WORCESTER POLYTECHNIC INSTITUTE

# A Study on the Sustainable Classroom Contract

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## Abstract

*Large amounts of resources are consumed in the classroom. The Sustainable Classroom Contract is designed to help conservation by setting up guidelines for students to follow. A study was conducted at Worcester Polytechnic Institute during B term 2012. Ten classes were divided into an experimental group who signed the contract and a control group who saw the guidelines but did not sign the contract. Students' attitudes and behaviors were measured quantitatively through two surveys which were taken at the beginning and end of the term. Analyses concluded that students in the experimental group did not improve their attitudes and behavior. Although the contract showed no evidence to benefit the environment in this study, the Sustainable Classroom Contract is still worth further investigation.*

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## Introduction

Everything humans do in their everyday lives can affect the environment. Many people change little things they do around the house in order to do their part to help the environment, such as buying green dish soap or making sure all their bottles end up in the recycling bin. There has been a lot of research done on these sorts of decisions and many programs have been put into place to help educate people about the environment and the things they can do to help it. There are many organizations dedicated to spreading the word about the environmental crisis, such as the National Environmental Education and Training Foundation and the Environmental Literacy Council.

Most of the people thinking about their carbon footprint and going green are homeowners. They usually have the easiest things to fix too. For example, properly insulating a house can reduce the heating and cooling bill by 10 percent (Hopley, 2009) and putting less energy or fossil fuels into heating is a great way to help the environment. Planting trees for shade and installing solar panels are also fantastic ways for homeowners to help the environment (Hopley, 2009).

Many other fixes can be done by homeowners and renters alike. Opening the blinds during the day lets in heat and closing them at night keeps the heat in. Using power strips that can be turned off when things aren't in use

and installing more efficient light bulbs can reduce the amount of energy used significantly (Hopley, 2009).

Changing their home is a great way for people to help save the environment but is it really enough? Outside of the home people still use energy and fossil fuels. The car, the air conditioner at work, the computers and phones in the office; they all use energy. What about at school?

A school setting is somewhat similar to an office setting when one is trying to reduce their energy consumption. As we discover new technology, more convenient yet energy consuming alternatives to how students currently study are emerging. Homework that is done entirely electronically can be convenient, but that means that the student must do it on the computer when they might not otherwise be using one. Late nights can lead to not caring how to dispose of a recyclable coffee cup, and long non-captivating lectures can lead to cell phone or other unnecessary electronic use.

The sustainable classroom contract, originally developed by St. Michael's College in VT, gives students and teachers the opportunity to change their behavior in the classroom to help the environment. The contract is a social contract that presents the students and professor in a class with a set of guidelines to follow while in the classroom and while studying at home. In theory, signing the contract adds social pressure on the signers to keep their agreement. The study was conducted to see if the idea of implementing

classroom contracts would cause a notable change in the environmental behavior and attitudes of students at Worcester Polytechnic Institute.

## Background

The investigators conducting the study started by doing research before beginning the study. All relevant research was included in this section. This research ensured that the study was not repetitive as well as ensuring that the criteria on the sustainable classroom contract would help the environment in the most effective ways.

Each item on this version of the Sustainable Classroom Contract has been hand selected and researched to make sure that the contract contains the most effective changes a student and Professor can make to cause a true effect on the environment.

The original Sustainable Classroom Contract developed at St. Michaels College was an idea that was greatly the work of the anthropology and gender studies professor Patricia Delaney. The contract was an idea instituted into one class but then quickly spread to other classrooms at the school. As Professor Delaney wrote to WPI student investigators, “The original idea for the sustainable classroom compact emerged in my class on “Sustainable Development”. Since this class focused on development outside the US, I was looking for ways to connect it to the realities of life in Vermont. As part of that process, my students completed field trips to various projects in our state … … Based on that experience, I think students on our Environmental Council (a volunteer group of faculty, staff, and students) decided to

adopt it campus wide. I do not know if any research has been done to determine the effectiveness of the contracts on our campus."

The first criterion that was set forth in the original classroom contract developed by St. Michaels College is not as clear cut as it may seem. The original wording was "No disposable containers allowed in the classroom (i.e. paper coffee cups and plastic water bottles). Instead, students and professors should consider bringing their own reusable mugs, bottles, or food containers". Upon investigation, it found that using a ceramic mug as opposed to a Styrofoam or plastic disposable cup was significantly less energy efficient. If a high efficiency dishwasher is used, the energy to use one ceramic mug and to wash it after each use would equal the amount of energy to consume 39 paper cups or 1009 Styrofoam cups. (Hocking, 1994). Bottled water in general is terribly energy consuming and bad for the environment. The process of transporting bottled water actually pollutes more water in the environment than is being transported in the bottles (Why use).

Due to most college students not having a high efficiency dishwasher, these numbers would be even higher, and possibly would never break even. This meant that it came down to a tradeoff of less waste versus less energy, and thus it was decided that the contract should focus on the more clear cut advantage of focusing on reusable water bottles. It was found that asking students to use reusable water bottles instead of plastic disposable bottles was a criteria that not only had few drawbacks (as most

college students would not wash a water bottle after each use, unlike reusable mugs), but also made a relatively large impact. For this reason, it was decided that it would be more beneficial to modify the original criteria created by Saint Michaels to reflect these findings.

Turning off lights in the classroom is one of the most effective ways to save energy and thus it was incorporated into the Sustainable Classroom Contract. Some individuals flip the lights on as soon as they enter a room. It is okay to turn the light on during a lecture or conference, but it is a problem when they are not turned off after the class. This is something that occurs in almost every classroom on campus. People have begun to take lighting for granted. Even when there is natural daylight shining in through the windows, it has become a habit to switch the light switch on. Using light that are not needed is a habit that needs to be broken in order to conserve energy. A normal bulb will use 60 watts of energy an hour, meaning that a single person could conserve nearly 22,000 watts of energy per year by just switching off one bulb for one hour every day. That's enough energy to power a television for a month. Just a little effort here and there can add up to make a large difference. It is important for people to remember to use lighting only when they need it. If it is the middle of the day and sunny outside, the windows should provide sufficient lighting. Of course in situations where windows are not available it is okay to use lights. Those individuals, though, who turn the light on regardless of where they are, need to break

that habit (When, 2012). The Sustainable Classroom Contract asks students to turn off the lights if they are the last one to leave the classroom (assuming the classroom has a light switch and is not motion activated) so that energy will not be wasted if there is no class in that room the following hour. The contract also asks teachers to only use lights that are necessary, requiring them to break the habit of using lights when there is plenty of sunlight coming through the windows. These habits should be easy to break and can make a big impact for the environment over time.

Another habit that students were asked to break is that of not using both sides of notebook paper. Often students will start a new day of notes on a new paper even though they barely used the paper from the previous day. Students also rarely print anything double sided even though it only takes a few extra seconds of effort. The contract suggests using both sides of notebook paper when taking notes, and to print double sided when possible. This criterion is relatively easy to follow, and there are no real drawbacks considering it'd save the student money, as well as reducing the amount of paper used and thus the amount of waste. The only drawback to consider in asking students to print double sided is that printers that are able to print double sided automatically can cost more and have a slightly lower life expectancy (L. Frye, T. Phillips et. all, 2007). As most if not all of the printers currently in the WPI library have duplex printing this should not be considered a drawback, and if a student prints on another printer and the extra cost poses to be a problem, they still have the ability

to manually print double sided, and thus the benefits of printing double sided vastly outweighs the drawbacks. Even though it seems like a simple thing to do, saving paper has a huge impact on the environment. The average person in the United States uses 27 pounds of paper every year.< http://www.cleanair.org/Waste/wasteFacts.html > Using both sides of the paper could cut that number in half! Even little changes add up to make a big difference.

As long as students follow the guidelines for using both sides of notebook paper, note taking on paper should be preferable to electronic notes. A laptop computer[1] having specifications close to that of WPI's recommended laptops specifications[2] would use on average approximately 48.5 watts. Thus, an average laptop in a 50 minute class period would use approximately 14.5 kJ of power. Most if not all of this power could be saved if students were to take notes on paper as opposed to on laptops.

Turning off the computer while studying is another effective way to help the environment. A typical desktop computer uses about 65 to 250 watts. Add another 15-70 watts for an LCD monitor, or about 80 watts if one has an old-school 17" CRT.

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[1] A Lenovo ThinkPad T410s with a 14 inch screen, 2.4 GHz Core i5, 4.0 GB RAM, 128 GB solid state drive, Windows 7 Ultimate

[2] http://www.wpi.edu/academics/CCC/Student/#computer

Most laptop computers use about 15-60 watts, far less than desktops. In particular, the amount of electricity a computer uses significantly increases when it is connected to the Internet. As long as a computer goes into sleep/standby when not in use, the computer doesn't use nearly as much electricity. People should absolutely make sure that their computers are set to sleep automatically after 15 minutes or so when they are not using them (Saving, 2012).

The same reasoning is used for the professor agreement to use whiteboards as opposed to PowerPoint. The computer and the projector both use a significant amount of energy and a simple solution is to use the reusable methods already available in the classroom such as whiteboards and chalkboards.

Another easy way for students to save energy while in school is to take the stairs to class rather than the elevator. An elevator consumes 2.5 Watt hours per floor (one direction, 3 meters). That is approximately 1/2 the amount of energy it takes to recharge a cell phone battery. If an elevator of a 3-storey building goes 80 round trips every day, the electricity it consumes is about how much a desktop computer and monitor use running for 2 hours. If you were to walk up and down 3 flights of stairs instead of an elevator, you would save 15 Watt-hour a day or 450 Watt-hour a month. That would be enough to power a 37" Plasma TV for 3 hours (Fat, 2007).

The most classic way to help the environment is by recycling. There are recycling bins in almost every classroom for both paper and plastic, but people often

don't use them. One hundred tons of wood could be saved each year if every American recycled their paper. Unfortunately, 80% of Americans throw away recyclables rather than putting them in the proper bin. Poor waste management has caused the creation of the great Pacific Garbage Patch which is now twice the size of Texas! Much of the island is made of plastic and all of the trash is hazardous to sea life. Recycling can help keep that garbage patch from growing. These criteria are determined to be the most effective ways for a classroom to help the environment and thus they are the ones to end up in the final Sustainable Classroom Contract used for this study.

By asking the professor to also follow the criteria, students will be helped in a variety of ways. First off, if the professor also follows the criteria, he or she can create prompts to remind the students what they should be doing. Prompts are actions, phrases, or objects that help remind or inspire people to behave in a certain way, in our case to be more environmentally friendly. An example of a subtle prompt would be to make sure that trashcans are in a visible area, so that people are reminded to use them. (Mckenzie-Mohr, 1999). This is also part of the reason why professors were asked to use environmental examples when possible in their lectures. When professors use an environmental example, it will help keep the contract and the concept of being environmentally friendly in the students' minds. The other way that having the professor follow the criteria can help the students in changing their

environmental behavior is by establishing a norm. A norm is what we perceive as normal, or how we should behave. For example, if we see many others throwing recyclable bottles in the trash instead of putting it in the correct receptacle, we are more likely to act in a similar fashion. The opposite also holds true. (Mckenzie-Mohr, 1999). Establishing a norm is achieved when students see the professor following one of the criteria. This makes it seem like the right thing to do, along with providing them something to conform to. Establishing a norm has a very strong influence on the students and should make them more apt to follow the contract (Mckenzie Mohr, 1999).

The second criterion that was asked of professors was to limit the use of paper handouts. This was due to personal observation that many students would immediately tuck away paper handouts in their backpacks or folders and would never look at them, resulting in unnecessary paper waste. This criteria could be implemented in a number of ways, from only printing out handouts when absolutely necessary (and to try to compress them into as few pages as possible by modifying margins and using other techniques), to other creative ways such as, if normally only half of the page would be used, print out two handouts per page and cutting them apart etc.

Appending this criterion to recommend putting all handouts online was considered, but it was concluded that this might not be the most environmentally

friendly option. Paper is a renewable resource, and produces little waste (when recycled, which was assumed due to recycling being one of the criteria of the classroom contract), compared to the energy required to view the handout online, which may come from non-renewable resources. If handouts were online, it would encourage students to have their computer on when they may otherwise not need it on, thus resulting in wasted energy. Finally, some students might have printed out the handout anyways, resulting in an even greater loss in energy.

It is expected that a classroom that has the option to sign the classroom contract will see a significant increase in environmentally friendly activity when compared to classrooms that are simply presented with the information without signing or to classrooms that are not given any information at all. This is due to the fact that the act of signing the contract will establish a social norm, along with bringing up the possibility for so-called "public shaming".

Students will be given two opportunities to sign the classroom contract. Giving the students to see the contract a second time is to serve two purposes. First, it is so that if they signed the contract the first time around, they are able to see how many other people have signed it. This is an attempt to establish a social norm. This makes signing the social contract the "right thing to do", which will encourage students to sign and follow it. If the students did not sign it the first time around, seeing the list of names of people who have already signed will encourage them to

sign it as well, as to conform to the norm. Also, being able to see who has already signed it will help enforce the “public shaming” aspect. The concept of public shaming is that students will know that other people have seen them sign the contract, and they will want themselves to appear to be men/women of their word, giving them an incentive to follow it, else be “shamed” (Mckenzie Mohr, 1999).

# Methodology

## Methodology Background

Statistically, the experiment will use both within-subjects design and between-subjects design. Within-subjects design is a statistical design in which the research participants generate two or more measures, while in a between-subjects design the research participants are exposed to one treatment each. Within-subjects design examines whether students in the experimental group develop more sustainable behavior and attitude after signing the contract. Between-subject design examines how influential signing the contract is to students' behavior and attitude, and how professors' attitudes towards the contract affect students. The first control group will only take a survey at the end of the term and will not be asked to change their behavior in any way. The second control group will be given surveys at the beginning and the end of the term, along with the classroom contract guidelines (with no place to sign) and educational materials but will not be asked to sign the contract. The experimental group will be given surveys at the beginning and the end of the term, along with the educational materials and the classroom contract, which they will be asked to sign if they wish to participate.

Ideally, probability sampling is to be drawn from the courses offered in B term, and simple random sampling is the most basic form of probability sampling. Probability sampling brings two major advantages; first, when a probability sampling method has been used, investigators can assure that the selected sample is representative of the population (in this study, the population will be all WPI students and faculty) from which it was drawn. Second, a probability sampling permits investigators to easily estimate the parameters of the population from the statistics of the selected sample. “However, in practice, simple random sampling is relatively difficult and costly to execute its main disadvantage is that it requires that all members of the population be identified so that elements can be independently and directly selected from the full population listing (the sampling frame). Once this has been accomplished, the simple random sample is drawn from the frame by applying a series of random numbers that lead to certain elements being chosen and others not. In many cases, it is impossible or impractical to enumerate every element of the population of interest, which rules out simple random sampling.” (Visser).

