs in students. The goal of environmental education is to “produce environmentally responsible citizens who can work for a balance between quality of life and quality of the environment” (Sia, Hungerford, and Tomera, 1985/86, p. 39). Similarly, when explaining the outcomes of service learning, Wutzdorf and Giles (1997) suggest that “service-learning constitutes a concrete means for achieving what so many institutions of higher learning promise: the development of students who will become significant actors within their communities and society at large for the betterment of both” (p. 115). Thus, the goal of environmental education and the outcomes of service learning seem to coincide.

Environmental literacy does not occur simply through acquisition of knowledge (Hsu, 2004; Hungerford & Volk, 1990; National Environmental Education & Training Foundation [NEETF], 2005; Ross, 2006). However, taking action, or seeing action taken with positive results can lead to REB (Haigh, 2006; Hsu, 2004; Hungerford & Volk, 1990; McMillan, Wright, & Beazley, 2004; Monroe, 2003; NEETF, 2005; Wilke 1995). Experiential learning methodologies like service learning, utilized in college courses may be what are needed to connect knowledge with behavior and help students continue to make environmentally responsible decisions throughout their lifetimes (Ballantyne & Packer, 2005; Haigh, 2006).

Problem Statement

If colleges and universities intend to produce informed and responsible citizens who can make responsible environmental decisions regarding the health of the planet, they must find effective and efficient ways of producing REBs in students while enrolled in college. REB and environmental literacy can be developed through active learning strategies in courses that are

designed to address environmental issues (Hsu, 2004). However, not all college students enroll in an environmental studies course during their college experience.

This study asks the question, “Can an active learning strategy, namely service learning, be utilized in a general education science course for non-science majors, to engender variables associated with REB and environmental literacy?” Based on the current lack of empirical evidence addressing how REB might be effectively engendered in students not majoring in science, the following two null research hypotheses are proposed.

1. *Integrating a service-learning project as a component in a general education science course for non-science majors will show no significant increase in internal locus of control for REB.*
2. *Integrating a service-learning project as a component in a general education science course for non-science majors will show no significant increase in student’s intent to act upon REB.*

Responsible Environmental Behavior

Sound educational pedagogy must be set within a theoretical understanding of how intended outcomes can be fostered. Since the goals of environmental education relate to engagement in REBs, it is important to understand models used to educate for these behaviors. Two concepts, locus of control (LOC), which refers to one’s perception of the effectiveness of their actions, and intention to act (ITA) upon an issue have emerged as important learning outcomes for the development of REBs in students. This was recognized most notably through the work of Hines, Hungerford, and Tomara (1986/87). Before that time, many environmental educators relied on the assumption that knowledge creates attitudes, which then result in changed behavior. However, the linear knowledge-attitudes-behavior model does not reveal the whole

picture (Kollmuss & Agyeman, 2002; Thapa, 1999). Hines et al conducted a meta-analysis to develop a model of how various cognitive and affective variables contribute to REB. They suggest that the knowledge dimension could be expanded to include knowledge of issues, knowledge of strategies for taking action, and knowledge of skills needed to take action. The attitude dimension, they realized, was just one of several affective or psychosocial variables, which also included locus of control (LOC), and personal or moral responsibility. They suggested that both the cognitive and affective variables are mediated by one's ITA, which then results in a particular behavior.

Hungerford and Volk (1990) further analyzed this model and suggested that all the identified variables could be organized into entry-level, ownership, and empowerment variables, which then result in REBs. The major empowerment variables critically necessary for REB to occur include knowledge and skills in using action strategies, internal LOC, and ITA. They note that, "these variables give human beings a sense that they can make changes and help resolve important environmental issues" (p. 12). They also suggest, however, that while the cognitive knowledge and skill variables can be, and have been, successfully taught in the classroom setting, internal LOC, and ITA, the two remaining affective variables, are much more difficult to foster using traditional teaching methods.

Though locus of control for REB and intent to act upon REB may be difficult to teach, studies have shown them to be vastly important in the development of REBs, with their presence being fairly accurate predictors of behavior (Hines et al 1986/87; Hsu & Roth, 1998; Smith-Sabasto & Fortner, 1994). Thus it is important to have a good understanding of these concepts if one is to attempt to predict future environmental behaviors as a result of an intervention such as service learning.

Defining the Empowerment Variables

LOC is generally defined as one's perceived ability to affect change due to one's actions. If one has an internal LOC, then one feels as though their actions will make a difference. On the other hand, an external LOC suggests that the world is controlled by powerful others, and it is not within one's ability to change it (Smith-Sebasto, 1995). LOC has been shown to predict high or low levels of REB in 82% of the cases (Smith-Sebasto & Fortner, 1994). Self-efficacy, a concept similar to LOC refers to one's perceived ability to effectively or competently act in a particular situation (Bandura, 1977). This perceived ability is based on several factors, including previous successful attempts, successful models based on people similar to one's self, encouragement from others, and physiological responses. Hines et al. (1986/87) felt that LOC and self-efficacy are similar enough to be considered a single variable. Thus for the purposes of this study, LOC will refer to both perceived effectiveness of one's actions, and perceived competence in acting in a responsible environmental way.

ITA refers to one's intended commitment to act upon a specific matter. Like LOC, Hungerford and Volk (1990) described it as an affective empowerment variable. Hsu and Roth (1998) found ITA to be one of the most important predictors of REB. They found that one's ITA is affected by both cognitive and affective REB variables. Thus when one has positive attitudes, an internal LOC, and feelings of personal responsibility for environmental issues, coupled with knowledge of those issues and skills and strategies for addressing them, the result will likely be an ITA in an environmentally responsible way. Thus, if REB is the goal of environmental education, these courses must broaden beyond cognitive knowledge and skills and seek to engender an internal LOC and an ITA in order to empower students for REB.

Educating for Empowerment

Responsible behaviors occur when the REB variables are brought together during a decision making process (Hines et al, 1986/87). Hungerford and Volk (1990) showed that behavior generally changes positively as a result of environmental instruction focused on ownership and empowerment. Several studies have addressed how one might educate for REB empowerment variables.

Smith-Sebasto (1995) found that when comparing an environmental studies class to a history class, knowledge and skills, internal LOC, and REB increased in the environmental studies class, while showing no significant change in the control class. This indicates that educators are able to facilitate the development of REB in students if the text and instructor intentionally focus on content relating environmental issues to their student's lives and behavior.

Hsu (2004) assessed the impact of an active learning methodology intended to engender environmental literacy and REB in students enrolled in an environmental education course in Taiwan. The study found that both ITA and LOC were significantly increased in students by the end of the course, showing that a full course devoted to engendering these outcomes through active learning could be successful in doing so. This however leaves questions that must be answered such as; can a course that is not fully devoted to teaching for these outcomes also develop REB in students? Can components within a course be effective at engendering these behaviors?

Service Learning

Service learning is an increasingly popular pedagogy among educators from primary through graduate schools. Bringle, Hatcher, and McIntosh (2006) have defined academic service learning as "a credit-bearing educational experience in which students participate in an organized service activity that meets identified community needs and reflect on the service activity in such

a way as to gain further understanding of course content, a broader appreciation of the discipline, and an enhanced sense of personal values and civic responsibility” (p.12). Though definitions of service learning may vary, some placing more emphasis on one aspect than another, service learning generally involves four components; 1) in-class preparation; 2) participation in service that meets a community need; 3) reflective activities that tie the service to course material; and 4) evaluation of learning. The service-learning framework has been utilized across the disciplines and has shown great success in facilitating many student learning outcomes including: academic learning, knowledge transfer, problem analysis, critical thinking, locus of control, moral development, intention to act, and others (Eyler, Giles, Stenson, & Gray, 2001).

For the last 15 years, most service learning activities have been placed into one of three types: indirect, direct, and advocacy. A fourth type, “research,” is also included by some as an additional form, and has been found to be popular among environmental service learning practitioners (England & Marcinkowski, 2007). Due to the interdisciplinary nature of environmental studies, environmental service learning projects have been designed to utilize any of the four types of service.