In this study, up to 45 classes with an ideal size of 30-40 students will be selected from a pool of classes taught by volunteer professors from the WPI main campus. Obviously, this is not a simple random sample, since volunteer subjects will be involved in the experiment. However, the prerequisite of simple random sampling is still assumed to be held. This is because investigators cannot expect every professor

to be willing to participate in the study. Thus, classes cannot be chosen randomly. Either way, the only subjects participating will be the voluntary professors with an ideal class size and their students. Although the sample is not randomly selected, all students take at least three classes, either large or small, in a single term, which is the duration of the experiment. Hence, it can be said that the selected students form a simple random sample, whose corresponding population is all WPI undergraduate students. Class size acts as a tool for investigators to better manage and communicate with student participants.

In contrast, the professor participants construct an opportunity sample, which means the first available units. In this study, the use of volunteer subjects may lead to biased conclusions in any statistical test. The professor sample is not a simple random sample representing all voluntary professors either, since professors with less ideal class size are excluded in the study. Therefore, it cannot be examined by general statistical tests whether professors in the experimental group develop more sustainable behavior and attitude after signing the contract.

## Initial research and handout creation

Before the study could be conducted, first initial research and the creation of the handouts to be distributed during the first visitation were needed. First, the student investigators familiarized themselves with the Sustainable Classroom Contract as laid out by Saint Michael's College. This included contacting the investigators

there and asking what (if any) research had been done in its creation, as well as seeing if others had done projects with a similar goal as this one.

The responses received indicated that the creators at Saint Michael's College had not done extensive research on the criteria selection, and thus it was deemed necessary to conduct further research to make sure that each criterion was actually environmentally friendly, and had a noticeable impact on energy consumed or the amount of waste. Some of the criteria originally set forth were deemed to be either potentially not environmentally friendly, or not have a significant impact (such as asking students to turn in assignments electronically) and were chosen to be excluded.

As they were going to be the primary source of information regarding the study, much time and research was put into the design on the surveys. Preliminary research was conducted by going over publicly available environmental attitude and behavior surveys, and investigating common trends and questions in them. It was decided that the surveys should be split into two distinct sections: an attitude section and a behavior section. The attitude sections questions were created from questions that closely resembled attitudes that might impact or be impacted by potential behavior changes induced by the contract. The behavior section simply asked how well each student thought they were following the criteria set forth in the contract. The behavior questions were asked twice on the pre-survey and three times on the post-survey, each time in regards to a different area (Inside class and out of class in

general for the pre-survey, and inside this class, inside other classes and outside of class for the post-survey). This was an attempt to isolate the impact caused by the classroom contract from other factors (such as the weather getting colder).

## Professor Selection

At the end of fall break, an email was sent from Professor Doyle to selected faculty who would have lectures in B term, asking for volunteers who would be willing to have at least one of their classes participate in the study. Initially, only a small number of professors responded, and thus Professor Doyle sent a second email in attempt to get more professors to respond. While looking for professors to participate in the study, the following criteria were favored: (1) had at most 50 students in their class, (2) their class was a good representative of a mix of majors or class years.

Initially the study was constructed to have three different groups: an experimental group that was given an opportunity to sign the classroom contract, a control group that was given an opportunity to read but not sign the classroom contract, and a control group that was not given an opportunity to read the classroom contract. Due to the small number of responses, the structure was changed such that only the experimental group signing the contract and the control group that was able to read the contract were kept. Due to only nine professors participating, it was deemed to be impractical to assign classes to groups in a truly random fashion. To

assign classes, first, the professor's classes were randomly assigned to be control or experimental (making sure that if a professor taught multiple classes, all of their classes would be in the same category), then classes were switched to make sure that both of the groups had a similar total number of students, and a similar subject makeup (for example, so that not all of the environmental classes were in the experimental group). Survey-taking dates were scheduled with participating professors as soon as two groups were set up, keeping in mind that dates closer to the start of term were preferred.

Nine professors' responses were received by the end of Oct. 23, the first day of B term. Due to only having nine professors respond to the canvasing, it was concluded that having all ten classes participate, and thus having a larger sample size outweighed the disadvantages of permitting classes that did not fit the ideal criteria. Professors were then contacted by email to set up times for researchers to either give them the materials to hand out in class, or for the student researchers to come into their class to distribute the materials.

## Initial classroom visitations (Pre-survey)

During the first week of B term, researchers went to all ten classes explaining the study with the assistance of professors. The participants in both experimental and control classes were told that their class had been chosen for participation in a strictly voluntary study examining people's attitudes and behaviors towards the environment,

and how that could be changed. After that, professors handed out the pre-study survey and educational material to their students. An informed consent form (seen in Appendix B1) was also passed out to detail the study to the students and inform them of their rights. The informed consent detailed the study and made it clear that the students were not required to take the survey or to answer any questions that they didn't feel comfortable answering. The professors in the experimental group then handed out the Sustainable Classroom Contracts to the students and gave them a chance to sign the contract. Another chance was given in a future lecture in case there were people who registered for class late or did not attend the first day of signing. This also gave people who were unsure if they should sign a chance to see how many other people signed up and encourage them to sign. Finally, it provided another opportunity for people to reconsider if they had not signed the contract during the first opportunity. The control group was given the same guidelines as the experimental group but not asked to make a public commitment by signing. In order to conduct the surveys, the student investigators had to go through the IRB application process to make sure no human rights were violated during the study. This involved the student investigators taking an online course about human rights and how to protect them while conducting a study. Full documents distributed can be seen in Appendix B along with the IRB application in Appendix D.

## Data Entry

Transferring survey information into Excel took two weeks. All data were kept in a single excel book, with a different excel sheet for each class. The excel sheets contained a header column with the questions asked on the survey, and then a column for each student that had filled out the survey. The descriptive scale "Never - … - Every time" was converted to a numerical scale, where 1 represented "Never", and 5 represented the "Every time". A 0 or a * was entered to represent "not applicable", and hyphens were entered for answers left blank. If two answers were circled, the average of the two equivalent numerical values were entered. In the case where there was no equivalent numerical value (such as circling two races), or information was written in (such as other for gender), the multiple values or written in response was entered.

Some elementary data manipulation was conducted based on the raw data pre-survey response. For each question, distribution tables and line graphs were made for all classes and both groups. For each question, calculated averages were found for all classes and both groups, and histograms were made for both groups. For each person, an average was taken of the answers of questions 1-6 to get his/her attitude mean, and an average was taken of answers to questions 7-19 to get his/her behavior mean. Answers of zero and unavailable answers were excluded when taking averages.

Some answers were adjusted before regression analysis such that 1-5 scale reflected least to most environmental friendliness for all questions. Scatter plots were

made and regression lines were added for both groups, where attitude is the independent variable and behavior is the dependent variable. Four comparisons of two means were conducted and they were tested based on the adjusted data; they were behavior means of both groups, altitude means of both groups, behavior means of both genders and attitude means of both genders.

## Classroom Observations

The first set of observations was conducted during the week before Thanksgiving break. The student investigators sat in on the classes to see the extent to which participants followed the contract's guidelines. During the class the number of people directly following or not following the criteria on the classroom contract, along with actions that the professor took regarding their portion of the contract were noted into the Classroom Critique Sheet, a blank copy of which can be seen in Appendix C. The critique sheet was designed to include all observable behaviors from the contract, such as bringing a reusable water bottle to class. Points were given to each class for the number of people who followed each guideline and taken away for each person who did not. Many of the things on the contract however were not observable and therefore relied on self-reporting to determine whether students were adhering to them or not. The second sets of observations were conducted three weeks later, during the 2nd to last week of the term. The procedure followed was identical

to that of the first. One professor had class during a time at which none of the student investigators were available, and thus they filled out the sheet instead.

**Second classroom visitations (Post-survey)**

At the end of the term, the post-study follow up survey was handed out to all participants in the same manner that the pre-study survey was. This survey repeated the questions on the pre-study survey, along with asking the students how they thought they did at following the classroom contract in their current class, other classes, and outside of class. It also asked if they felt there was any outside influence (such as other projects) that impacted their behavior. A survey was also distributed to the professors, asking them how well they thought their class did at following the guidelines, and how many actions they took that may have impacted their student's performance. This survey can be seen in Appendix B5 and Appendix B6.

The second classroom visitation did not go as smoothly as the first had. This was attributed to it being during finals week, and also due to the fact that if something went wrong there was little time to schedule a make-up visit. One of the professors in the study (who taught two out of the five control group classes) became ill, and thus an online survey had to be conducted. This was done by creating a Google Forum that contained the same questions in the same order as the regular post-survey. Then, the professor emailed out a link to each class asking them to take the survey. (It should be noted that there were two separate surveys, as to distinguish between the

classes). Because the response received was not as much as initially hoped for (zero responses from one class, and only three from the other), after two weeks the professor sent out the link and asked their class again to please take the survey if they had not already. This resulted in more (although still not ideal) results of six from each class.

Another professor's class was not available to take the post-survey, and an online survey was conducted in a manner similar to the above. In this case, a more favorable response (11 students) was obtained after the professor emailing their class only once, and thus they did not email their class a second time unlike the first professor mentioned.

## Data Analysis

Once all of the post-surveys had been collected, the data collected from both post and pre-surveys were analyzed. The main questions that the analysis tried to answer were as follows: (1) Is there any difference between the control and the experimental group in the pre-survey? (2) Is there any difference between the control and the experimental group in the post-survey? (3) Is there any difference between the control and the experimental group's change in response between the post-survey and the pre-survey? (4) Is there any difference between experimental survey responses who signed the contract versus who did not sign the contract? (5) Did students who changed their behavior in class also change their behavior outside of class?

Demographics were also analyzed, specifically seeing if there was any difference between genders when it came to behavior means of pre and post-surveys.

The enrollment data for each class can be seen in Table 1.

**Table 1: Class enrollment and participation**

| Number | Beginning of B term | | | End of B term | |
|---|---|---|---|---|---|
| | Enrollment | Taking survey | Signing contract | Enrollment | Taking survey |
| **PSY1401** | 50 | 37 | | 51 | 30 |
| **PSY1402** | 40 | 38 | 38 | 37 | 30 |
| **ENV1100** | 47 | 44 | 31 | 49 | 10 |
| **MA1022** | 27 | 23 | 26 | 32 | 24 |
| **EN2237** | 11 | 8 | 10 | 10 | 6 |
| **EN2231** | 17 | 10 | - | 16 | 11 |
| **CE3050** | 8 | 26 | - | 28 | 6 |
| **CE3074** | 31 | 29 | - | 32 | 11 |
| **CS4341** | 31 | 25 | - | 26 | 19 |
| **PSY2406** | 30 | 24 | - | 28 | 20 |

The gender composition of the control and experimental group in the pre and post-surveys and how it compares to the gender distribution at WPI can be seen in Table 2.

**Table 2: Survey Gender information versus WPI Gender information**

| | female | male | NA |
|---|---|---|---|
| **WPI** | 31.77% | 68.23% | 0 |
| **pre-experiment** | 38% | 59.33% | 2.67% |
| **pre-control** | 35.96% | 63.15% | 0.89% |
| **pre-total** | 36.98% | 60.75% | 2.26% |
| **post-experiment** | 36.36% | 55.56% | 8.08% |

| | | | |
|---|---|---|---|
| **post-control** | 33.87% | 61.29% | 4.84% |
| **post-total** | 35.80% | 57.41% | 6.79% |

Graphical comparisons of this data can be seen in the Fig A1 in the appendix.

Also, it is important to be able to know that our survey sample is an accurate representation of the general WPI student body in terms of race. This data is reproduced below in Table 3.

**Table 3: Survey race information versus WPI race information**

| | **Nonresident Alien** | **Hispanic / Latino** | **American Indian /Alaska native** | **Asian** | **Black / African American** | **Native Hawaiian / Pacific Islander** | **White** | **Two or more** | **NA** |
|---|---|---|---|---|---|---|---|---|---|
| **WPI** | 11.77% | 7.23% | 0.21% | 5.01% | 2.57% | 0% | 68.04% | 2.73% | 2% |
| | American Indian Alaskan Native | Asian | Black or African American | Other / No Answer | | Pacific Islander | | White | |
| **pre-experiment** | 0.74% | 8.09% | 5.88% | 2.21% | | 0.00% | | 83.09% | |
| **pre-control** | 0.85% | 11.97% | 3.42% | 7.69% | | 0.00% | | 76.07% | |
| **pre-total** | 0.79% | 9.88% | 4.74% | 4.74% | | 0% | | 79.84% | |
| **post-experiment** | 1.10% | 3.30% | 6.59% | 9.89% | | 0% | | 79.12% | |

| | | | | | | |
|---|---|---|---|---|---|---|
| **post-control** | 1.69% | 8.47% | 3.39% | 5.08% | 0% | 81.36% |
| **post-total** | 1.33% | 5.33% | 5.33% | 8.00% | 0.00% | 80.00% |

Graphical comparisons of this data can be seen in the Fig A3 in the appendix.

## Results

Surveys were handed out to participants at the beginning and the end of the term that asked questions about the student's attitude and behavior in relation to the environment. The survey results were used in statistical analysis to determine the effectiveness of the sustainable classroom contract.

The survey had two sections, one on behavior and one on attitude. Each section was assigned a scoring system based on the answer circled. For example, if the questions had a scale with five options, the score would be a number between one and five corresponding to which answer they chose, with one being the least environmentally friendly and five being the most environmentally friendly. A score was developed for each section (behavior and attitude) by taking an average for all of the questions in the section. There are two subsections of the behavior portion on the first survey (in this class and at home) and three subsections for behavior on the second survey (in this class, in other classes, and at home).

Students in the experimental group were given the opportunity to sign a contract that said they would follow the sustainable guidelines set forth by the student investigators during the course of the term.

All statistical analyses involving a confidence interval were done at the 0.05 significance level.

**Is there any difference between the experimental and control groups in the pre-survey?**

After the pre-survey was conducted, it was necessary to analyze the responses to determine whether the experimental and control groups were statistically similar enough that if a change was detected in behavior or attitude in the post-survey that it would not be due to the composition of the groups. This was done by comparing the behavior mean and the attitude mean of the experimental and control group. The mean for the behavior was calculated with the behavior scores for the participating class only. The initial results obtained are reproduced below in Table 4.

**Table 4: Experimental vs. Control pre-survey behavior response**

| | Behavior in the participating class | Attitude |
|---|---|---|
| Experimental group who signed the contract | 3.996110 | 5.172316 |
| Experimental group who chose not to sign the contract | 3.687145 | 4.792593 |
| Experimental group total | 3.809685 | 4.942953 |
| Control group | 3.847515 | 5.105263 |

The analysis was conducted by calculating the 95% confidence interval using Equation 1 through Equation 3 below, and then interpreting the results. All confidence

intervals were calculated using the behavior scores for in the participating class only. The at home mean was only included to look for affects the contract may have had on other aspects of the participant's life.

**Equation 1: Difference in sample means**

$$\overline{x_d} = \overline{x_2} - \overline{x_1}$$

**Equation 2: Standard Error Equation**

$$\boldsymbol{SE} = \sqrt{\frac{\boldsymbol{s_1^2}}{\boldsymbol{n_1}} + \frac{\boldsymbol{s_2^2}}{\boldsymbol{n_2}}}$$

**Equation 3: Formula for 95% confidence interval**

$$\overline{x_d} \pm t_{0.025,n} \times SE$$

The results of these calculations are reproduced below in Table 5.

**Table 5: Experimental vs. Control pre-survey behavior calculated results**

| $\overline{x_d} = \overline{x_2} - \overline{x_1}$ | Standard error | df | $t_{0.025,113}$ | Confidence Interval |
|---|---|---|---|---|
| -0.03783 | 0.07876 | 113 | 1.9812 | (-0.194,0.118) |

Due to the confidence interval containing zero, it can be concluded that there is no significant difference between the behavior of the participants of the experimental group and those of the control group

The same technique was used to analyze the pre-survey attitude means. Again, because the confidence interval contained zero, it was concluded that there is no significant difference between the attitude of the participants in the experimental group and those of the control group. The results of these calculations are reproduced below in

Table 6 and Table 7.

**Table 6: Experimental vs. Control pre-survey attitude response**

| Group | Size (n) | Mean | Standard deviation (s) |
|---|---|---|---|
| Experimental ($x_1$) | 149 | 4.942953 | 1.026264 |
| Control ($x_2$) | 114 | 5.105263 | 0.89445 |

As can be seen in the table, the attitude scores at the beginning of the term were very similar between the control and experimental groups.

**Table 7: Experimental vs. Control pre-survey attitude calculated results**

| $\overline{x_d} = \overline{x_2} - \overline{x_1}$ | Standard | df | $t_{0.025,113}$ | Confidence |
|---|---|---|---|---|

| | error | | | Interval |
|---|---|---|---|---|
| 0.16231 | 0.137287 | 113 | 1.9812 | (-0.073,0.397) |

The combination of these two analyses established that the investigators can conclude that the students in the experimental group and the students in the control group did not differ in a statistically significant way before the start of the study. This conclusion is ideal because then if there is a significant difference in the post-survey data then it can be concluded that the Sustainable Classroom Contract may have had an effect.

**Is there any difference between the control and the experimental group in the post-survey?**

Once the post-survey data was received, the confidence intervals where again calculated for the behavior and attitude mean. The number of participants decreased between the beginning and the end of term. This could be due to people dropping the class or to people not showing up on the day of the post survey. Another possibility is that people simply did not take the second survey. The means for the post survey data can be seen in Table 8.

**Table 8: Experimental vs. Control post-survey behavior response**

| Group | Size | Mean | Standard deviation |
|---|---|---|---|
| Experimental ($x_1$) | 99 | 3.858081 | 0.574275 |
| Control ($x_2$) | 62 | 3.829032 | 0.662156 |

As can be seen in the table, the means for the control and the experimental group for the second survey were very similar, showing that the experimental group did not have better habits during the term than the control group. The confidence interval calculation results can be seen in Table 9.

**Table 9: Experimental vs. Control post-survey behavior calculated results**

| $\overline{x}_d = \overline{x}_2 - \overline{x}_1$ | Standard error | df | $t_{0.025,61}$ | Confidence Interval |
|---|---|---|---|---|
| 0.029049 | 0.101995 | 61 | 2.0000 | (-0.175,0.233) |

The table shows a confidence interval containing zero. This means that in the post-survey data, it can be concluded that there was no statistical difference between the means of the control and experimental groups for the post-survey.

The same calculations were done for the post-survey attitude scores to calculate the difference in attitude in the participating groups during the observation period. The averages for the attitude post survey can be seen in Table 10.

**Table 10: Experimental vs. Control post-survey attitude response**

| Group | Size | Mean | Standard deviation |
|---|---|---|---|
| Experimental ($x_1$) | 99 | 5.119529 | 1.079872 |
| Control ($x_2$) | 62 | 5.319892 | 0.675015 |

The means are once again very similar, possibly indicating that the attitudes of the experimental group did not improve more than the control group. The results of the calculations for the confidence interval of the post-survey attitude scores can be seen in Table 11.

.

**Table 11: Experimental vs. Control post-survey attitude calculated results**

| $\bar{x}_d = \bar{x}_2 - \bar{x}_1$ | Standard error | df | $t_{0.025,61}$ | Confidence Interval |
|---|---|---|---|---|
| 0.200363 | 0.138305 | 61 | 2.0000 | (0.076,0.477) |

Looking at Table 8, it is evident that the 95% confidence interval contains only positive numbers. This means that there was a marginally significant difference between the attitudes of the control and experimental post-surveys. This indicates that the control group had a marginally greater attitude about the environment in the post survey. These results could be due to many outside factors such as the class they were participating in since many of the control groups were in fact environmentally related. This could be a negative effect of using a voluntary sample instead of a simple random sample. The results could also be due to the very low number of responses received in the post survey from the control group.

It should be noted that only the means were analyzed here, and thus it would also be prudent to look at more specific pieces of data such as individual change to determine if the survey had any effect.

**Is there any difference between the control and the experimental group's change in response between the post-survey and the pre-survey?**

The surveys of students in the experimental group were individually analyzed to determine whether individual students in the experimental group had a significant change in behavior or attitude toward the environment. This was done by calculating the difference in the scores of each student between the before and after surveys. This could only be done with the surveys of students that could be matched up between the before and after surveys. The data showing behavior scores for these students and the amount of change can be seen in Table G1 in the appendix.

The data was used to determine whether there is any statistical difference in the mean behavior and attitude scores of people in the experimental group during the period of the study, regardless of whether or not they signed the contract. This was done by computing the confidence interval. The results of these calculations can be seen below in Table 12.

**Table 12: Data for the Confidence Interval of Behavior Scores for Students in the Experimental Group**

| $\overline{x}_1$ | $\overline{x}_2$ | $\overline{x}_d = \overline{x}_2 - \overline{x}_1$ | n | Standard deviation | Standard error | df | Confidence Interval |
|---|---|---|---|---|---|---|---|

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 3.906081 | 3.879505 | -0.026576 | 75 | 0.767529 | 0.088627 | 74 | (-0.203,0.150) |

The information in Table 12 shows that there is no significant difference in the behavior of the experimental group at the beginning and end of the study period.

The same analysis was done for the attitude scores of the experimental group. The raw data for the experimental group attitude scores can be seen in Table G2Table G2. The calculated data for the confidence interval is shown in Table 13.

**Table 13 : Data for the Confidence Interval of Attitude Scores for Students in the Experimental Group**

| $\overline{x}_1$ | $\overline{x}_2$ | $\overline{x}_d = \overline{x}_2 - \overline{x}_1$ | n | Standard deviation | Standard error | df | Confidence Interval |
|---|---|---|---|---|---|---|---|
| 4.9932 | 5.2162 | 0.2230 | 75 | 1.2786 | 0.1476 | 74 | (-0.0711, 0.5171) |

Since the confidence interval contains 0, investigators can be confident that there is no significant difference between the attitude of the participants of experimental group before and after the observation period. Signing the Sustainable Classroom Contract may have little effect on making a student more concerned about the environment or on their behavior toward the environment. This data however includes students who did not sign the contract and therefor were not obligated to follow the guidelines set forth by the contract.

For comparison, the next set of analyses was done on the data collected from the control group. Participants in the control group were not given the chance to sign a

contract but instead were simply presented with the same suggested guidelines as were on the contract. To determine the effect of the contract, it is necessary to look at the difference that occurs simply from being presented with guidelines on behavior that will positively affect the environment. This way, it is possible to say whether any change observed when the contract is signed is due to the social pressure of making a commitment in front of peers or simply from a desire to help the environment.

Surveys from the control group were matched up based on the demographic info as was done with the experimental group. Only surveys that could be matched were used. The behavior and attitude scores for the control group can be seen in Table G5 and Table G6 in the appendix

| Students | Before | After | Difference |
|---|---|---|---|
| 1 | 3 | 3 | 0 |
| 2 | 4.25 | 4 | -0.25 |
| 3 | 3.6 | 3.166667 | -0.43333 |
| 4 | 4.2 | 3.666667 | -0.53333 |
| 5 | 3.4 | 2.5 | -0.9 |
| 6 | 3.833333 | 3.833333 | 0 |
| 7 | 4.166667 | 4 | -0.16667 |
| 8 | 2.833333 | 3.833333 | 1 |
| 9 | 4.5 | 4.5 | 0 |
| 10 | 2.833333 | 2.666667 | -0.16667 |
| 11 | 4.5 | 4.5 | 0 |
| 12 | 4 | 3.333333 | -0.66667 |
| 13 | 3.75 | 4.2 | 0.45 |
| 14 | 4.666667 | 5 | 0.333333 |

| | | | |
|---|---|---|---|
| 15 | 3.5 | 3.5 | 0 |
| 16 | 3.8 | 4.166667 | 0.366667 |
| 17 | 4.4 | 4.4 | 0 |
| 18 | 3.5 | 4.333333 | 0.833333 |
| 19 | 4.5 | 4.833333 | 0.333333 |
| 20 | 3.8 | 3 | -0.8 |
| 21 | 3.333333 | 2.5 | -0.83333 |
| 22 | 3.666667 | 2.166667 | -1.5 |
| 23 | 3.333333 | 3.666667 | 0.333333 |
| 24 | 4.166667 | 3.5 | -0.66667 |
| 25 | 3.666667 | 2.833333 | -0.83333 |
| 26 | 4.333333 | 4.166667 | -0.16667 |
| 27 | 3.6 | 3.5 | -0.1 |
| 28 | 4.5 | 4.833333 | 0.333333 |
| 29 | 3 | 3 | 0 |
| 30 | 3.5 | 3.833333 | 0.333333 |
| 31 | 4.333333 | 4.166667 | -0.16667 |
| 32 | 4.5 | 4.333333 | -0.16667 |
| 33 | 3.666667 | 3.666667 | 0 |
| 34 | 4.666667 | 4.166667 | -0.5 |
| 35 | 4.666667 | 4.166667 | -0.5 |
| 36 | 3.833333 | 3.5 | -0.33333 |
| 37 | 4 | 4 | 0 |
| 38 | 4.5 | 4.333333 | -0.16667 |
| 39 | 3.666667 | 3.333333 | -0.33333 |
| 40 | 4.5 | 4.5 | 0 |
| 41 | 4 | 4.166667 | 0.166667 |
| 42 | 5 | 5 | 0 |
| 43 | 2.833333 | 3.166667 | 0.333333 |
| 44 | 4.333333 | 3.5 | -0.83333 |

| | | | |
|---|---|---|---|
| 45 | 4. 833333 | 4. 8 | −0. 03333 |
| 46 | 4 | 3. 833333 | −0. 16667 |

Table G6 respectively. This data was used to determine the confidence interval in the same way as the data from the experimental group. The data for the calculation of the confidence interval for the behavior scores of the control group can be seen in **Error! Reference source not found.**14.

**Table 14: Confidence Interval Data for Control Group Behavior Scores**

| $\overline{x}_1$ | $\overline{x}_2$ | $\overline{x}_d = \overline{x}_2 - \overline{x}_1$ | n | Standard deviation | Standard error | df | Confidence Interval |
|---|---|---|---|---|---|---|---|
| 3.944928 | 3.805797 | -0.139131 | 46 | 0.4707 | 0.0694 | 45 | (-0.2789,0.0006) |

Since the confidence interval contains 0, it concluded that there is no significant difference between the behavior of the participants of control group before and after the observation period. However, the interval only barley contains zero, indicating that the control group behavior may have gotten marginally worse. Without signing the Sustainable Classroom Contract, a student's behavior toward the environment was not improved.

The same test was done on the attitude scores. The data for the calculation of the confidence interval of the control group attitude scores can be seen in Table 12.

**Table 15: Calculated Data for the Confidence Interval of the Control Group Attitude Scores**

| $\overline{x}_1$ | $\overline{x}_2$ | $\overline{x}_d = \overline{x}_2 - \overline{x}_1$ | n | Standard deviation | Standard error | df | Confidence Interval |
|---|---|---|---|---|---|---|---|
| 5.1304 | 5.3514 | 0.2210 | 46 | 0.5953 | 0.0878 | 45 | (0.0442,0.3978) |

Since the confidence interval contains all positive values, investigators can conclude that the participants of control group become more concerned about the environment after the observation period. Though the interval does not contain zero, it is still very close to containing zero, indicating that though the students changed their attitude, it was only a small amount. Even though the control group did not sign the contract, the students' attitude toward the environment may be improved by some other external factors. Despite the improvement in attitude, the control group had no positive change in behavior. It is harder to change behavior than attitude because behavior requires sacrifices.

When compared to the results of the experimental group, this gives the impression that the social pressure of the contract not only didn't improve the students' attitudes toward the environment, but may have somehow hindered the effect of environmental suggestions. This is not true however in the case of participant behavior. The lack of statistical significance of the change in behavior in both the experimental and control group shows that with or without social pressure, students are not likely to change their behavior in order to benefit the environment.

The results of these experiments show that though students changed their attitude, it did not necessarily mean that they changed their behavior. This result was a little unexpected as caring about the environment should theoretically lead to better behavior toward the environment. However, there are many possible explanations for this. For example, students may simply be too stressed during classes to think about their behavior toward the environment. Also, if the students are not being reminded of the contract, they may have simply forgotten the guidelines they were supposed to be following.

**Is there any difference between experimental survey responses who signed the contract versus who did not sign the contract?**

Next, an analysis was done only of the students who signed the contract to determine if those students who signed changed their behavior. This was done by comparing the surveys from the beginning and the end of the term of those students who signed the contract based on their behavior and attitude scores.

The purpose of this test was to show whether there is any statistical difference in the mean behavior and attitude scores of people before and after signing the sustainable classroom contract. The behavior scores for students who signed the sustainable classroom contract and the difference between the before and after surveys can be seen in Table G3 in the appendix**Error! Reference source not found.**.

The data from the table was then used to find the confidence interval for

$\mu_2 - \mu_1$. The results of these calculations can be seen in Table 16.