Indirect service is a service experience that provides clear benefits for the larger community but has less direct emphasis upon building relationships with the community it is serving. It is designed to result in student’s ability to work as a team, organize, and prioritize time and effort (Follman, 2009). Indirect service is completed through projects such as cleaning up at a park, removing invasive plant species (Johnson-Pynn & Johnson, 2005), or planting native grasses (Covitt, 2002).

Direct service is relational, and generally involves one-on-one contact with a community partner through mentorship, teaching, or tutoring. Direct service is designed to promote care for

others, responsibility, problem-solving, and big-picture learning (Follman, 2009). Examples of direct service projects include teaching primary school students about environmental issues, consulting with local community members about watershed management (Curry et al., 2002) or teaching migrant farm workers about pesticide safety (Eisenhut & Flannery, 2005).

Advocacy service involves identifying and advocating for or against an issue that affects the community and working to create public interest and action. Advocacy service is designed to impact student's understanding of rules, systems, and processes, and provide opportunity for students to participate in engaged citizenship (Follman, 2009). This type of service may include advocating for habitat protection, industrial groundwater withdrawals, or responsible disposal of wastes (McDonald & Dominguez, 2005; Schneller, 2008).

Finally, research-based service generally entails utilizing surveys, evaluations, studies, experiments, and interviews in order to collect information to address a community need. It is designed to impact student's ability to find information, make informed judgments, work systematically, and organize, assess, and evaluate relevant information about an issue (Follman, 2009). Projects may include water quality assessments, or the impact of land use activities on local environments (McDonald & Dominguez, 2005).

A recent study by England and Marcinkowski (2007) showed that indirect and research-based service learning were the most commonly used types of environmental service in college programs. This may be due to the natural fit of research in environmental classrooms and the ease of instituting an indirect service project. The increasing popularity of service learning projects may be due to observed and anecdotal evidence of its ability to impact knowledge and behaviors (Ward, 1999).

Janet Eyster (2000) suggests that many service-learning studies have not effectively connected the service project with the outcomes that they want. She notes, “stacking soup cans in a food pantry is not likely to have an impact on public speaking... clearing a trash-filled city block is obviously not connected to improved critical thinking capacity” (p. 12). Zlotkowski (2000) notes that there is little reliable data measuring the efficacy of service learning in math, natural sciences, business, and the humanities, as relevant service projects are most easily tied to the social sciences. Thus, there is great need for discipline specific service learning research that utilizes service-learning projects closely tied to the learning outcomes of that discipline. Accordingly, if environmental education outcomes are desired, then the service-learning project must be closely tied to community environmental issues.

Environmental service learning is still in its early stages of development (Schneller, 2008). Few empirical studies have specifically addressed cognitive or affective variables tied to environmental education theories, thus making its ability to engender environmental literacy and REBs unclear. No studies were found to have controlled for the outcomes of the service-learning project itself, which limit the ability of outcomes to be tied directly to service-learning projects. And few have been conducted within the context of a formal educational setting, particularly higher education, reducing the validity of the studies for use in such environments. However, the few empirical studies available that have reported outcomes related to REB may serve as a basis for further investigation.

In a yearlong middle-school environmental learning course in Mexico, Schneller (2008) found that a service learning experience promoted pro-environmental attitudes and behaviors in students after completing the course. The students in this class were involved in both an advocacy-based project for sea turtle habitat preservation and an indirect service beach cleanup

project. The study found that these attitudes and behaviors were still present in students two years after the class was taken, showing that service learning experiences can have lasting effects on student behaviors.

A study by Eisenhut and Flannery (2005), one of the few empirical studies that looked at environmental service learning outcomes in college students, explored how service learning could be used in an environmental health course to increase support for environmental protection. Students in a community cleanup project and migrant farm worker education project, grew in their sense of environmental responsibility; increased in their level of concern for several environmental variables; and viewed community action as empowering. In addition, student concern regarding issues related to specific service projects increased significantly by the end of the course. Though these results are encouraging, there were several confounding variables that were not controlled, such as the student's majors (environmental science and health science) that may have predisposed them to particular attitudes, and that the whole course was focused on environmental health, with the service project being only one component of the experience. Nevertheless, some qualitative data does appear to indicate that the service-learning project contributed significantly to student's increased levels of concern for the environment and motivation to act upon that concern.

Several service-learning studies have found that affective empowerment variables are engendered through service learning. Johnson-Pynn and Johnson (2005) found that service-learning programs increased student's perceived self-efficacy or LOC, as well as local conservation knowledge, and problem-solving skills. This study was based on two community-based environmental education programs in Uganda and Tanzania for primary and secondary school students. Students in these programs participated in advocacy and indirect service projects

related to agro-forestry, plastic bag pollution, community health, and animal welfare. The study found that primary and secondary students who had participated in local service learning projects reported that participating in the projects significantly impacted their belief that they could make a difference in the world. However qualitative interviews with students did not achieve similar results. Self-efficacy in this case may not be directly related to their LOC for REB, and instead speaks more to their general feelings about their ability to make a difference through their actions.

One study that looked at whether a research-based service-learning project could engender positive attitudes in a required statistics course for business majors found that it increased knowledge and skills, positive attitudes towards course material, and intention to act on the subject (Evangelopoulos et al., 2003). This study therefore provides a strong basis for the use of service learning as a method of engendering both cognitive and affective empowerment variables for REB.

Myers-Lipton (1998) conducted a study to test for general learning outcomes of civic responsibility, LOC, and civic behavior; all variables closely associated with environmental literacy and REB. Three groups of students were evaluated: students who took a service-learning course, students who engaged in non-course-based community service, and students who participated in neither. These results revealed that service-learning groups showed very strong increases in LOC and civic behavior, and moderate to strong increases in civic responsibility.

In conclusion, much research is still needed to more fully understand environmental education. Rickenson (2006) states it clearly in saying, “we need to think carefully not only about ‘the what’ (i.e., foci and outcomes) but also about ‘the how’ (i.e. processes) of environmental learning” (p. 448). If we are to more fully understand the value of environmental

service learning in environmental education, research must seek the most effective means by which processes and outcomes can align. Recent research seems to indicate that environmental service learning may be an effective way of addressing “the how” in meeting the goals of environmental education. Indeed, many universities are already utilizing environmental service learning in the curriculum (England & Marcinkowski, 2007; Moody & Hartel, 2007; Ward, 1999). However few studies have yet considered environmental service learning’s actual ability to produce environmental education outcomes.

CHAPTER 2

METHODS

To assess the effects of a course on REBs in students, some studies have used self-report instruments that ask direct questions about the number of times specific REBs are acted upon within a period of time (Hsu, 2004; Smith-Sabasto & Fortner, 1994; Smith-Sabasto, 1995). Because service learning is an active learning strategy in which many of these behaviors are actually acted upon for the purpose of the project, there may be validity issues with measuring REB in this way. Additionally, since this service-learning project was conducted over a period of several weeks with the post-test being administered soon afterwards, an instrument that is intended to measure changed behavior by measuring recent actions may not accurately describe recently changed perspectives that will result in intended future behavior. In the same way, knowledge, skills and action strategies for addressing environmental issues are an inherent part of the service-learning project design, therefore reducing the validity of instruments that ask about involvement or knowledge of these behaviors as a result of the experience. However, affective constructs like LOC and ITA, which have been shown to predict REB, may be better able to measure changes in REB in students (Hsu, 1997; Smith-Sabasto & Fortner, 1994). For these constructs, students were asked about whether they believe certain actions will make a difference or whether they intend to act upon certain actions, thus predicting feelings and attitudes which may have been recently changed or adjusted.

Design

This study was designed to determine the impact of service learning upon LOC for REB and ITA upon REB among students in a general education science course. A pretest, posttest nonequivalent control group design was used. The study was done in a general education chemistry course (CHE 100) at a small liberal arts university in the Midwest in the fall of 2008. The course had two sections, which met in the afternoon, for 50 minutes, three times a week for 15 weeks. The course also included weekly lab periods where students would participate in basic laboratory experiences. The course also included one field trip to a local industry where students took a tour and were introduced to practical applications of chemistry. During the study, the course had a total of 73 students enrolled, with 37 students enrolled in the service-learning section and 36 students enrolled in the control section, both of which were taught by the same instructor.

Participant Demographics

The study included 73.0% (n=27) of the students completing the service-learning section and 72.2% (n=26) of the students completing the control section. Nearly all the students involved in the study reported race as Caucasian/White (98.1%) and all students were between the ages of 18 and 22. There were no environmental or natural science majors enrolled in either section. Both sections were diverse, with 19 different majors represented in the experimental group and 17 in the control group. Grade point averages were similar in both groups with approximately 70% reporting a GPA of 3.0 or above (see Figure 1). Gender showed the greatest difference between experimental and control groups with the experimental group (n=27) composed of 22.2% males and 77.8% females, while the control group (n= 26) contained 53.8% males and 46.2% females (see Figure 2). Year in school also showed some difference between the two groups with the experimental group containing 18.5% first-years, 33.3% second-years, 29.6%

third-years, and 18.5% fourth-years, while the control group contained 7.7% first-years, 57.7% second-years, 19.2% third-years, and 15.4% fourth-years (see Figure 3).

At this particular institution, students are required to take two general education science courses. Except for Environment and Society, none of these courses have an environmental emphasis. In the experimental group, 52% (n=14) had not completed any science course and only one student had completed Environment and Society. In the control group, 61% (n=16) had completed a science course and 2 students had completed Environment and Society (see Figure 4).

Course Description

The course utilized three components to teach the course material. In the first component, basic chemistry concepts and “tools” were taught in lecture, and supplemented with reading from a text. In the second component, students were to apply these concepts and tools to daily life and current issues through lab experiments, a more in-depth investigation of a particular issue through a large group project, and a field trip to a local industry. In the third component, students participated in weekly discussion groups composed of four to six members led by former students of the course. This component was to help students more fully consider the material and work out and discuss difficulties they might have with the concepts presented in the first two components. The course utilized quizzes and tests for evaluation of learning.

Course Projects and Control Group

Each section was given a different group project to complete as outlined in the second component of the class. One section participated in research projects on alternative energy, which did not include a service component. This section served as the control group for the study. The remaining section participated in a research-based service-learning project that

addressed carbon emissions. This section served as the experimental group for this study. Both projects were explained to their respective sections on the 9th week of class after students had covered these topics in the course.

The alternative energy project involved groups of students investigating an alternative energy system in the literature and conducting a telephone interview with an “expert,” who they were to identify and contact. The “expert” interviews ranged from local industry leaders to heads of state energy departments. The groups were responsible for several short reports through the course of their investigation and for a short presentation to the class to complete the project. This project focused on introducing the students to skills in conducting investigations of science related topics, but did not involve a service to any outside community group or organization.

Service-Learning Project as Experimental Group

The carbon emissions service-learning project was designed to further develop material presented in five days of class time devoted to the Chemistry of Global Warming section. This was the first time that this particular project was conducted in this course and the first time this instructor had utilized a formal service-learning project in a class. This project partnered with the company that runs the Facilities Services department at the school to complete a carbon emissions audit of the campus. The Facilities Services department had been interested in completing an audit as the basis for future sustainability initiatives on campus, but had been unable to devote anyone to a project of that magnitude. When the possibility of the CHE 100 class undertaking the audit was suggested, the department responded enthusiastically. Before the projects began an executive administrator and the Director of Facilities Services spoke briefly with the class about the need for the carbon audit and the value of their work. This was done to

establish the significance of the student's work, and offer the support of the administration as partners in the project.

The carbon emissions service-learning project included eight discussion groups composed of four to six students. Each group investigated one of seven topics (with the exception of one topic which had two groups investigating it due to its complexity) which involved emissions from: commuting, institutional air travel, fleet and equipment, events and food services, grounds and chemicals, waste management, and energy. This structure allowed for easy division of projects between the groups as well as a weekly venue for discussion of the topic, brainstorming solutions, and recommending strategies for improvements.

The project was set up in a "What? So what? Now what?" format. The "What?" component referred to the school's current level of carbon emissions. Students were to investigate the status of the campus in relation to their emissions topic. To discover this, students developed an investigation strategy, contacted various offices on campus, developed and implemented surveys, and conducted interviews as needed.

The "So what?" component was meant to address attitudes concerning this topic. Based on their data, students were to make recommendations for how Taylor might be able to reduce carbon emissions in their particular area. Groups submitted a report with their findings and suggestions to the instructor, which was then passed on to the Facilities Services department.

Finally, for the "Now what?" component, which was intended to allow students to begin taking action and developing behaviors to address an issue, the groups presented their data and suggestions for improvement to the class and the Director of Facility Services. Additionally, they supplied a plan to Facilities Services for how their recommendations could be practically

implemented on campus. Students were encouraged to take steps to implement their plan. The posttest was then given at the end of the course after projects had been fully completed.

Service-Learning Project Validity

There is some debate about whether service projects completed in the campus community are as effective as those for the benefit of the surrounding community (J. Hatcher, personal communication, October 30, 2008). For this project, and perhaps other environmental service-learning projects, the lines are somewhat blurred as the actions of the university both directly and indirectly affect the local community. The university is set in a small rural town in the Midwest where many of the local community members are associated with the institution in some way. Thus the actions of the school directly impact community members. Further, the issue of global climate change is a global issue, and the university's decisions indirectly impact both the local and global community. This is the root of environmental literacy, recognizing that individuals are a part of a larger community and that the actions of one impact the greater system. For this class, it was decided that a project that addressed the global issue of climate change by addressing local campus behaviors would constitute an appropriate environmental service-learning project. In this way, students would be providing a service addressing global issues while grounded in, and learning more fully about, a particular place. As Curry, Heffner, and Warners (2002) suggested, "when we deepen our understanding of the places where we live, we gain a greater understanding of who we are, the intricacies of our place, and our responsibilities as citizens of these places" (p. 59).

Instrumentation

The pretest and posttest were composed of two constructs, an instrument measuring LOC, and another measuring ITA. LOC was tested using Smith-Sabasto and Fortner's (1994)

Environmental Action Internal Control Inventory (EAICI). The EAICI was developed to specifically measure LOC for REB, making it a more reliable scale for this behavior than a generic LOC scale. The EAICI utilizes 28 questions on a 5-point Likert Scale. Possible scores on this scale can range from 28, which represents an extremely high external LOCR for REB, to 140 which represents an extremely high internal LOCR for REB. Reliability for this instrument was high, with a Cronbach alpha score of 0.95.

Intention to act was measured using the Intention to Act Scale (ITAS) developed by Hsu (1997) to measure ITA on environmental issues as a component of a larger scale measuring variables of REB. The ITAS uses five questions on a 5-point Likert scale. The five questions address the five different categories of environmental action: eco-management, consumer/economic action, persuasion, legal action, and political action (Hsu, 1997). Reliability for this measure was moderate with a Cronbach alpha score of 0.68.

Both constructs were included in a single survey. Students were also asked to supply demographic information, which included age, gender, ethnicity, year in school, major/minor, GPA range, and any environmental science related courses they have completed in college. Surveys were administered two weeks before the projects were announced and again one week later for those who missed the first opportunity. The service-learning component was randomly assigned to one of the two sections. On week seven of the course, the two separate projects were announced to their respective sections. The posttest survey was then given the last week of class and again during the final exam period for those who missed the previous opportunity. To ensure participation, students were offered a small bonus on their final exam as an incentive to fill out the survey, or alternatively, a short description of their perceptions of the course, which was not a part of the study. Most students opted for the survey.

Analysis was completed using SPSS (version 15). Total mean scores were compiled from the pretest and posttest for the experimental and control group. These scores were then compared to determine change in LOC and ITA. The pretest scores were subtracted from the posttest scores to indicate positive or negative change in LOC and ITA. These data were then analyzed using an independent-samples t test to determine significance. Regression analysis was used to determine any covariate effects. An alpha level of 0.5 was used for all statistical tests. Individual change scores were also analyzed to show positive, negative, or zero change for the entire sample population. Missing data were addressed by taking the total mean score for that particular question, thus supplying a data point but not impacting the overall mean change.

CHAPTER 3

RESULTS

Of the total students, 72.6% chose to complete both the pretest and posttest. For the experimental group, 27 matching surveys were collected. For the control group, 26 matching surveys were collected. Means were then calculated and the significance of their differences were assessed (see Table 1)

Table 1.