**Table 16: Data for Confidence Interval Calculation for the Behavior of Students Who Signed the Contract**

| $\overline{x_1}$ | $\overline{x_2}$ | $\overline{x_d} = \overline{x_2} - \overline{x_1}$ | n | Standard deviation | Standard error | df | Confidence Interval |
|---|---|---|---|---|---|---|---|
| 3.953390 | 3.825424 | -0.127966 | 59 | 0.884289 | 0.115125 | 58 | (-0.3584,0.1025) |

Since the confidence interval contains 0, it can be concluded that there is no significant difference in the behavior of the participants who signed the contract during the observation period.

The same calculations were done with the data for the attitude scores of the students who signed the contract. The raw data for the attitude scores of these students can be seen in Table G4 in the appendixTable G4. The confidence interval calculations for the attitude section of the surveys can be seen in Table 17.

Table 17: Confidence Interval Data for Attitude Section of Surveys for Students Who Signed the Contract

| $\overline{x_1}$ | $\overline{x_2}$ | $\overline{x_d} = \overline{x_2} - \overline{x_1}$ | n | Standard deviation | Standard error | df | Confidence interval |
|---|---|---|---|---|---|---|---|
| 5.172316 | 5.313559 | 0.141243 | 59 | 0.613399 | 0.079858 | 58 | (-0.0186,0.3011) |

Since the confidence interval again contains 0, it can be concluded that there is no significant difference between the attitude of the participants who signed the contract before and after the observation period. However, this interval is very close to being positive, indicating that there is in fact a marginal change in attitude for students who signed the contract. This change in attitude again did not seem to induce a change in behavior.

Since there is no difference in the behavior or attitude of the participants who signed the contract, it seems as though the contract was not effective.

## Did students who changed their behavior in class also change their behavior outside of class?

A summary of the data can be seen in Table 18 below.

Table 18: Summary of Behavior and Attitude Means

| | Pre Behavior in participating class | Post Behavior in participating class | Pre Attitude | Post Attitude | Post Behavior in other classes | Post Behavior at home |
|---|---|---|---|---|---|---|

| | | | | | | |
|---|---|---|---|---|---|---|
| Experimental group who signed | 3.996110 | 3.953390 | 5.172316 | 5.313559 | 3.90226 | 3.697135 |
| Experimental group who did not sign | 3.687145 | 3.717500 | 4.792593 | 4.833335 | 3.732916 | 3.460772 |
| Experimental group total | 3.809685 | 3.858081 | 4.942953 | 5.119529 | 3.833838 | 3.601635 |
| Control group total | 3.847515 | 3.829032 | 5.105263 | 5.319892 | 3.744086 | 3.656111 |

The data from Table 18 shows that not only was there no significant difference in the behavior of students in the classroom that was participating in the study, but there was no real difference in the behavior at home or in other class.

Each class was observed twice in B term, and notes were taken on the behavior of the students (based on the criteria set forth by the contract) as well as the behavior of the professors. This data was obtained in order to determine if the self-reporting by students was accurate. This data was also collected in order to determine if classes with outstanding results were due to the influence of the professor. However, it was determined that no classes or professors had any outstanding behavior. The data collected during these observations can be seen in Appendix H.

## Conclusion

A lot of the changes people make to "go green" in their home are easy and help them in a lot of ways, such as saving money on electricity and plastic water bottles. The classroom however is a different story. Students are focused on assignments and grades, not on how their actions affect the environment.

The Sustainable Classroom Contract provided students with easy guidelines to follow during class to help the environment. Some of them even provided similar benefits to those changes that can be made at home, such as less money spent on plastic water bottles. The idea was that the professor would set an example for the students to follow and that signing the contract would contribute enough social pressure to keep the students following the guidelines. If the students changes little behaviors in class, it was hoped that they would continue to make changes in other parts of their lives in order to benefit the environment.

Unfortunately, this study of the Sustainable Classroom Contract showed no statistical benefit of the contract. Students who signed did not change their behavior or their attitude toward the environment enough for the contract to be worthwhile.

As in most studies, this experiment had its limitations that could have contributed to the lack of change found during the testing period. The original plan for the study involved many more participating classes with a wider variety of majors and class types. However, in order to get professors that would be the most willing to lead by example, soliciting was done on a volunteer basis. This led to a smaller sample size for the study as well as a limited ability to do random selection and a limited variety of majors and class years. The smaller sample size can distort the data because each individual carries more weight over the group's average. The

limited variety of classes may have also contributed to certain trends in the data because some of the classes were aimed at environmental studies while others were not.

Another limitation of the study was the necessity of relying primarily on self-reporting from the participants. In many cases, people may not have been entirely accurate on the survey because they did not want to appear as though they did not do their part for the environment. Also, many people did not fill out the information that allowed investigators to compare the before and after surveys, further limiting the quantity of usable data for comparison.

A third limitation of the study is the amount of participation of the professors. Despite the efforts of the investigators, it is really up to the professors to set a good example for their students as well as remind them that about their commitment. Observation of the classes showed that the professors' amount of leading by example was limited.

Last but not least, it can be seen from Table 1 that the number of students who took the post-survey was about sixty percent of the number of students who took the pre-survey. Only one half of the students in the experimental group were found to have taken both surveys, and as few as forty percent of the students were found to have signed the contract and taken both surveys. If there had been more data obtained from the post-survey, a more significant result could have been concluded.

A few suggestions are provided to further investigators in order to conduct a more successful study.

1) Plan ahead of time. Start recruiting classes two weeks before a new semester/term. Therefore, if there are not enough professors responding, investigators still have time to negotiate with professors to make them participate in the study.

2) Have more classes interested in the experiment. Only 10 classes were involved in this study, all of which were voluntary. This violated the assumption of simple random sample and thus made statistical analyses less accurate.
3) Print out surveys. Although paper surveys violate the guidelines in the contract, it is an efficient way to obtain enough responses compared to online surveys. Due to an avoidable event, two classes had their rest of lectures canceled when the post-survey was scheduled. A link to the post-survey was given to these two classes, only 17 out of 60 students took the survey during a two-month period.
4) Keep reminding the professors in the experimental group of the contract the signed and force them to set a good example and to follow the guidelines. As one of the goal is to test how social pressure can change a person's attitude and behavior, if professors don't attach importance to the guidelines, neither do students. Then the contract ends up being meaninglessness.

Though this study did not turn up any significant evidence that the Sustainable Classroom Contract is beneficial to the environment, there is definitely room for further testing. It is definitely possible that greater participation of the professors, more frequent reminders about the contract, and a larger group of volunteers could positively impact the outcome of a similar study.

# Appendix

## Appendix A: Study Population Compared to Population of WPI

### A1. Gender

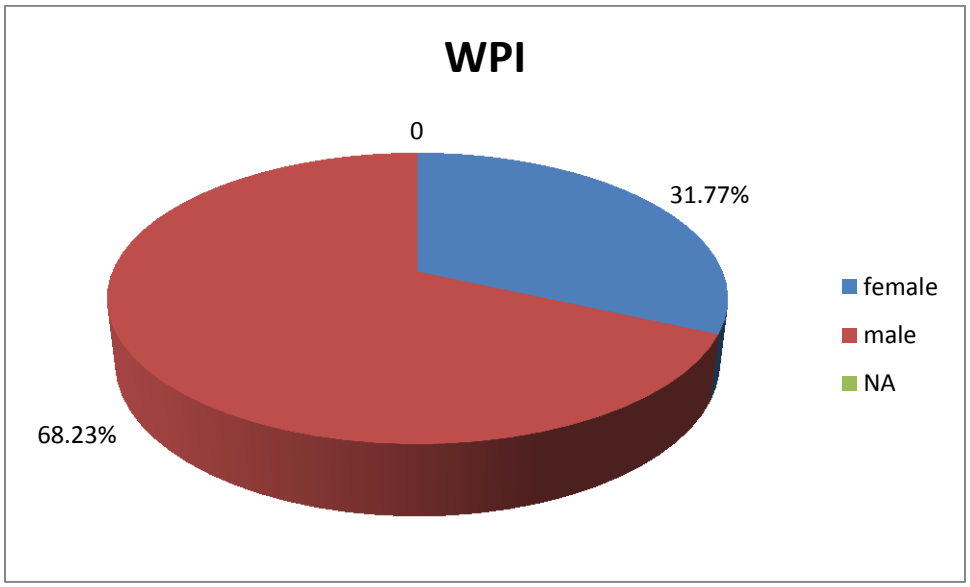


Figure A1: Gender composition of undergraduates at WPI during the 2012-2013 school year.

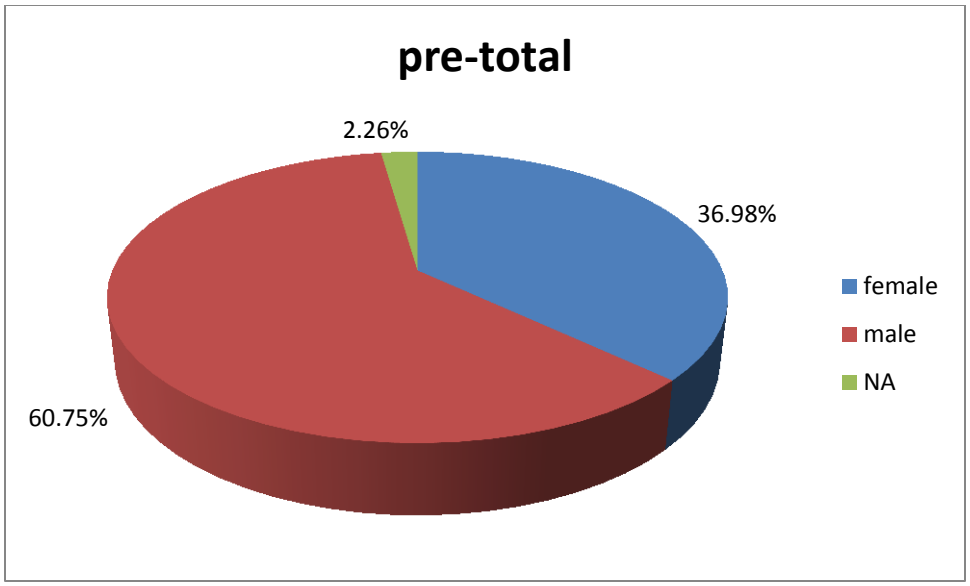


Figure A2: Gender composition of students responding to the pre-survey

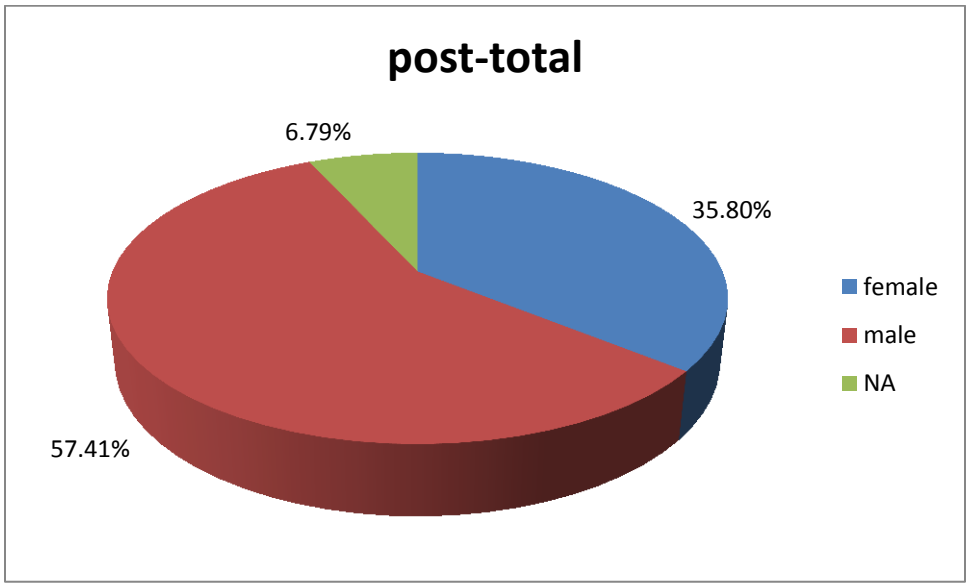


Figure A3: Gender composition of students responding to the post-survey

**A2. Class year**

It should be noted that this study was taken during the 2012-2013 school year, and as thus a graduating year of 2013 corresponds to a senior, 2014 to a junior, 2015 to a sophomore and 2016 to a freshman.

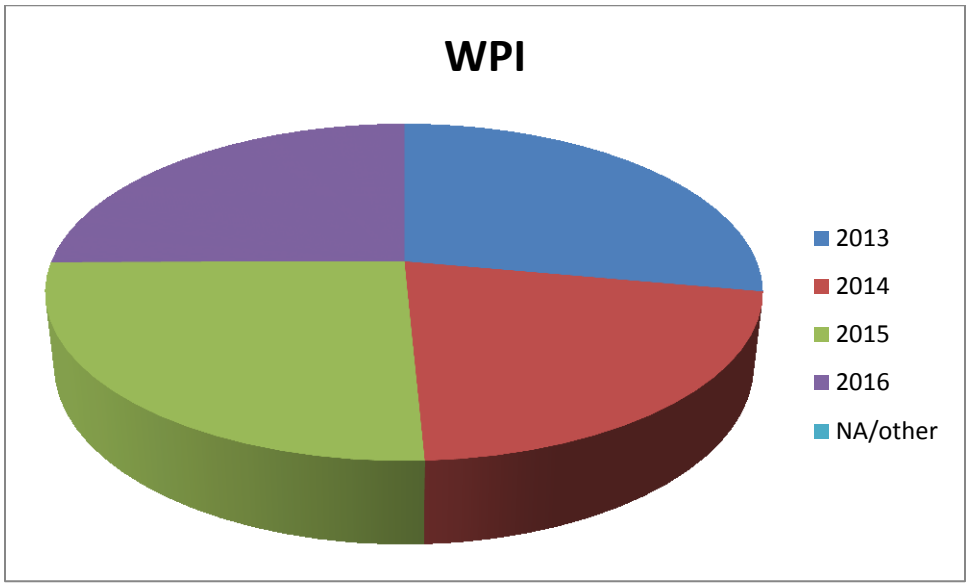


Figure A4: Class year composition of undergraduates at WPI during the 2012-2013 school year.