Comparison of the t test scores on the effects of service learning on responsible environmental behavior affective empowerment variables.

	Pretest		Posttest		<i>t</i>	<i>df</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
EAICI							
Service Learning (<i>n</i> = 27)	100.18	11.85	100.63	17.06	-0.176	26	0.862
Control (<i>n</i> = 26)	95.92	11.07	96.43	16.05	-0.168	25	0.868
ITAS							
Service Learning (<i>n</i> = 27)	14.36	3.87	14.52	3.29	-0.342	26	0.735
Control (<i>n</i> = 25)	13.52	3.22	14.02	3.25	-0.997	24	0.329

For the experimental group, a total of 27 usable instruments were returned by students who completed both a pretest and posttest. Table 1 shows the group mean for the EAICI was 100.18 for the pretest, indicating a very weak LOC for REB, and 100.62 for the posttest, which represents a statistically non-significant, $t(26) = -0.176$, $p = 0.862$, change between the pretest and posttest. The group mean for the ITAS was 14.36 for the pretest and 14.52 for the posttest, also showing a statistically non-significant, $t(26) = -0.342$, $p = 0.735$, change between the pretest and posttest.

For the control group, 26 usable instruments were returned for the EAICI and 25 returned for the ITAS. The group mean for EAICI was 95.92 for the pretest and 96.43 for the posttest, which represents a statistically non-significant, $t(25) = -0.168$, $p = 0.868$, change between the pretest and posttest. The group mean for the ITAS was 13.52 for the pretest and 14.02 for the posttest, which also represents a statistically non-significant, $t(24) = -0.997$, $p = 0.329$, change between the pretest and posttest. A *t* test was used to compare the change scores of the experimental and control group (see Table 2). This

analysis showed that there was no significant difference between the scores of the experimental group and the control group for both the EAICI ($p = 0.99$) and the ITAS ($p = 0.63$).

To understand the impact of pretest scores upon the change scores, regression equations were run for the experimental and control sections of both the EAICI and ITAS. Results showed no relation between the pretest scores and change scores for the EAICI. Regression analysis of the ITAS construct however revealed a negative linear relationship ($p = 0.004$) between change in ITA and ITA pretest scores in the experimental group. (see Table 3).

Table 2.

Comparison of the t test scores for affective responsible environmental behavior on mean change between the service learning and control groups

Construct	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
EAICI			-0.015	51	0.988
Service Learning ($n = 27$)	0.4483	13.23207			
Control ($n = 26$)	0.5073	15.37173			
ITAS			-0.491	50	0.626
Service Learning ($n = 27$)	0.1619	2.46069			
Control ($n = 25$)	0.5000	2.50832			

Table 3.

Regression analysis of pretest scores and change scores.

Variable	<i>B</i>	<i>SE B</i>	β	R^2	<i>p</i>
EAICI					

Service Learning ($n = 27$)	-0.09	0.22	-0.080	0.01	0.698
Control ($n = 26$)	-0.41	0.27	-0.300	0.09	0.140
ITAS					
Service Learning ($n = 27$)	-0.34	0.11	-0.537	0.29	0.004
Control ($n = 25$)	-0.29	0.15	-0.374	0.14	0.065

While whole-sample mean scores showed no significant change between the experimental and control groups or for all participants together, individual change scores did indicate that the course as a whole had an overall positive effect upon student empowerment variables. Results showed that 51.9% of students displayed increased LOC and 48.1% showed increased ITA, while 46.1% reported decreased LOC and 38.5% showed decreased ITA, with 1.9% and 13.5% showing no change in LOC or ITA respectively (see Table 4).

Table 4.

Percent change in LOC and ITA for students as a whole.

Variable	Negative Change	Zero Change	Positive Change
Locus of Control ($n = 53$)	46.1%	1.9%	51.9%
Intent to Act ($n = 52$)	38.5%	13.5%	48.1%

CHAPTER 4

DISCUSSION

This study utilized a pretest, posttest nonequivalent control group design to investigate the ability of service learning to impact REB. Two affective empowerment variables shown to be able to predict REB were tested. The study was done in a general education science course for non-science majors in order to test for the impact of the service learning experience on students who may have no other opportunity to take a course that addresses environmental issues. The results indicate that the service-learning project was generally unable to increase LOC for REB and ITA upon REB, which confirms both null hypotheses. However there are two interesting factors that must also be considered for a fuller understanding of the implications of this study.

First, analysis of the results show that for both the service learning and control groups, there were more students who showed an increase in LOC for REB and ITA upon REB than decrease. In other words, more students showed positive change for both constructs than showed negative change. This seems to indicate that within the time period in which the students were

involved in either an environmental service learning project or an alternative energy project, the course had a positive effect upon the student's empowerment for REB. Since this relationship is present in both the service learning and control group it is unclear which factors contributed to this change.

Second, investigation of factors that may have contributed to change in students revealed that in the service-learning group, change in ITA was negatively related to ITA pretest scores. The same relationship was not observed in the control group or in the LOC construct. These results indicate that service learning is able to positively affect students with an already low ITA, while it may negatively impact ITA in students who already had a high ITA. This is interesting as it seems to suggest that service learning used in a course with students who have generally low ITA scores may be able to positively impact them. Some students in Eisenhut and Flannery's (2005) study of service learning's ability to affect environmental concern reported in the qualitative portion of the study a greater motivation to act upon their concern which they noted was developed through the service projects. This study seems to support those findings in students who have low levels of ITA. However, the results of this study also raise other questions, such as, why did students with an already high ITA show a generally negative change, and why was a similar relationship not seen in the LOC construct? The latter question will be addressed more fully in the limitations section.

It is unclear why students with high ITA scores would regress as a result of the service-learning project. It appears to be more complex than simply suggesting that service learning has a negative effect upon students with high ITA upon REB. The students in Eisenhut and Flannery's (2005) study showed initial environmental concern levels well above the national average and yet their quantitative concern results and qualitative reports suggest they were still

positively affected and showed greater motivation to act upon their environmental concern. One possible reason for this inconsistency may be that the experiential nature of the service-learning project, which had students investigating and proposing ways of reducing carbon emissions, led them to clarify their views concerning their own ITA upon REB.

McMillan (2003) noted the same result in student's environmental values; while many increased in environmental values, some regressed. McMillan suggests that this may be due to clarification of their values concerning their relationship to the environment due to the material. In the pretest, students may have indicated a high ITA, but upon realizing the greater implications of what it might take to act in an environmentally responsible way, recognized that they were not as committed to REBs as they previously thought. This may in the end lead them to make more thoughtful decisions about REBs, but verification of this suggestion is beyond the scope of this study.

Nevertheless, it is important to note that this study shows with a high level of significance ($p = 0.004$) that college students who have a generally low ITA seem to be positively impacted by taking an environmental service-learning course. Thus, service learning may be a valuable component for classes that generally have students with low ITA upon REB, such as general education science courses.

Limitations

Due to the limited research available on environmental service learning, future studies may benefit from discussion of the limitations of this study. These limitations were in large part due to: this being the first time the service-learning project was included in the course, limited opportunities for individual or guided student reflection, the broad nature of the issue being addressed (global climate change), and a limited ability for the students to see their work make a

difference (which may have impacted LOC outcomes). Each limitation will now be addressed further.

This study was the first time this service-learning project was included in this course. As this was the first time that large group projects were required of the students, this may have violated their expectations for the workload associated with a general education course. When students have little interest regarding a subject in the general education curriculum, they may choose a course based upon the popular opinion of the amount of time necessary to do well in that particular course rather than actual interest in the subject. When new course components are developed, especially those that are perceived as requiring significant additional time and effort, student expectations based on popular opinion may be violated, and attitudes towards the activity and the intended learning may be negatively affected. Subsequent evaluations of classes who expect the project may effectively test this hypothesis. Additionally, when an instructor has administered a project several times, the instructor is more able to address issues and anticipate problems. While there were no large problems identified with this project, there is always room for improvement in how to best facilitate the experience.

Another limitation was the lack of opportunities for directed reflection. Reflection is one of the main components of service learning pedagogy. Reflection helps students relate service work to course content to enhance learning and discover how it might impact one personally. Several types of reflection, such as written reports, journaling, discussion, and presentations are commonly used. England and Marcinkowski (2007) showed in their review of college environmental service learning programs that the majority of reflective activities are conducted through class discussions. In this study, presentations, reports, and discussions were the main reflective methods used. However, there were no individual reflective practices built into the

project beyond the discussion groups. It is also unknown how work was divided between group members. One or more students may have completed the report writing for the group, while another developed the presentation, thus limiting individual reflection among other group members. It is also unknown how much reflective discussion actually occurred in their groups since no guided reflection questions were supplied to the group leaders. It was hoped that by having students develop solutions to the issues they investigated this reflective discussion would occur. However, it cannot be assumed that this occurred. Therefore, individual reflection and participation, an important part of service learning, may have been limited in this project and should be included and assessed in future studies. Covitt (2002) in her study of motives and intentions of middle school students who engaged in an environmental service learning program, suggested that unequal involvement in project participation may have been a major limiting factor in her assessment of outcomes. She also noted that this is a common aspect of service-learning activities that must be considered when designing the project. Ward (1999) in his book *Acting Locally: Concepts and Models for Service-Learning in Environmental Studies* noted that minimal engagement in reflective activities in environmental service learning courses seem to be the current norm. He suggests that this may be due to many science instructors stumbling upon methods similar to service learning while seeking practical experience for students, instead of through best practices in the literature.

There may have been limitations associated with the instruments used in this study. While the EAICI and the ITAS are designed to assess LOC and ITA (respectively) associated with REB, the behaviors that the students may have developed due to this course, particularly those related to global climate change, may not have been sufficiently measured.

Additionally, global climate change may have been too broad an issue to be personalized by engaging in local action. Service learning is generally conducted with a community partner addressing community issues. By engaging in these issues, students are able to personalize this local problem and help to enact change. The students may not have felt empowered by participating in a global issue upon which individual actions generally have little overall impact. As a result, students were not able to see the fruits of their labor directly through the solving of a problem, which may have severely limited student development in LOC.

On the same note, a final limitation may have been the lack of tangible evidence that the student's efforts made a difference in the local community. This could have been a significant factor in why LOC in particular was not impacted by the service-learning course. Students developed proposals for the community partner, which contained suggested actions to reduce carbon emissions in the area that they investigated. When students presented their material to the class and the community partner, only one representative was there to receive the recommendations. Other departments may have benefited from these suggestions as well, however students did not have tangible evidence that the appropriate partners received the suggestions, or that any of their suggestions would be utilized. If students feel that their work made no difference, their LOC will be negatively affected. This may have been the case in this project. Future projects should be sure to make clear that the work that students participate in will be useful, and will be shared directly with the partners that will use the information.

Implications for Future Research

There is great need for further research in environmental service learning. This study was one of the first to address how service learning impacts REB-related outcomes in a general education science class. There has been little empirical research on environmental service

learning in general. To date, most studies in this area have looked at outcomes in primary or secondary schools or programs associated with that demographic. The following are suggested directions in which future research might go.

It is interesting that students with initially high ITA upon REB decreased in the service learning class. This outcome could have implications for the use of environmental service learning in classes for natural science majors who may already have higher levels of ITA. Does it in fact help them clarify their current understanding of their commitment to act upon REB, or does it really simply decrease their commitment to REB? This question requires further investigation.

More empirical studies that address environmental education outcomes are necessary in order to better understand the implications of environmental service learning as a whole. This research should focus on investigating outcomes related to larger environmental education theories and models such as responsible environmental behavior and environmental literacy. To date, there are few studies with a strong basis in theory.

Future studies could consider the ability of the four different types of service learning (indirect, direct, advocacy, and research) to promote specific behaviors associated with the three main types of environmental issues (sustainability, biodiversity, and environmental justice). This study addressed the effects of research-based service learning that addressed sustainability issues on student's empowerment variables for REB. While most REBs focus on issues of sustainability, some also focus on threats to biodiversity and environmental justice. Indirect and advocacy service learning projects may promote outcomes concerned with threats to biodiversity, such as invasive plant species removal or advocating for threatened or endangered species in local natural areas. Direct and advocacy service projects may promote outcomes

related to environmental justice concerns, such as location of proposed waste sites or migrant farm worker health and safety programs such as those conducted by Eisenhut and Flannery (2002) with positive results in increasing levels of environmental concern.

Though not addressed in the original research question, when one asks, “how many students were positively impacted due to this course regardless of group?” we find that for both constructs, more students were positively impacted than negatively impacted by the course. This indicates that at least one of two affective empowerment variables can be positively impacted in a majority of students to some degree by a general education science course. These results confirm other studies that have shown that science courses are able to positively impact affective variables associated with REB (Hsu, 2004; Smith-Sabasto & Fortner, 1994; Smith-Sabasto, 1995; Wolfe, 2001). These results are distinct however in that the students involved were not natural science majors and this course was not focused primarily upon environmental issues. In fact, while some environmental issues related to chemistry were covered in class, most had been covered before the pretest was administered, thus controlling for the classroom based instruction of these topics and not contributing to the student’s change scores. This may indicate that the two group projects in which the students participated addressing alternative energy and the carbon cycle, may have together been contributing factors to students’ increased LOC for REB and ITA upon REB. More studies are needed to investigate this possibility.

Finally, further research should be done on quantitative instruments that assess environmental education outcomes. Both LOC and ITA are specific to the issue being addressed. While the instruments used in this study showed high reliability and face validity, instruments that are able to measure empowerment outcomes related to specific environmental issues could be beneficial. These would ensure that the instrument is in fact measure what it is intended to

measure. Specific instruments would also allow for continued assessment of learning and better course and project design.

Conclusion

As the need becomes more critical for an environmentally literate society evidenced by citizens who regularly participate in REBs, it is increasingly important that environmental educators investigate innovative ways of facilitating the development of REB. Service learning has shown some promise as an effective tool for environmental educators (Eisenhut & Flannery, 2005; Johnson-Pyne & Johnson, 2005; Shneller, 2008). In this study, conducted with a population of college students with little previous introduction to environmental issues in college, results did not generally show service learning to have an impact upon two empowerment variables associated with REB: LOC for REB or ITA upon REB. However, it did indicate that students with a low ITA may be positively impacted by a service-learning project, while students with a high ITA may decrease in their ITA upon REB, possibly due to a clearer understanding of environmental action. This relationship needs more research.

Limitations of design may have contributed to lack of general change. Future studies should ensure that directed reflection is built into the project design in such a way that all students can and will participate. Additionally, students should be able to see the outcomes of their efforts in a timely way in order to increase perceptions that their work was significant and useful. Future studies are required to further understand why service learning had no effect upon LOC, why students with high ITA regressed in the service learning course, and how different types of service learning might be utilized to address various types of environmental issues.

There is currently a great need for more empirical studies that consider the outcomes of environmental service learning in college students and the means by which those outcomes can

be most effectively fostered. This study serves as a basis for future investigations in environmental service learning. Some results support the use of environmental service learning for some student populations, but not others. More work is needed in this area if environmental educators hope to more effectively impact REB in college students today.

REFERENCES

- Anderson, M. W., Teisl, M., Criner, G., Tisher, S., Smith, S., Hunter, M., et al. (2007). Attitude changes of undergraduate university students in general education courses. *JGE: The Journal of General Education*, 56, 149-168.
- Astin, A. W., Vogelgesang, L. J., Ikeda, E. K., & Yee, J. A. (2000). *How service learning affects students*. Los Angeles: Higher Education Research Institute.