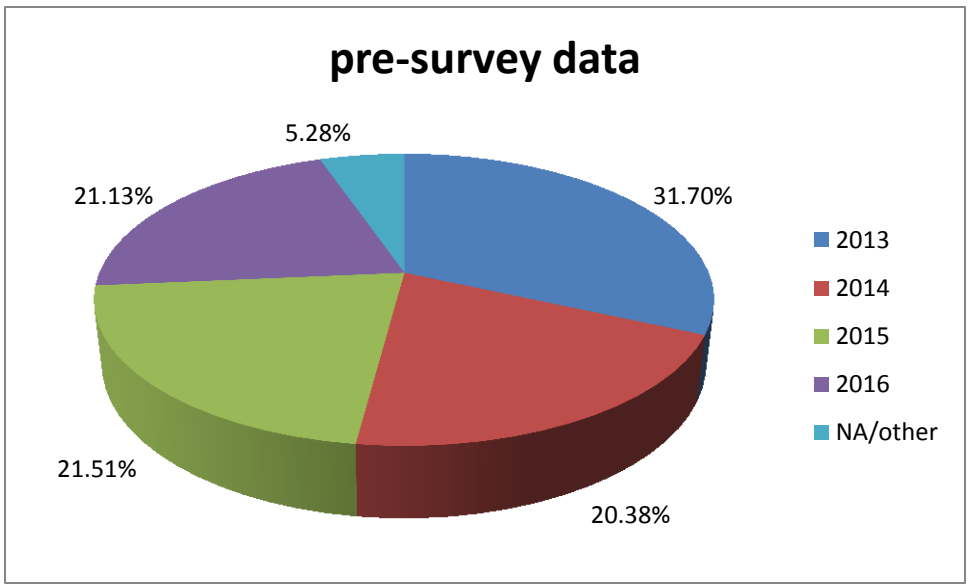


Figure A5: Class composition of students responding to the pre-survey

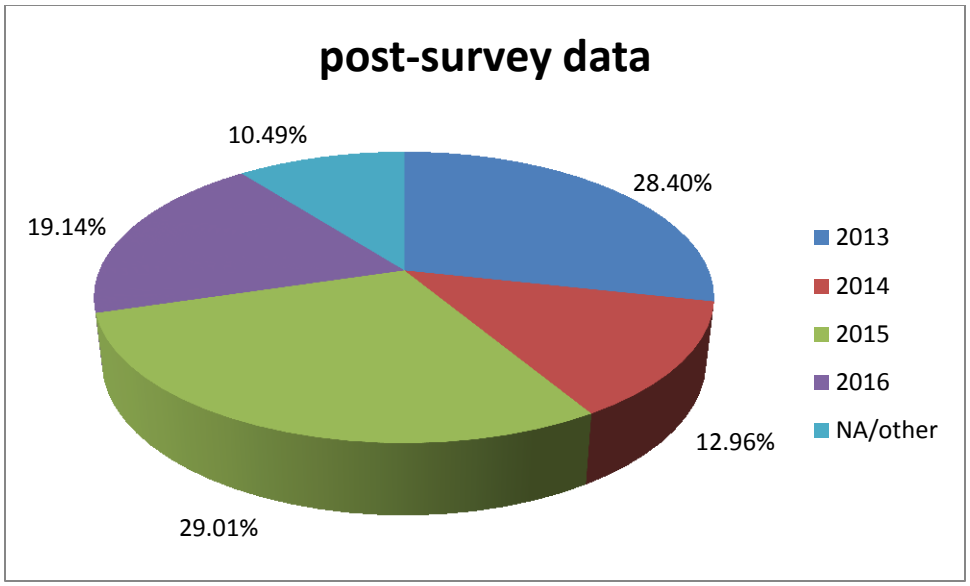


Figure A6: Class composition of students responding to the post-survey

## A3. Race

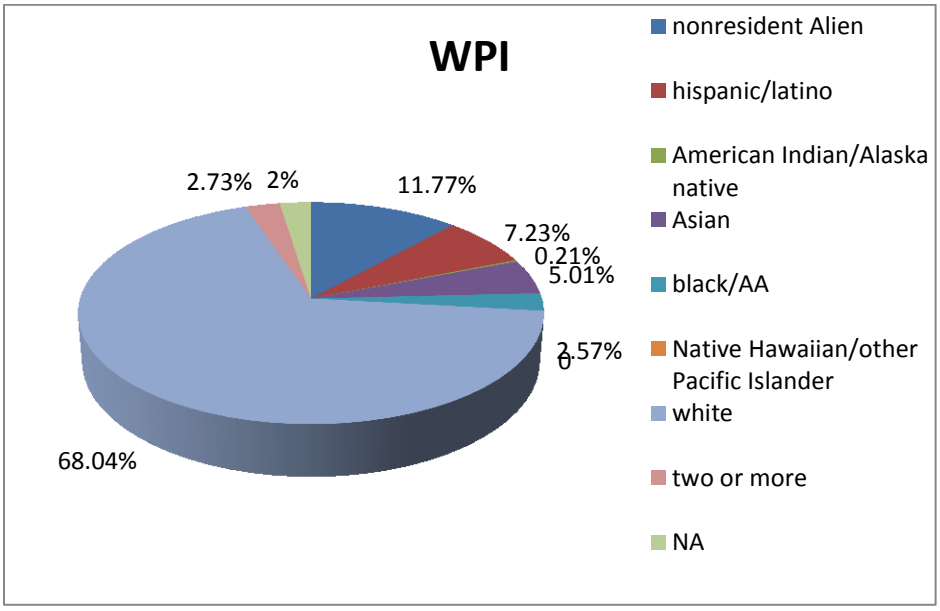


Figure A7: Race composition of undergraduates at WPI during the 2012-2013 school year.

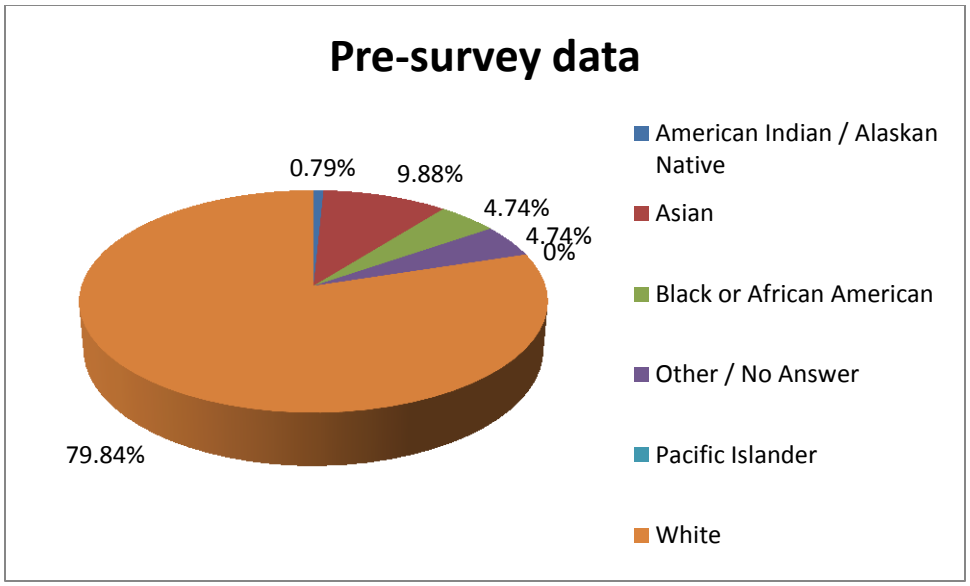


Figure A8: Race composition of control and experimental groups as reported on the pre-surveys

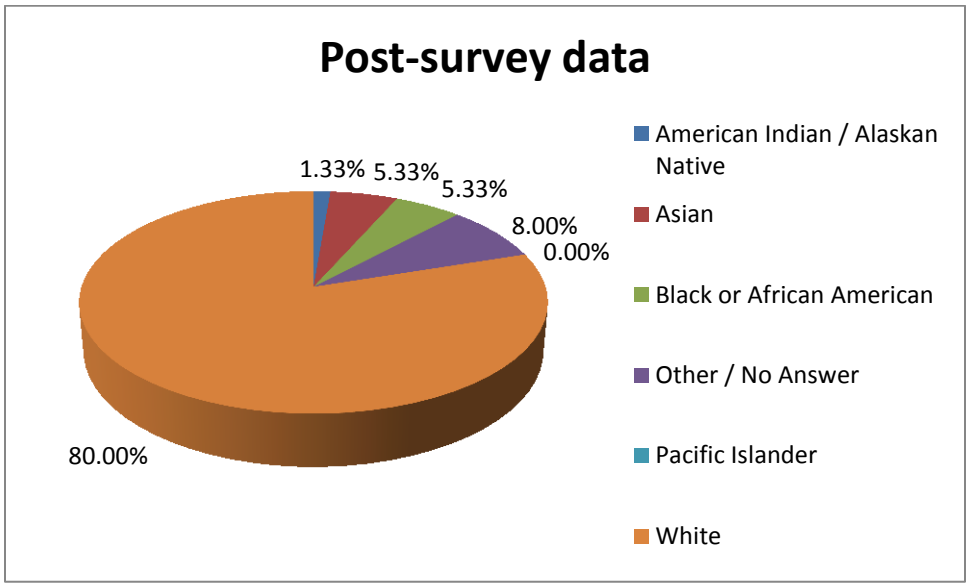


Figure A9: Race composition of control and experimental groups as reported on post-surveys

## Appendix B: Materials distributed to classes

### B1. Informed consent

Informed Consent Agreement for Participation in a Research Study

**Investigator:** James Kevin Doyle

**Contact Information:** Department of Social Science and Policy Studies, Worcester Polytechnic Institute, 100 Institute Road, Worcester, MA 01609, 508-831-5583, doyle@wpi.edu

**Title of Research Study:** Sustainable Classroom Surveys

**Purpose of the study:** The purpose of this study is to monitor environmental behavior and attitudes in students at WPI.

**Procedure:** Your participation in this study consists of filling out surveys. You may also be given the opportunity to change your behavior in an environmental way.

**Risks to study participants:** None.

**Benefits of the Study:** Your participation in this study will provide information that can be used to determine effective methods of classroom sustainability which can contribute to a greener future.

**Recording keeping:** Records will be kept confidential. Surveys will be anonymous and each survey will be matched by a code consisting of birthdate, 2nd letter of first name and 3rd letter of last name. All records will be kept in a locked filing cabinet.

**Payment:** You will not be compensated for your participation in this study.

**Your participation in this study is voluntary:** Your refusal to participate will not result in any penalty or loss of benefits to which you may otherwise be entitled and will have no effect on

your grade. You may stop participating in this investigation at any time. You may refuse to answer any or all questions asked on the presented surveys.

**For more information about this research or about the rights of research participants, or in case of research-related injury, contact:** Professor James Doyle (see top of page). You can also contact the IRB Chair: Professor Kent Rissmiller, Tel. 508-831-5019, Email: kjr@wpi.edu or the University Compliance Officer Michael J. Curley, Tel. 508-831-6919, Email: mjcurley@wpi.edu.

## VOLUNTEER'S STATEMENT:

I understand that all participation in this study is strictly voluntary. I may stop participating at any time without being punished or suffering any adverse effects.

By consenting to participate in this study, I have not waived any of my legal rights.

_____ _____

Sign Date

## B2. Educational Material Distributed to Participants
## Why Should I Do This?

1. Use reusable water bottles instead of disposable plastic water bottles.
    - Water Extraction for bottling causes local water shortages for nearby farms and consumers
    - The production of one year's worth of water bottles uses enough oil to power 100,00 cars for a year.
    - Delivery vehicle emissions pollute more water than is in the bottles.
2. Always participate in recycling by using the correct bins.
    - 100 tons of wood could be saved each year if every American recycled.
    - 80% of what Americans throw away is recyclable
    - The great Pacific Garbage Patch is twice the size of Texas
3. Use both sides of notebook paper and print double-sided whenever possible.
    - Try not to leave unnecessary white space.
    - Re-use scrap paper instead of fresh pieces of paper when possible
    - Try to use recycled paper when possible
    - On average, each person in the U.S. uses around 27 pounds of paper annually
4. Make sure the lights are off if I am the last one to leave the room
    - Incandescent lights are the least efficient type of lighting.90% of the energy they use is given off as heat, and only about 10% results in light.
    - A normal bulb will use 60 watts of energy an hour, meaning that you could conserve nearly 22,000 watts of energy per year just by switching off one bulb for one hour every day.
5. Only use an elevator to get to class if I am unable to use stairs.
    - An elevator consumes 2.5 Watt hours per floor (one direction, 3 meters). That is approximately 1/2 the amount of energy it takes to recharge a cell phone battery.

- If an elevator of a 3-storey building goes 80 round trips every day, the electricity it consumes is about how much a desktop computer and monitor use running for 2 hours.

6. Turn off my computer when studying from printed material.

   - Most laptop computers use about 15-60 watts.
   - The amount of electricity a computer uses significantly increases when it is connected to the Internet.
   - You should absolutely make sure your computer is set to sleep automatically when you're not using it.

7. Take notes on paper as opposed to electronics.

   - A notes-taking software costs extra electricity compared to what the label tells you at the back of your computer.
   - Excessive using electronics cause a short life expectancy of them and thus bring them into electronic-waste.

8. Limit the use of paper handouts

   - Paper accounts of ~40% of waste in landfills

9. Use whiteboards instead of the computer (PowerPoint) when possible.

   - A typical desktop computer uses about 65 to 250 watts.
   - Add another 15-70 watts for an LCD monitor, or about 80 watts if you have an old-school 17" CRT.
   - Any software you use contributes to electricity consumption.

10. Make sure that the projector and other electronics are off when not in use.

    - Even in a standby model, the projector's power consumption is 5 watts.
    - A sleeping monitor consumes 15 watts.

## Common Misconceptions

1. Electronic submission and handouts isn't necessarily greener than paper.

- In 2006, the carbon released from harvesting wood was less than the carbon sequestered on forested lands.
- It takes more energy to read material online then it does to read it on paper

2. Reusable Ceramic cups are not necessarily more energy efficient than disposable plastic and Styrofoam cups
    - It takes 39 plastic or 1006 Styrofoam cups to equal the amount of energy to produce and clean one ceramic cup, assuming a high efficiency dishwasher
    - If washing by hand, a ceramic cup may never break even.

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## B3. The Sustainable Classroom Contract

# Sustainable Classroom Contract

By signing below you are making a voluntary public pledge to honor this contract during the remainder of the course. This Sustainable Classroom Contract was developed by students and staff at St. Michael's College, Colchester, VT and later refined by students at Worcester Polytechnic Institute, Worcester, MA

As a student I will…

1. Use reusable water bottles instead of disposable plastic water bottles.
2. Always participate in recycling by using the correct bins.
3. Use both sides of notebook paper and print double-sided whenever possible.
4. Make sure the lights are off if I am the last one to leave the room.
5. Only use an elevator to get to class if I am unable to use the stairs.
6. Turn off my computer when studying from printed material.
7. Take notes on paper as opposed to electronics.