- Astin, A. W., & Sax, L. J. (1998). How undergraduates are affected by service participation. *Journal of College Student Development, 39*, 251-263.
- Ballantyne, R., & Packer, J. (2005). Promoting environmentally sustainable attitudes and behavior through free-choice learning experiences: What is the state of the game? *Environmental Education Research, 11*, 281-295.
- Bandura A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review, 84*, 191-215.
- Bingle, R. G., & Hatcher, J. A., & McIntosh, R. E. (2006). Analyzing mortin's typology of service paradigms and integrity. *Michigan Journal of Community Service Learning, 13*, 5-15.
- Carver, R. L. (1997). Theoretical underpinnings of service learning. *Theory into Practice, 36*, 143-149.
- Covitt, B. A. (2002). Motivating environmentally responsible behavior through service-learning. In S. Billing & Furco (Eds.), *Service learning through a multidisciplinary lens* (pp. 177-197). Greenwich, CT: Information Age.
- Curry, J. M., Heffner, G., & Warners, D. (2002). Environmental service-learning: Social transformation through caring for a particular place. *Michigan Journal of Community Service Learning, 9*, 58-66.
- Eisenhut A., & Flannery, D. (2005). Fostering and environmental ethic through service learning. *Californian Journal of Health Promotion, 3*, 92-102.

- England, Y. A., & Marcinkowski, T. (2007). Environmental service-learning programs in florida high schools and colleges: Nature, status, and effects as determined by a statewide program census. *The Journal of Environmental Education, 38*, 51-60.
- Evangelopoulos, N., Sidorova, A., Riolli, L. (2003). Can service-learning help students appreciate and unpopular course?: A theoretical framework. *Michigan Journal of Community Service Learning, 9*, 15-24.
- Eyler, J. S. (2000). What do we most need to know about the impact of service-learning on student learning?. *Michigan Journal of Community Service Learning: Strategic Directions for Service-Learning Research, Special Issue*. 11-17.
- Eyler, J., Giles, D. E. Jr. (1999). *Where's the learning in service-learning*. San Francisco: Jossey-Bass.
- Eyler, J., Giles, D. E. Jr., Stenson, C. M., & Gray, C. J. (2001). *At a glance: What we know about the effects of service-learning on college students, faculty, institutions and communities, 1993-2000*. Nashville: Vanderbilt University.
- Follman, J. (2009). *Florida learn & serve application workshop* [Powerpoint slides]. Retrieved from <http://www.marylandpublicschools.org/NR/rdonlyres/86F7D7E3-8BEF-4F09-9DFE-6A21E9E657F2/.../ServiceLearning101Web2008.ppt>
- Haigh, M. J. (2006). Promoting environmental education for sustainable development: The value of links between higher education and non-governmental organizations (NGOs). *Journal of Geography in Higher Education, 30*, 327-349.

- Hines, J. M., Hungerford, H. R., & Tomera, A. N. (1986/87). Analysis and synthesis of research on responsible environmental behavior: A meta-analysis. *The Journal of Environmental Education*, 18(2), 1-8.
- Hsu, S. J. (2004). The effects of an environmental education program on responsible environmental behavior and associated environmental literacy variables in taiwanese college students. *The Journal of Environmental Education*, 35, 37-48
- Hsu, S. J. (1997). An assessment of environmental literacy and analysis of predictors of responsible environmental behavior held by secondary teachers in hualian county of Taiwan. Unpublished doctoral dissertation. The Ohio State University, Columbus.
- Hsu, S. J., & Roth, R. E. (1998). An assessment of environmental literacy and analysis of predictors of responsible environmental behavior held by secondary teachers in the hualien area of taiwan. *Environmental Education Research*, 4, 229-249.
- Hungerford, H. R., & Volk, T. L. (1990). Changing learner behavior through environmental education. *The Journal of Environmental Education*, 21, 8-22.
- Johnson-Pynn, J. S., & Johnson, L. R. (2005). Successes and challenges in east african conservation education. *The Journal of Environmental Education*, 36, 25-39.
- Kaplowitz, M. D., & Levine, R. (2005). How environmental knowledge measures up at a big ten university. *Environmental Education Research*, 11, 143-160.

- Kollmuss, A., & Agyeman, J. (2002). Mind the gap: Why do people act environmentally and what are the barriers to pro-environmental behavior? *Environmental Education Research*, 8, 241-260.
- McDonald, J., & Dominguez, L. (2005). Moving from content knowledge to engagement. *Journal of College Science Teaching*, 35, 18-22.
- McMillan, E. E., Wright, T., & Beazley, K. (2004). Impact of a university-level environmental studies class on students' values. *The Journal of Environmental Education*, 35, 19-27.
- Monroe, M. C., (2003). Two avenues for encouraging conservation behaviors. *Human Ecology Research*, 10, 113-125.
- Moody, G. L., & Hartel, P. G. (2007). Evaluating an environmental literacy requirement chosen as a method to produce environmentally literate university students. *International Journal of Sustainability in Higher Education*, 8, 355-370.
- Myers-Lipton, S. J. (1998). Effect of a comprehensive service-learning program on college students' civic responsibility. *Teaching Sociology*, 26, 243-258.
- National Environmental Education & Training Foundation (NEETF). (2005). *Environmental literacy in america: What ten years of neetf/roper research and related studies say about environmental literacy in the u.s.* Washington D.C.: Coyle, K
- Orr, D. W. (1992). *Ecological literacy: Education and the transition to a postmodern world.* Albany, N.Y.: State University of New York Press.

- Rickinson, M. (2006). Researching and understanding environmental learning: Hopes for the next 10 years. *Environmental Education Research, 12*, 445-457.
- Ross, M. (2006). How do communities change their culture towards more sustainable patterns of living, working, and learning?. Kelowna, BC: University of British Columbia, Okanagan.
- Rowe, D. (2002). Environmental literacy and sustainability as core requirements: Success stories and models. In W.L. Filho (Ed.), *Teaching Sustainability at Universities* (79-103). New York: Peter Lang.
- Schneller, J. A. (2008). Environmental service learning: Outcomes of innovative pedagogy in baja california sur, mexico. *The Journal of Environmental Education, 14*, 291-307.
- Sia, A. P., Hungerford, H. R., & Tomera, A. N. (1985/86). Selected predictors of responsible environmental behavior: An analysis. *The Journal of Environmental Education, 17*, 31-40.
- Smith-Sebasto, N. J., & Fortner, R. (1994). The environmental action index. *The Journal of Environmental Education, 25*, 23-30.
- Smith-Sebasto, N. (1995). The effects of an environmental studies course on selected variables related to environmentally responsible behavior. *Journal of Environmental Education, 26*, 30-34.
- Thapa, B. (1999). Environmentalism: The relation of environmental attitudes and environmentally responsible behaviors among undergraduate students. *Bulletin of Science, Technology & Society, 9*, 426-438.

- Ward, H. (1999). *Acting locally: Concepts and models for service-learning in environmental studies*. Washington D.C.: American Association for Higher Education.
- Wilke, R. (1995). Environmental literacy and the college curriculum: Colleges and universities have a challenge to meet. *EPA Journal*, 21, 28.
- Wolfe, V. L. (2001). A survey of the environmental education of students in non-environmental majors at four-year institutions in the USA. *International Journal of Sustainability in Higher Education*, 4, 301-315.
- Wutzdorff, A. J., Giles, D. E. (1997). Service learning in higher education. In J. Schine (Ed.), *Service learning: Ninety-sixth yearbook of the national society for the study of education* (pp. 105-117). Chicago: University of Chicago Press.
- Zlotkowski, E. (2000). Service-learning research in the disciplines. *Michigan Journal of Community Service Learning: Strategic Directions for Service-Learning Research, Special Issue*, 61-67.

FIGURES

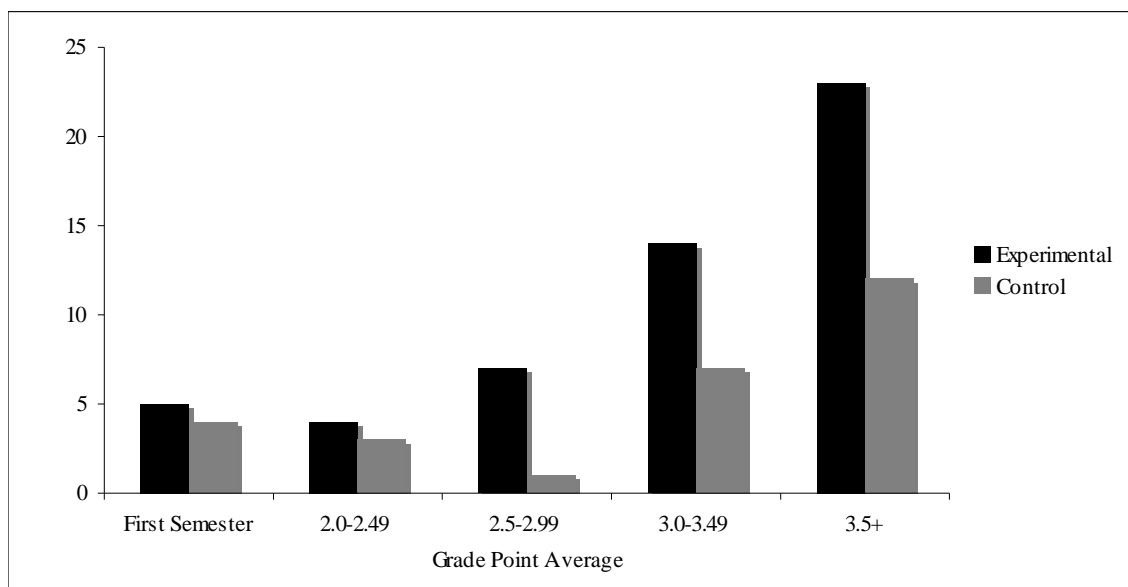


Figure 1. Grade point average frequencies of students in both experimental and control sections

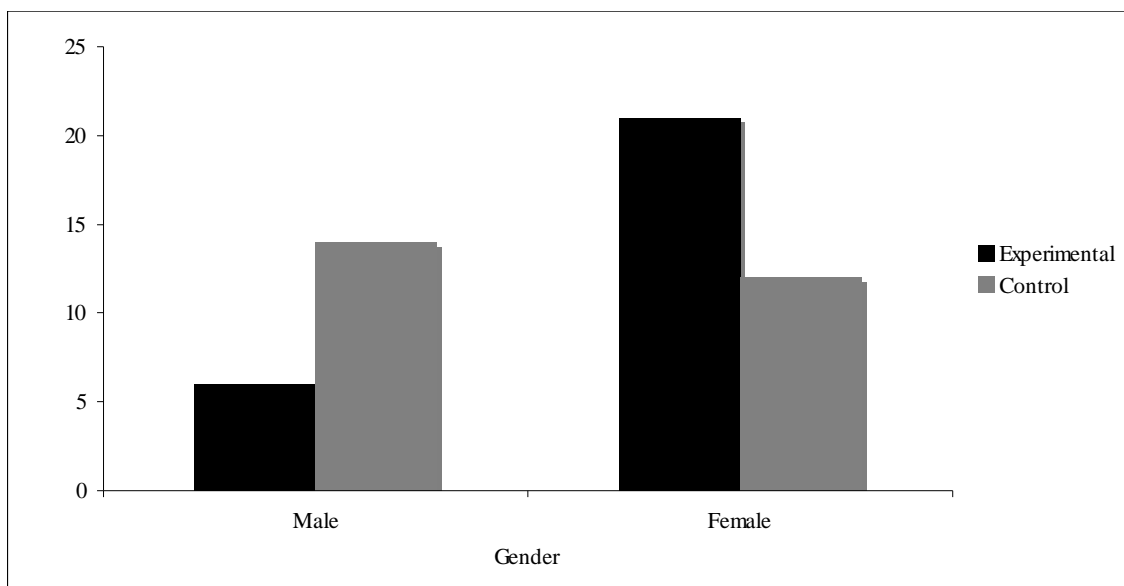


Figure 2. Student frequencies for gender in both experimental and control sections

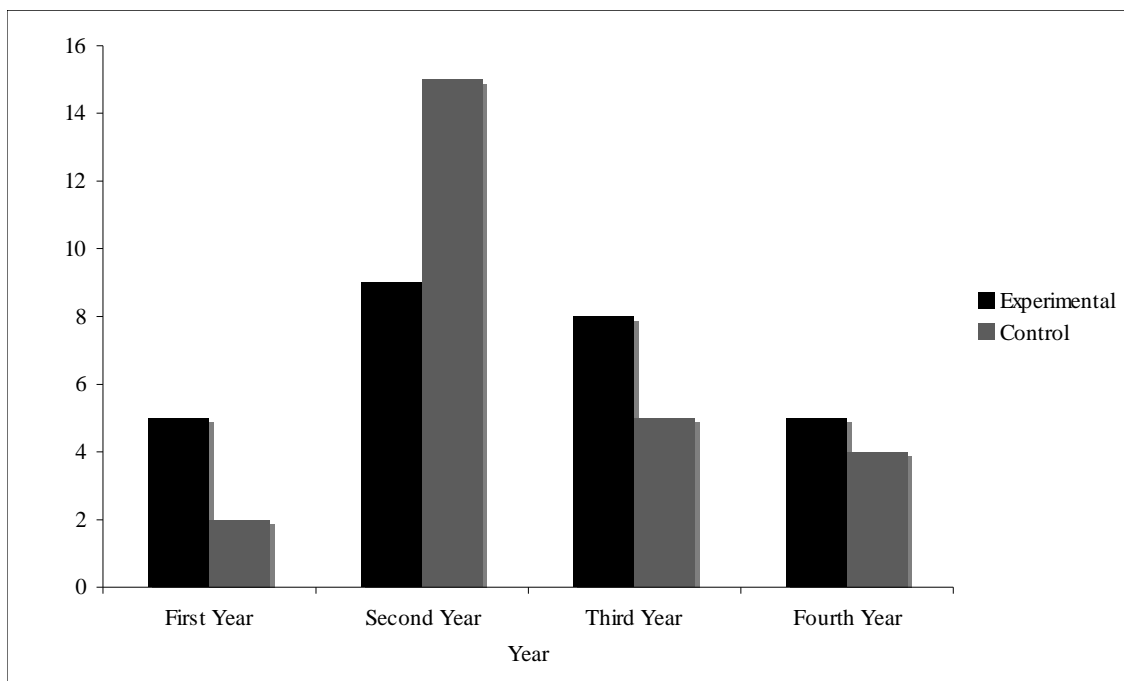


Figure 3. Student frequencies for year in college for both experimental and control sections

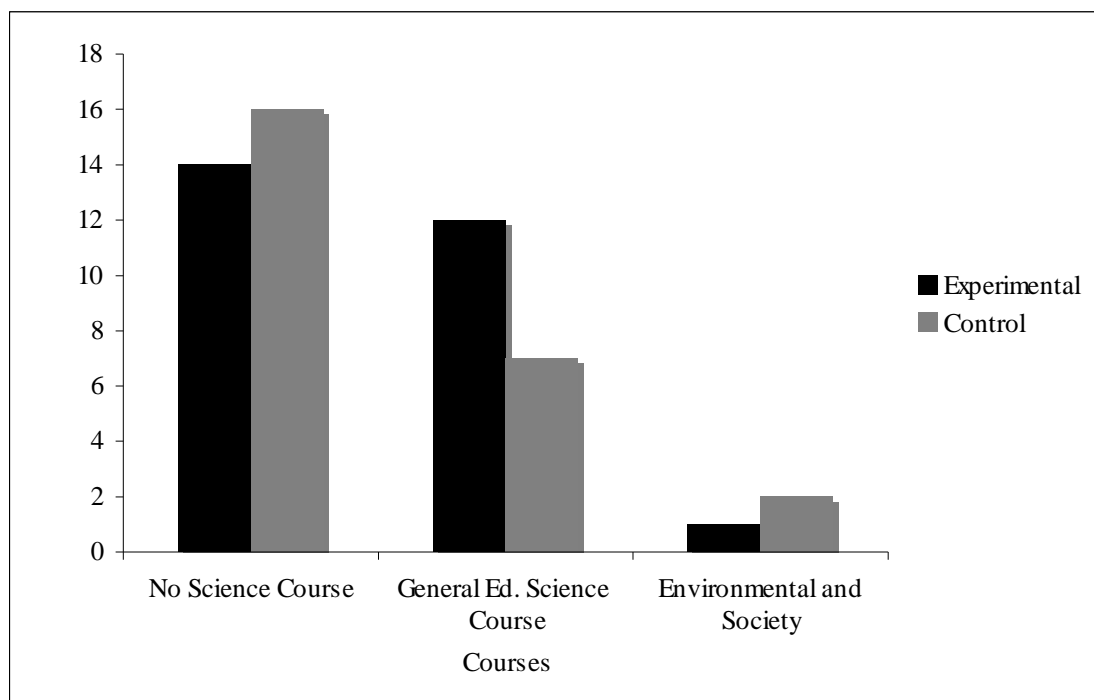


Figure 4. Student frequencies for science courses taken in college for both experimental and control sections