As a professor I will…

1. Help set a good example by following the criteria above.
2. Limit the use of paper handouts.
3. Use Whiteboards instead of the computer (PowerPoint) when possible.
4. Make sure that the projector and other electronics are off when not in use.
5. Only use lights that are needed.
6. Use examples related to the environment whenever possible.

| Name | Signature |
| --- | --- |
| | |
| | |
| | |
| | |
| | |
| | |
| | |

**B4. Survey Taken by Students at Beginning of Observation Period**

## Environmental Attitude and Behavior Survey

This is an optional survey, if you do not wish to participate please hand the survey back to the professor.

### Environmental Attitudes

First, we would like to ask you some questions about your attitudes regarding the environment

1. How concerned are you about the environment, on a global scale?

1 2 3 4 5 6 7

Not at all concerned Extremely concerned

2. How often do you consider the environment when making everyday consumer decisions?

1 2 3 4 5 6 7

Never Always

3. How important do you consider turning off lights that aren't being used?

1 2 3 4 5 6 7

Not at all important Extremely important

4. How important do you consider recycling of everyday paper, glass, metal, and plastic items?

1 2 3 4 5 6 7

Not at all important Extremely important

5. How important do you consider reusing the things you have instead of buying new?

1 2 3 4 5 6 7

Not at all important Extremely important

6. How important do you consider reducing the amount of garbage you create?

1 2 3 4 5 6 7

Not at all important Extremely important

## Environmental Behaviors

Now, we'd like to ask you some questions about how often you did certain environmentally friendly activities.

**In A term during class, how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Turn off the lights / make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Use the elevator to get to class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use electronics during class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

**In A term outside of class (including elsewhere on campus and where you live), how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the proper recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Print double sided?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Turn off the lights when not in use/ make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use the elevator?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

7. Use your computer while studying from printed material?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

## Demographics

Now we just need to know a few things about you.

Birth Date ____/____/_____ 2nd letter of First Name _____ 3rd letter of last name _____

Gender: Male Female Other / Prefer not to answer

Class Year: _____

| | | |
|---|---|---|
| Race: | American Indian or Alaska Native | Asian |
| | Black or African American | Pacific Islander |
| | White | Other / Prefer not to answer |
| Ethnicity: | Hispanic or Latino | Not Hispanic or Latino |

Thanks for filling out the survey!

If you have any comments or questions regarding this survey or the classroom contract, please contact us at sustainclass@wpi.edu.

**B5. Survey Taken by the Experimental Group at the End of the Observation Period**

## Environmental Attitude and Behavior Survey

This is an optional survey, if you do not wish to participate please hand the survey back to the professor.

### Environmental Attitudes

First, we would like to ask you some questions about your attitudes regarding the environment

1. How concerned are you about the environment, on a global scale?

   1 2 3 4 5 6 7

   Not at all concerned extremely concerned

2. How often do you consider the environment when making everyday consumer decisions?

   1 2 3 4 5 6 7

   Never Always

3. How important do you consider turning off lights that aren't being used?

   1 2 3 4 5 6 7

   Not at all important extremely important

4. How important do you consider recycling of everyday paper, glass, metal, and plastic items?

   1 2 3 4 5 6 7

   Not at all important extremely important

5. How important do you consider reusing the things you have instead of buying new?

   1 2 3 4 5 6 7

   Not at all important extremely important

6. How important do you consider reducing the amount of garbage you create?

1 2 3 4 5 6 7

Not at all important extremely important

## Environmental Behaviors

Now, we'd like to ask you some questions about how often you did certain environmentally friendly activities.

**In the past 3 weeks, during this class how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Turn off the lights / make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Use the elevator to get to class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use electronics during class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

**In the past 3 weeks, in other classes how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Turn off the lights / make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Use the elevator to get to class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use electronics during class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

**In the past 3 weeks, outside of class (including on campus and where you live) how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the proper recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Print double sided?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Turn off the lights when not in use/ make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use the elevator?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

7. Use your computer while studying from printed material?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

## Short Answer Questions

1. Did you participate in any environmental programs or events outside of class this term? Please describe:

2. During the term did you adopt any new environmental or energy/resource conservation behaviors that were not on the sustainable classroom contract? If so, what:

## Demographics

Now we just need to know a few things about you.

Birth Date ____/____/_____ 2nd letter of First Name _____ 3rd letter of last name _____

Gender: Male Female Other / Prefer not to answer

Class Year: _____

Race: American Indian or Alaska Native Asian

Black or African American Pacific Islander

White Other / Prefer not to answer

Ethnicity: Hispanic or Latino Not Hispanic or Latino

Thanks for filling out the survey!

If you have any comments or questions regarding this survey or the classroom contract, please contact us at sustainclass@wpi.edu.

**B6. Survey Taken By Control Group at the End of the Observation Period**

## Environmental Attitude and Behavior Survey

This is an optional survey, if you do not wish to participate please hand the survey back to the professor.

### Environmental Attitudes

First, we would like to ask you some questions about your attitudes regarding the environment

1. How concerned are you about the environment, on a global scale?

   1 2 3 4 5 6 7

   Not at all concerned extremely concerned

2. How often do you consider the environment when making everyday consumer decisions?

   1 2 3 4 5 6 7

   Never Always

3. How important do you consider turning off lights that aren't being used?

   1 2 3 4 5 6 7

   Not at all important extremely important

4. How important do you consider recycling of everyday paper, glass, metal, and plastic items?

   1 2 3 4 5 6 7

   Not at all important extremely important

5. How important do you consider reusing the things you have instead of buying new?

   1 2 3 4 5 6 7

   Not at all important extremely important

6. How important do you consider reducing the amount of garbage you create?

1 2 3 4 5 6 7

Not at all important extremely important

## Environmental Behaviors

Now, we'd like to ask you some questions about how often you did certain environmentally friendly activities.

**In the past 3 weeks, during this class how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Turn off the lights / make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Use the elevator to get to class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use electronics during class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

**In the past 3 weeks, in other classes how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Turn off the lights / make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Use the elevator to get to class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use electronics during class?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

**In the past 3 weeks, outside of class (including on campus and where you live) how often did you...**

1. Choose a reusable water bottle instead of a disposable one?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Put recyclables in the proper recycling bin?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Use both sides of notebook paper?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Print double sided?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Turn off the lights when not in use/ make sure that the lights were off when you left?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. Use the elevator?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

7. Use your computer while studying from printed material?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

## Demographics

Now we just need to know a few things about you.

Birth Date ____/____/_____ 2nd letter of First Name _____ 3rd letter of last name _____

Gender: Male Female Other / Prefer not to answer

Class Year: _____

| | | |
|---|---|---|
| Race: | American Indian or Alaska Native | Asian |
| | Black or African American | Pacific Islander |
| | White | Other / Prefer not to answer |

Ethnicity: Hispanic or Latino Not Hispanic or Latino

Thanks for filling out the survey!

If you have any comments or questions regarding this survey or the classroom contract, please contact us at sustainclass@wpi.edu.

**B7. Survey for Professors at End of Term**

## Professor Survey

## How often did you…

1. Turn off unneeded lights?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

2. Turn off projectors, computers when not in use?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

3. Reduce the paper handouts you would use?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

4. Write notes with whiteboards instead of the computer when possible?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

5. Interweave your lecture with examples on environmental themes?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

6. See students following the contract guidelines?

Never - Somewhat Often - Often - Very Often - Every time - Not Applicable

## Comments:

Thanks again!

## Appendix C: Sheet for Observation of Class Behavior

Professor: _____ Class: _____

Time: _____Room: _____ Group: _____

Students

| Criteria | # For | # Against | Score (For – Against) |
|---|---|---|---|
| Reusable water bottles | | | |
| Recycling | | | |
| Both sides of paper | | | |
| Turn off lights leaving room | | | |
| Unnecessary elevator use | | | |
| Electronic use | | | |
| Total Number of students | --- | --- | |

Professor

| Criteria | Follow | Doesn't Follow |
|---|---|---|
| Use whiteboards instead of | | |

| | | |
|---|---|---|
| PowerPoint | | |
| Only use needed lights | | |
| Environmental Examples | | |
| Comments | | |

# Appendix D: IRB application

**WORCESTER POLYTECHNIC INSTITUTE**
**Institutional Review Board**
**Application for Approval to Use Human Subjects in Research**

| WPI IRB use only |
|---|
| IRB # _____ |
| Date: _____ |

**This application is for:** *(Please check one)* ☒ Expedited Review ☐ Full Review

WPI IRB use only

**Principal Investigator (PI) or Project Faculty Advisor:** *(NOT a student or fellow; must be a WPI employee)*

Name: James Kevin Doyle Tel No: 1-508-831-5583 E-Mail Address: doyle@wpi.edu ☐

Department: Social Science & Policy Studies

**Co-Investigator(s):** *(Co-PI(s)/non students)*

Name: _____ Tel No: _____ E-Mail Address: _____ ☐

Name: _____ Tel No: _____ E-Mail Address: _____ ☐

**Student Investigator(s):**

Name: Oliver Hammond Tel No: 6036827537 E-Mail Address: oliver@wpi.edu ☐

Name: Lindsay Jones Tel No: 4139493086 E-Mail Address: sjlins@wpi.edu ☐

Check if: ☒ **Undergraduate project** *(MQP, IQP, Suff., other)* IQP

☐ **Graduate project** *(M.S. Ph.D., other)* _____

Has an IRB ever suspended or terminated a study of any investigator listed above?
No ☒ Yes ☐ *(Attach a summary of the event and resolution.)*

**Vulnerable Populations:** The proposed research will involve the following (Check all that apply):
pregnant women ☐ human fetuses ☐ neonates ☐ minors/children ☐ prisoners ☐
students ☒ individuals with mental disabilities ☐ individuals with physical disabilities ☐

**Collaborating Institutions:** (*Please list all collaborating Institutions.*)
WPI

**Locations of Research:** (*If at WPI, please indicate where on campus. If off campus, please give details of locations.*)
Academic Buildings

**Project Title**: Sustainable Classroom Contracts

**Funding:** *(If the research is funded, please enclose one copy of the research proposal or most recent draft with your application.)*

Funding Agency: _____ WPI Fund: _____

**Human Subjects Research:** (***All*** *study personnel having direct contact with subjects* ***must*** *take and pass a training course on human subjects research. There are links to web-based training courses that can be accessed under the Training link on the IRB web site http://www.wpi.edu/offices/irb/training.html.* ***The IRB requires a copy of the completion certificate from the course or proof of an equivalent program****.)*

**Anticipated Dates of Research:**

Start Date: 10/23/2012 Completion Date: 3/1/2012

**WORCESTER POLYTECHNIC INSTITUTE**
**Institutional Review Board**
**Application for Approval to Use Human Subjects in Research**

| WPI IRB use only |
|---|
| IRB # _____ |
| Date: _____ |

**Instructions:** Answer all questions. If you are asked to provide an explanation, please do so with adequate details. If needed, attach itemized replies. Any incomplete application will be returned.

**1.) Purpose of Study:** *(Please provide a concise statement of the background, nature and reasons for the proposed study. Insert below using non-technical language that can be understood by non-scientist members of the IRB.)*

To determine if sustainable classroom contracts are effective (change people's behavior/attitude)

**2.) Study Protocol:** *(Please attach sufficient information for effective review by non-scientist members of the IRB. Define all abbreviations and use simple words. Unless justification is provided this part of the application must not exceed 5 pages. Attaching sections of a grant application is not an acceptable substitute.)*

A.) For **biomedical, engineering and related research**, please provide an outline of the actual experiments to be performed. Where applicable, provide a detailed description of the experimental devices or procedures to be used, detailed information on the exact dosages of drugs or chemicals to be used, total quantity of blood samples to be used, and descriptions of special diets.

B.) For applications in the **social sciences, management and other non-biomedical disciplines** please provide a detailed description of your proposed study. Where applicable, include copies of any questionnaires or standardized tests you plan to incorporate into your study. If your study involves interviews please submit an outline indicating the types of questions you will include.

C.) If the study involves **investigational drugs or investigational medical devices**, and the PI is obtaining an Investigational New Drug (IND) number or Investigational Device Exemption (IDE) number from the FDA, please provide details.

D.) Please note if any **hazardous materials** are being used in this study.

E.) Please note if any **special diets** are being used in this study.

**3.) Subject Information:**

A.) Please provide the exact number of subjects you plan to enroll in this study and describe your subject population. *(eg. WPI students, WPI staff, UMASS Medical patient, other)*

Males: _____ Females: _____ Description: WPI Students

B.) Will subjects who do not understand English be enrolled?
No ☒ Yes ☐ *(Please insert below the language(s) that will be translated on the consent form.)*

C.) Are there any circumstances under which your study population may feel coerced into participating in this study?
No ☒ Yes ☐ *(Please insert below a description of how you will assure your subjects do not feel coerced.)*

D.) Are the subjects at risk of harm if their participation in the study becomes known?
No ☒ Yes ☐ *(Please insert below a description of possible effects on your subjects.)*

E.) Are there reasons for excluding possible subjects from this research?
No ☒ Yes ☐ *(If yes, please explain.)*

F.) How will subjects be recruited for participation? *(Check all that apply.)*

☐ Referral: *(By whom)* _____

☒ Other: *(Identify)* Volunteers in selected courses

☐ Database: *(Describe how database populated)*

F.) Have the subjects in the database agreed to be contacted for research projects? No ☐ Yes ☐ N/A ☒

☐ Direct subject advertising, including: *(Please provide a copy of the proposed ad. All direct subject advertising must be approved by the WPI IRB prior to use.)*

☐ Newspaper ☐ Bulletin board
☐ Radio ☐ Flyers
☐ Television ☐ Letters
☐ Internet ☐ E-mail

G.) Are the subjects being paid for participating? *(Consider all types of reimbursement, ex. stipend, parking, travel.)*
No ☒ Yes ☐ *(Check all that apply.)* ☐ Cash ☐ Check ☐ Gift certificate ☐ Other: _____

Amount of compensation _____

**4.) Informed Consent:**

A.) Who will discuss the study with and obtain consent of prospective subjects? *(Check all that apply.)*
☐ Principal Investigator ☐ Co-Investigator(s) ☒ Student Investigator(s)

B.) Are you aware that subjects must read and sign and Informed Consent Form prior to conducting any study-related procedures and agree that all subjects will be consented prior to initiating study related procedures? No ☐ Yes ☒

C.) Are you aware that you must consent subjects using only the IRB-approved Informed Consent Form? No ☐ Yes ☒

D.) Will subjects be consented in a private room, not in a public space? No ☒ Yes ☐

E.) Do you agree to spend as much time as needed to thoroughly explain and respond to any subject's questions about the study, and allow them as much time as needed to consider their decision prior to enrolling them as subjects? No ☐ Yes ☒

F.) Do you agree that the person obtaining consent will explain the risks of the study, the subject's right to decide not to participate, and the subject's right to withdraw from the study at any time? No ☐ Yes ☒

G.) Do you agree to either 1.) retain signed copies of all informed consent agreements in a secure location for at least three years or 2.) supply copies of all signed informed consent agreements in .pdf format for retention by the IRB in electronic form? No ☐ Yes ☒

*(If you answer No to any of the questions above, please provide an explanation.)*

It will be presented in a classroom setting

**5.) Potential Risks:** *(A risk is a potential harm that a reasonable person would consider important in deciding whether to participate in research. Risks can be categorized as physical, psychological, sociological, economic and legal, and include pain, stress, invasion of privacy, embarrassment or exposure of sensitive or confidential data. All potential risks and discomforts must be minimized to the greatest extent possible by using e.g. appropriate monitoring, safety devices and withdrawal of a subject if there is evidence of a specific adverse event.)*

A.) What are the risks / discomforts associated with each intervention or procedure in the study?