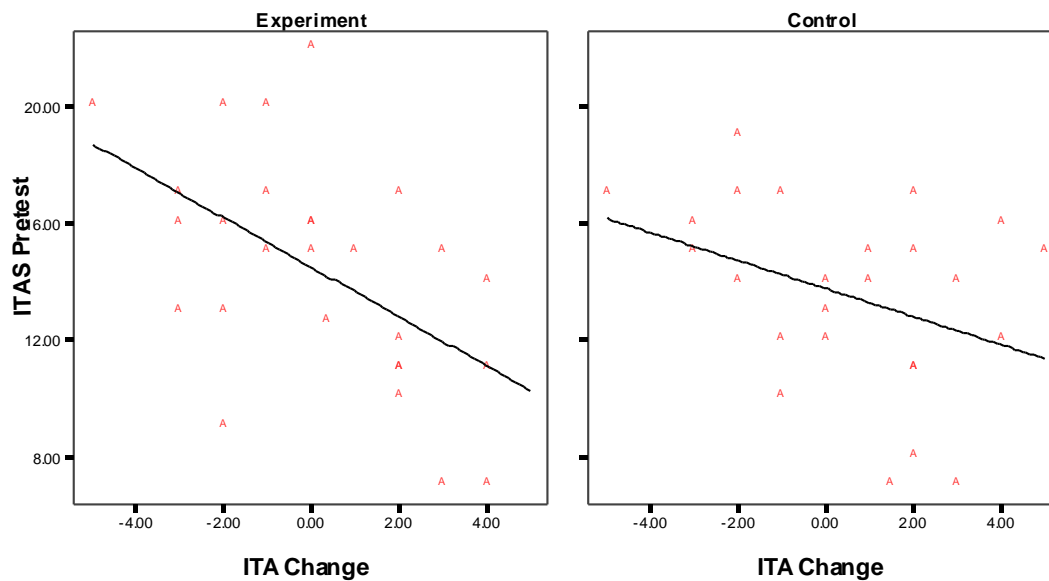


Figure 5. Experimental and control results for the ITAS. The experimental graph indicates a strong negative correlation between student pretest scores and change scores.

APPENDIX: INSTRUMENT

Survey for use in CHEM 100 Chemistry For Living course
October 2008

Rights and Obligations

This survey is meant to measure how you feel about different aspects of the environment. By taking this survey, you are consenting to be a participant in this study. However, you do have the option to not participate, and may opt out at any time. You will not be penalized in any way for doing so. All personal information will be kept confidential.

Demographic Information

ID Number: _____

Age: _____

Gender: M F

Ethnicity/Race: African-America American Indian/Alaskan Native Asian or Pacific Islander
Caucasian/White Hispanic Other race
Prefer not respond

Year: Fr So Jr Sr

Major: _____

Minor: _____

Current GPA: 3.5 or above 3.0-3.49 2.5-2.99 2.0-2.49 1.99 or below First Semester

Have you taken any other science or environmental science related courses in college? If so, please list them below.

INSTRUCTIONS

Please read the partial statement in bold letters below followed by the action described after each number. Then, carefully fill the choice on the answer sheet which best indicates how strongly you agree or disagree with the **whole** statement.

Please respond to **every** statement with **only one** choice.

KEY: 1 = Strongly Disagree; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Strongly Agree

My individual actions would improve the quality of the environment if I were to...	
1. ...learn about the recycling facilities in my area.	1 2 3 4 5
2. ...attend a community meeting that involves concern over a local environmental issue.	1 2 3 4 5
3. ...buy resource conservation devices, such as low-flow faucet aerators for my sinks and low-flow shower heads.	1 2 3 4 5
4. ...buy products packaged in containers that either can be reused or recycled or are made of recycled materials.	1 2 3 4 5
5. ...report someone who violates a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.	1 2 3 4 5
6. ...report someone who tampers with the anti-pollution devices on a car to the proper authorities.	1 2 3 4 5
7. ...reduce the amount of my household trash by reusing or recycling items to the fullest extent possible.	1 2 3 4 5
8. ...set my home appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.	1 2 3 4 5
9. ...take my old tires to a recycling center.	1 2 3 4 5
10. ...carpool instead of driving alone.	1 2 3 4 5
11. ...open windows for ventilation rather than using a fan or air conditioner.	1 2 3 4 5
12. ...convince someone to boycott a store that sells products that damage the environment.	1 2 3 4 5
13. ...convince someone to sign a petition regarding an environmental issue.	1 2 3 4 5
14. ...convince someone to learn about the recycling facilities in her/his area.	1 2 3 4 5
15. ...convince someone to have a home 'energy audit' to find the heat leaks in her/his house or apartment.	1 2 3 4 5
16. ...convince someone to obtain a copy of the League of Conservation Voters' <i>Environmental Scorecard</i> .	1 2 3 4 5
KEY 1 = Strongly Disagree; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Strongly Agree	

My individual actions would improve the quality of the environment if I were to...

17. ...convince someone to buy household cleaning and/or laundry products that don't harm the environment.	1 2 3 4 5
--	-----------

18. ...convince someone to buy fruits and vegetables loose rather than in plastic bags.	1	2	3	4	5
19. ...convince someone to buy products packaged in containers that either can be reused or recycled or are made of recycled materials.	1	2	3	4	5
20. ...convince someone to report someone who violated a law or laws that protect our natural resources (e.g., illegal fishing, hunting, or trapping or illegal tree cutting) to the proper authorities.	1	2	3	4	5
21. ...convince someone to reuse envelopes by putting a label over the old address.	1	2	3	4	5
22. ...convince someone to set her/his household appliances, such as the refrigerator, dishwasher, water heater, etc. to 'energy saver' levels.	1	2	3	4	5
23. ...convince someone to keep her/his car tires properly inflated.	1	2	3	4	5
24. ...convince someone to take old tires to a recycling center.	1	2	3	4	5
25. ...convince someone to conserve water by not running the water while brushing her/his teeth or shaving and/or installing a water saving device in the tank of her/his toilet(s).	1	2	3	4	5
26. ...convince someone to avoid idling her/his car unnecessarily.	1	2	3	4	5
27. ...convince someone to reduce the amount he/she drives her/his car by carpooling instead of driving alone and/or driving only when necessary.	1	2	3	4	5
28. ...convince someone to reduce the amount of her/his household trash by reusing or recycling items to the fullest extent possible.	1	2	3	4	5

INSTRUCTIONS

This section is to ask you how you feel about different aspects of the environment.
Please circle the number that best reflects how you feel

	No	A great
--	----	---------

	extent			extent	
1. To what extent do you believe that you are <u>willing</u> to make use of those environmental actions in which people work directly with the natural world (i.g., recycling; planting trees or flowers; energy conservation; garbage reduction) to help prevent or resolve environmental problems?	1	2	3	4	5
2. To what extent do you believe that you are <u>willing</u> to make use of those environmental actions in which people make use of consumer/economic actions (e.g., avoid buying products which cause pollution; paying membership fees or donating money to environmental groups) to help prevent or resolve environmental problems?	1	2	3	4	5
3. To what extent do you believe that you are <u>willing</u> to make use of <u>persuasion</u> to help prevent or resolve environmental problems?	1	2	3	4	5
4. To what extent do you believe that you are willing to make use of <u>political action</u> (e.g., voting for a “pro” environment candidate; writing or calling elected officials persuading them to support environmental protection) to help prevent or resolve environmental problems?	1	2	3	4	5
5. To what extent do you believe that you are willing to make use of <u>legal action</u> (e.g., reporting pollution violations or illegal cultivating to authorities) to help prevent or resolve environmental problems?	1	2	3	4	5

THANK YOU