Minimal

B.) What procedures will be in place to prevent / minimize potential risks or discomfort?

The participants can stop at any time

**6.) Potential Benefits:**

A.) What potential benefits other than payment may subjects receive from participating in the study?

Save money by reducing consumption in accordance to the contract

B.) What potential benefits can society expect from the study?

Information regarding the incorporation of sustainability in a classroom setting

**7.) Data Collection, Storage, and Confidentiality:**

A.) How will data be collected?

Survey

B.) Will a subject's voice, face or identifiable body features *(eg. tattoo, scar)* be recorded by audio or videotaping?
No ☒ Yes ☐ *(Explain the recording procedures you plan to follow.)*

C.) Will personal identifying information be recorded? No ☒ Yes ☐ *(If yes, explain how the identifying information will be protected. How will personal identifying information be coded and how will the code key be kept confidential?)*

D.) Where will the data be stored and how will it be secured?

A locked filing cabinet in professor Doyle's office

E.) What will happen to the data when the study is completed?

Paper data will be shredded after data entry. Electronic data will be kept in a password protected WPI account

F.) Can data acquired in the study adversely affect a subject's relationship with other individuals? *(i.e. employee-supervisor, student-teacher, family relationships)*

No

G.) Do you plan to use or disclose identifiable information outside of the investigation personnel?
No ☒ Yes ☐ *(Please explain.)*

H.) Do you plan to use or disclose identifiable information outside of WPI including non-WPI investigators?
No ☒ Yes ☐ *(Please explain.)*

**8.) Incidental findings:** *In the conduct of information gathering, is it possible that the investigator will encounter any incidental findings? If so, how will these be handled? (An incidental finding is information discovered about a subject which should be of concern to the subject but is not the focus of the research. For example, a researcher monitoring heart rates during exercise could discover that a subject has an irregular heartbeat.)*

No

**9.) Deception:** *(Investigators must not exclude information from a subject that a reasonable person would want to know in deciding whether to participate in a study.)*

Will the information about the research purpose and design be withheld from the subjects?
No ☒ Yes ☐ *(Please explain.)*

**10.) Adverse effects:** *(Serious or unexpected adverse reactions or injuries must be reported to the WPI IRB within 48 hours using the IRB Adverse Event Form found out at http://www.wpi.edu/offices/irb/forms.html. Other adverse events should be reported within 10 working days.)*

What follow-up efforts will be made to detect any harm to subjects and how will the WPI IRB be kept informed?

None necessary

**11.) Conflict of Interest:** *(A conflict of interest occurs when an investigator or other key personnel in a study may enjoy material benefits based on study results. Relationships that give rise to a conflict of interest or the appearance of a conflict of interest must be disclosed in the informed consent statement provided to study subjects. More information, including examples of relationships that require disclosure and those that do not, can be found here.)*

A.) Do any of the investigators listed on this application have a potential or actual conflict of interest with regard to this study?

a. Investigator (name) _James K. Doyle_____ No ☒ Yes ☐
b. Investigator (name) _Oliver Hammond_____ No ☒ Yes ☐
c. Investigator (name) _Lindsay Jones_____ No ☒ Yes ☐

B.) If any of the answers to 11A. are "Yes," please attach an explanation of the nature of the conflict to this application and identify appropriate language for use in the consent form. Examples of consent language are found on the IRB website, here.

C.) Does each investigator named above have a current WPI conflict of interest disclosure form on file with the appropriate supervisor/department head? No ☐ Yes ☒

D.) Do any of the investigators' COI forms on file with WPI contain information regarding this research?
No ☒ Yes ☐
a. If "Yes," identify the investigator(s) _ _____

**12.) Informed consent:** *(Documented informed consent must be obtained from all participants in studies that involve human subjects. You must use the templates available at http://www.wpi.edu/offices/irb/forms.html to prepare these forms.* ***Informed consent forms must be included with this application.*** *Under certain circumstances the WPI IRB may waive the requirement for informed consent.)*

**Investigator's Assurance:**

I certify the information provided in this application is complete and correct.

I understand that I have ultimate responsibility for the conduct of the study, the ethical performance of the project, the protection of the rights and welfare of human subjects, and strict adherence to any stipulations imposed by the WPI IRB.

I agree to comply with all WPI policies, as well all federal, state and local laws on the protection of human subjects in research, including:

- ensuring the satisfactory completion of human subjects training.
- performing the study in accordance with the WPI IRB approved protocol.
- implementing study changes only after WPI IRB approval.
- obtaining informed consent from subjects using only the WPI IRB approved consent form.
- promptly reporting significant adverse effects to the WPI IRB.

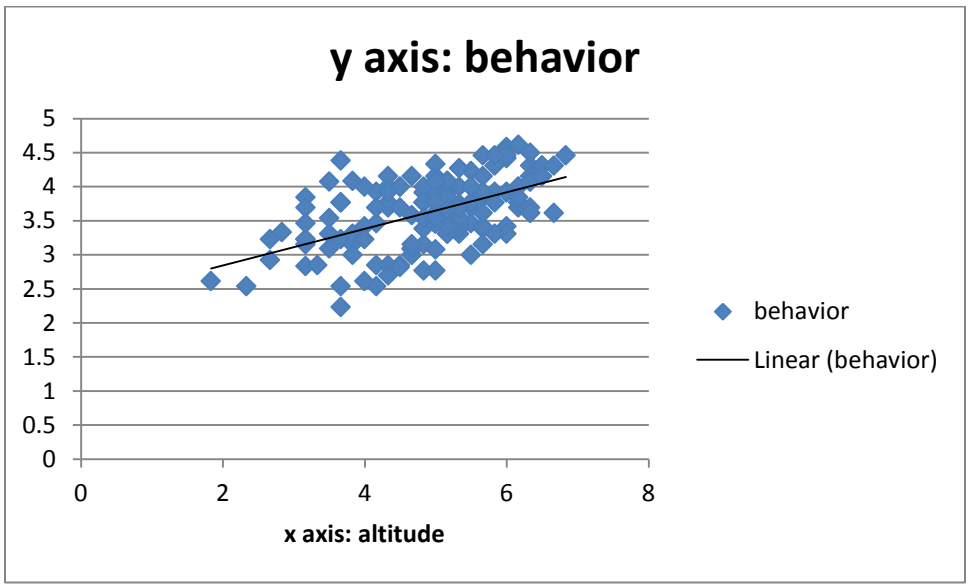
Signature of Principal Investigator _____ Date _____

Print Full Name and Title _____

*Please return a signed hard copy of this application to the WPI IRB c/o Ruth McKeogh 2nd Floor Project Center*
*Or email an electronic copy to irb@wpi.edu*
*If you have any questions, please call (508) 831-6699.*

## Appendix E: Relationship between Attitude and Behavior

1. **Scatter plot of behavior against attitude for experimental group using pre-surveys data**




2. **Regression analysis for behavior vs. attitude for experimental group using pre-surveys data**

Regression statistics

| Multiple R | $R^2$ | Adjusted $R^2$ | Standard Error | Observations |
|---|---|---|---|---|
| 0.5466 | 0.2988 | 0.2940 | 0.4236 | 149 |

ANOVA

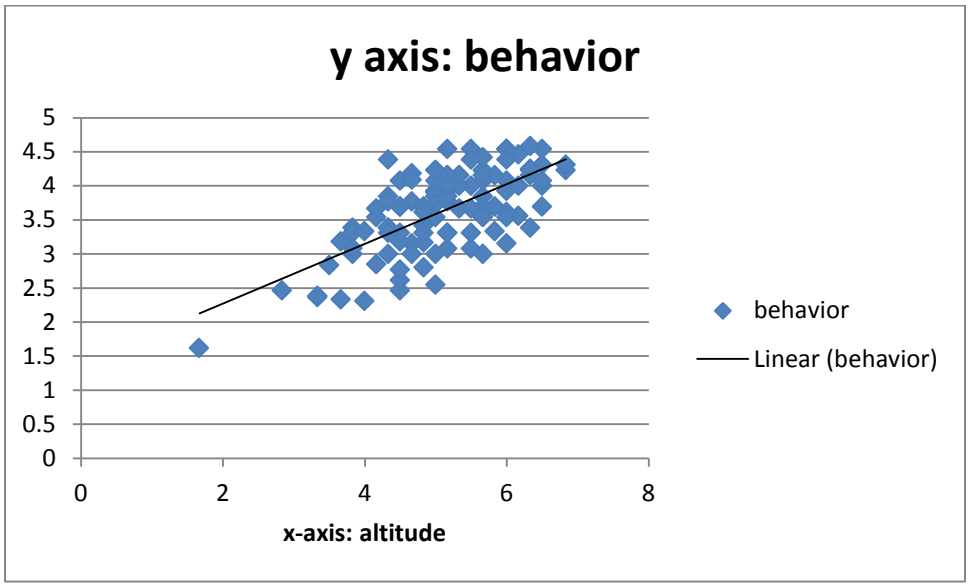
| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 1 | 11.2401 | 11.2401 | 62.6390 | 5.53E-13 |
| Residual | 147 | 26.3781 | 0.1794 | | |

| | | | | | |
|---|---|---|---|---|---|
| Total | 148 | 37.6182 | | | |

T-test

| | Coefficients | Standard Error | T Stat | P value |
|---|---|---|---|---|
| Interception | 2.3073 (α) | 0.1713 | 13.4723 | 1.89E-27 |
| Attitude | 0.2685 (β) | 0.0339 | 7.9145 | 5.53E-13 |

3. **Scatter plot of attitude against behavior for control group using pre-surveys data**




4. **Regression analysis for behavior vs. attitude for control group using pre-surveys data**

Regression statistics

| Multiple R | $R^2$ | Adjusted $R^2$ | Standard Error | Observations |
|---|---|---|---|---|
| 0.6623 | 0.4386 | 0.4336 | 0.4455 | 114 |

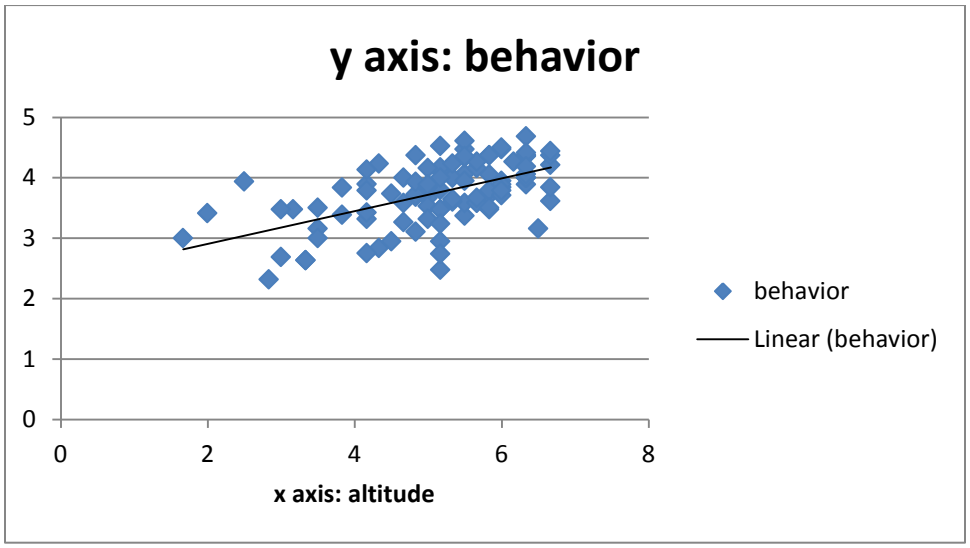
ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 1 | 17.3659 | 17.3659 | 87.5155 | 1.02E-15 |
| Residual | 112 | 22.2244 | 0.1984 | | |
| Total | 113 | 39.5903 | | | |

T-test

| | Coefficients | Standard Error | T Stat | P value |
|---|---|---|---|---|
| Interception | 1.3956 (α) | 0.2428 | 5.7479 | 7.92E-08 |
| Attitude | 0.4383 (β) | 0.0469 | 9.3550 | 1.02E-15 |

5. **Scatter plot of behavior against attitude for experimental group using post survey data**




6. **Regression analysis for behavior vs. attitude for experimental group using post survey data**

Regression statistics

| Multiple R | $R^2$ | Adjusted $R^2$ | Standard Error | Observations |
|---|---|---|---|---|
| 0.5556 | 0.3087 | 0.3016 | 0.4391 | 99 |

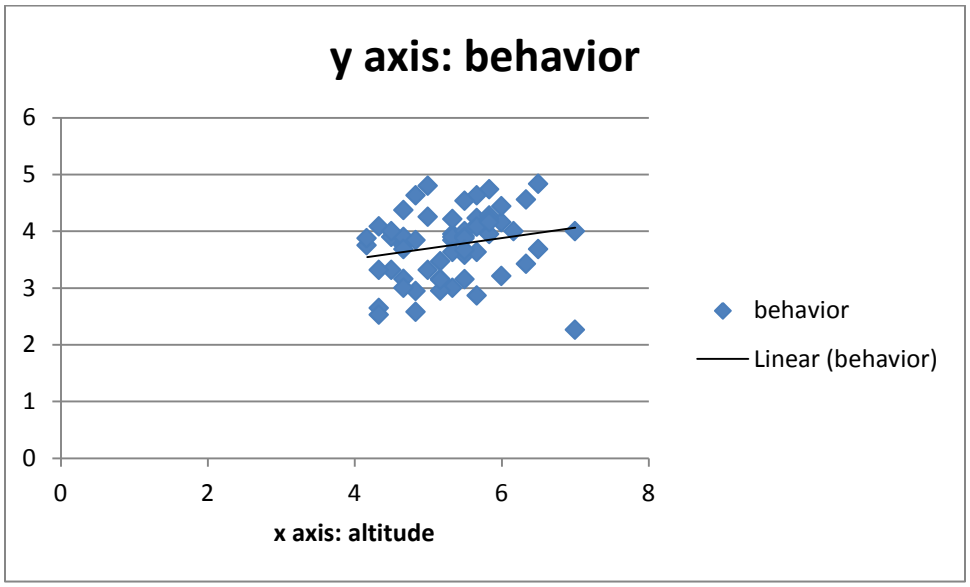
ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 1 | 8.3520 | 38.3520 | 43.3147 | 2.38E-09 |
| Residual | 97 | 18.7038 | 0.1928 | | |
| Total | 98 | 27.0558 | | | |

T-test

| | Coefficients | Standard Error | T Stat | P value |
|---|---|---|---|---|
| Interception | 2.3671 (α) | 0.2149 | 11.0160 | 8.73E-19 |
| Attitude | 0.2703 (β) | 0.0411 | 6.5814 | 2.38E-09 |

7. **Scatter plot of attitude against behavior for control group using post survey data**




8. **Regression analysis for behavior vs. attitude for control group using post survey data**

Regression statistics

| Multiple R | $R^2$ | Adjusted $R^2$ | Standard Error | Observations |
|---|---|---|---|---|
| 0.2093 | 0.0438 | 0.0279 | 0.5830 | 62 |

ANOVA

| | df | SS | MS | F | Significance F |
|---|---|---|---|---|---|
| Regression | 1 | 0.9345 | 0.9345 | 2.7490 | 0.1025 |
| Residual | 60 | 20.3967 | 0.3399 | | |
| Total | 61 | 21.3312 | | | |

T-test

| | Coefficients | Standard Error | T Stat | P value |
|---|---|---|---|---|
| Interception | 2.7794(α) | 0.5930 | 4.6872 | 1.64E-05 |
| Attitude | 0.1834(β) | 0.1106 | 1.6580 | 0.1025 |

## Appendix F: Comparison between Genders

### 1. Behavior Means for Pre-survey

| Group | Size | Mean | Standard deviation |
|---|---|---|---|
| Female ($u_1$) | 98 | 3.729217 | 0.555837 |
| Male ($u_2$) | 161 | 3.591899 | 0.523851 |

### 2. Behavior Means for Post-survey

| Group | Size | Mean | Standard deviation |
|---|---|---|---|
| Female ($u_1$) | 57 | 3.849480 | 0.525849 |
| Male ($u_2$) | 93 | 3.706944 | 0.560135 |

### 3. Attitude Means for Pre-survey

| Group | Size | Mean | Standard deviation |
|---|---|---|---|
| Female ($v_1$) | 98 | 5.073129 | 1.060611 |
| Male ($v_2$) | 161 | 4.995859 | 0.918171 |

### 4. Attitude Means for Post-survey

| Group | Size | Mean | Standard deviation |
|---|---|---|---|
| Female ($v_1$) | 57 | 5.289474 | 0.947284 |
| Male ($v_2$) | 93 | 5.175627 | 0.903016 |

# Appendix G: Raw Data of Change in Responses of Students

**Table G1: Behavior Scores for Students in the Experimental Group Who Took Both Surveys**

| Student | Before | After | Difference |
|---|---|---|---|
| 1 | 4.333333 | 3.666667 | -0.66667 |
| 2 | 3.666667 | 3.833333 | 0.166667 |
| 3 | 4.5 | | -4.5 |
| 4 | 3.833333 | 3.333333 | -0.5 |
| 5 | 3.666667 | 3.833333 | 0.166667 |
| 6 | 3.666667 | | -3.66667 |
| 7 | 4.333333 | 4 | -0.33333 |
| 8 | 4.25 | | -4.25 |
| 9 | 3.833333 | 4.333333 | 0.5 |
| 10 | 4.166667 | 4.666667 | 0.5 |
| 11 | 2.833333 | 4.333333 | 1.5 |
| 12 | 4 | 4.333333 | 0.333333 |
| 13 | 4 | 3.833333 | -0.16667 |
| 14 | 3.666667 | | -3.66667 |
| 15 | 3.333333 | | -3.33333 |
| 16 | 3.833333 | 3 | -0.83333 |
| 17 | 4.166667 | 4.333333 | 0.166667 |
| 18 | 4.166667 | 3.8 | -0.36667 |
| 19 | 3.166667 | 3.4 | 0.233333 |
| 20 | 4 | 4 | 0 |
| 21 | 4.166667 | 3.666667 | -0.5 |
| 22 | 4.333333 | 4 | -0.33333 |
| 23 | 4.166667 | 4.5 | 0.333333 |
| 24 | 4 | 3.833333 | -0.16667 |
| 25 | 3.333333 | 3.8 | 0.466667 |

| | | | |
|---|---|---|---|
| 26 | 4.166667 | 4.333333 | 0.166667 |
| 27 | 4.5 | 3.833333 | -0.66667 |
| 28 | 4.166667 | 3.666667 | -0.5 |
| 29 | 3.833333 | | -3.83333 |
| 30 | 3.5 | 4.5 | 1 |
| 31 | 4.6 | 4 | -0.6 |
| 32 | 4.2 | 4.666667 | 0.466667 |
| 33 | 4 | 4.166667 | 0.166667 |
| 34 | 4.166667 | 3.666667 | -0.5 |
| 35 | 4 | | -4 |
| 36 | 2.666667 | 4.4 | 1.733333 |
| 37 | 4.166667 | 4.5 | 0.333333 |
| 38 | 4.5 | 3.5 | -1 |
| 39 | 3.666667 | 3 | -0.66667 |
| 40 | 4.166667 | | -4.16667 |
| 41 | 2.5 | | -2.5 |
| 42 | 3.333333 | 3.666667 | 0.333333 |
| 43 | 4.166667 | 5 | 0.833333 |
| 44 | 4.166667 | 4 | -0.16667 |
| 45 | 4.166667 | 2.666667 | -1.5 |
| 46 | 3.166667 | | -3.16667 |
| 47 | 4.166667 | | -4.16667 |
| 48 | 3.5 | 4 | 0.5 |
| 49 | 2.166667 | 4.5 | 2.333333 |
| 50 | 4.333333 | 4 | -0.33333 |
| 51 | 4.166667 | 3.8 | -0.36667 |
| 52 | 4.333333 | 3.5 | -0.83333 |
| 53 | 4 | 3.166667 | -0.83333 |
| 54 | 3.833333 | 4.333333 | 0.5 |

| | | | |
|---|---|---|---|
| 55 | 4.333333 | 3.166667 | -1.16667 |
| 56 | 3.833333 | 3.833333 | 0 |
| 57 | 4 | 4.2 | 0.2 |
| 58 | 4 | 4.166667 | 0.166667 |
| 59 | 4 | | -4 |
| 60 | 3.5 | 4.666667 | 1.166667 |
| 61 | 4.333333 | 4.5 | 0.166667 |
| 62 | 4.666667 | 4.6 | -0.06667 |
| 63 | 3.833333 | 3.833333 | 0 |
| 64 | 3.666667 | | -3.66667 |
| 65 | 3 | 4.833333 | 1.833333 |
| 66 | 4.833333 | 2.166667 | -2.66667 |
| 67 | 2.5 | 3 | 0.5 |
| 68 | 3.5 | 3.833333 | 0.333333 |
| 69 | 4.166667 | | -4.16667 |
| 70 | 4 | 3.666667 | -0.33333 |
| 71 | 3.166667 | | -3.16667 |
| 72 | 4.833333 | 4.75 | -0.08333 |
| 73 | 4.5 | 4.166667 | -0.33333 |
| 74 | 4.666667 | 4.5 | -0.16667 |

**Table G2: Data of Attitude Scores for Students in the Experimental Group Before and After the Duration of the Study**

| student | before | after | difference |
|---|---|---|---|
| 1 | 6.5 | 6 | -0.5 |
| 2 | 5.333333 | 6 | 0.666667 |
| 3 | 6.5 | 5.833333 | -0.66667 |
| 4 | 5.5 | 5.166667 | -0.33333 |
| 5 | 4.166667 | 3.833333 | -0.33333 |

| | | | |
|---|---|---|---|
| 6 | 5.333333 | 5.166667 | -0.16667 |
| 7 | 6 | 6.666667 | 0.666667 |
| 8 | 4.5 | 5.166667 | 0.666667 |
| 9 | 5 | 5.5 | 0.5 |
| 10 | 5.666667 | 6.333333 | 0.666667 |
| 11 | 3.833333 | 5.166667 | 1.333333 |
| 12 | 5 | 5.5 | 0.5 |
| 13 | 4.333333 | 6 | 1.666667 |
| 14 | 5.166667 | 4.666667 | -0.5 |
| 15 | 3.166667 | 6.333333 | 3.166667 |
| 16 | 4.833333 | 4.5 | -0.33333 |
| 17 | 6 | 5.666667 | -0.33333 |
| 18 | 5.833333 | 6.333333 | 0.5 |
| 19 | 4.666667 | 4.833333 | 0.166667 |
| 20 | 5 | 5.5 | 0.5 |
| 21 | 5 | 5.166667 | 0.166667 |
| 22 | 5.333333 | 5 | -0.33333 |
| 23 | 6.166667 | 6.666667 | 0.5 |
| 24 | 5.5 | 5 | -0.5 |
| 25 | 5.666667 | 5.333333 | -0.33333 |
| 26 | 5.166667 | 5.333333 | 0.166667 |
| 27 | 4.666667 | 5.5 | 0.833333 |
| 28 | 5.666667 | 5.5 | -0.16667 |
| 29 | 4.333333 | 4.833333 | 0.5 |
| 30 | 4.833333 | 5.666667 | 0.833333 |
| 31 | 5.166667 | 4.5 | -0.66667 |
| 32 | 4.833333 | 4.833333 | 0 |
| 33 | 3.666667 | 5 | 1.333333 |
| 34 | 4.166667 | 6.333333 | 2.166667 |

| | | | |
|---|---|---|---|
| 35 | 5.5 | 3.333333 | -2.16667 |
| 36 | 2.333333 | 4.666667 | 2.333333 |
| 37 | 4.333333 | 6 | 1.666667 |
| 38 | 6 | 3 | -3 |
| 39 | 4.166667 | 5.166667 | 1 |
| 40 | 5.166667 | 3.5 | -1.66667 |
| 41 | 3.166667 | 4.333333 | 1.166667 |
| 42 | 4.166667 | 6.666667 | 2.5 |
| 43 | 6.166667 | 6 | -0.16667 |
| 44 | 6.333333 | 4.833333 | -1.5 |
| 45 | 5 | 4.166667 | -0.83333 |
| 46 | 3.333333 | 5.833333 | 2.5 |
| 47 | 5 | 3.166667 | -1.83333 |
| 48 | 2.666667 | 1.666667 | -1 |
| 49 | 3.666667 | 5.833333 | 2.166667 |
| 50 | 6.5 | 5.166667 | -1.33333 |
| 51 | 5.5 | 5.333333 | -0.16667 |
| 52 | 6.166667 | 3.5 | -2.66667 |
| 53 | 3.166667 | 4.166667 | 1 |
| 54 | 3.166667 | 6.166667 | 3 |
| 55 | 5.666667 | 6.5 | 0.833333 |
| 56 | 5.833333 | 5.166667 | -0.66667 |
| 57 | 5.5 | 6.333333 | 0.833333 |
| 58 | 6 | 6.333333 | 0.333333 |
| 59 | 6.5 | 6 | -0.5 |
| 60 | 5.666667 | 5.5 | -0.16667 |
| 61 | 4.833333 | 6.666667 | 1.833333 |
| 62 | 6.166667 | 5.333333 | -0.83333 |
| 63 | 5.166667 | 5.666667 | 0.5 |

| | | | |
|---|---|---|---|
| 64 | 5 | 5.166667 | 0.166667 |
| 65 | 4 | 5.5 | 1.5 |
| 66 | 6 | 2.833333 | -3.16667 |
| 67 | 3.666667 | 5.833333 | 2.166667 |
| 68 | 5.666667 | 5.833333 | 0.166667 |
| 69 | 5.333333 | 5.333333 | 0 |
| 70 | 4.5 | 4.166667 | -0.33333 |
| 71 | 4.166667 | 3.833333 | -0.33333 |
| 72 | 3.5 | 4.166667 | 0.666667 |
| 73 | 6.333333 | 6.666667 | 0.333333 |
| 74 | 6 | 5.833333 | -0.16667 |

**Table G3: Behavior Score Data of Students Who Signed the Contract**

| Student | Before | After | Difference |
|---|---|---|---|
| 1 | 3.666667 | 3 | -0.66667 |
| 2 | 3.833333 | 4.5 | 0.666667 |
| 3 | 3.333333 | 4.2 | 0.866667 |
| 4 | 3.833333 | 4.166667 | 0.333333 |
| 5 | 4 | 4 | 0 |
| 6 | 4.333333 | 3.833333 | -0.5 |
| 7 | 4.666667 | 4.166667 | -0.5 |
| 8 | 4.333333 | 4.666667 | 0.333333 |
| 9 | 4.333333 | 3.833333 | -0.5 |
| 10 | 3.833333 | 4 | 0.166667 |
| 11 | 3 | 4.333333 | 1.333333 |
| 12 | 4.333333 | 4.166667 | -0.16667 |
| 13 | 3.8 | 3.333333 | -0.46667 |
| 14 | 3.4 | 3.166667 | -0.23333 |

| | | | |
|---|---|---|---|
| 15 | 4 | 2.5 | -1.5 |
| 16 | 3.666667 | 3 | -0.66667 |
| 17 | 4 | 3.833333 | -0.16667 |
| 18 | 4.5 | 2.166667 | -2.33333 |
| 19 | 3.833333 | 2.5 | -1.33333 |
| 20 | 3.8 | 4 | 0.2 |
| 21 | 4.333333 | 4.2 | -0.13333 |
| 22 | 3.833333 | 3.666667 | -0.16667 |
| 23 | 3.666667 | 3 | -0.66667 |
| 24 | 4.5 | 4 | -0.5 |
| 25 | 4 | 2.833333 | -1.16667 |
| 26 | 4.666667 | 3.833333 | -0.83333 |
| 27 | 4.166667 | 3.5 | -0.66667 |
| 28 | 3.666667 | 2.833333 | -0.83333 |
| 29 | 4.4 | 3.5 | -0.9 |
| 30 | 4.5 | 3 | -1.5 |
| 31 | 3.5 | 5 | 1.5 |
| 32 | 3 | 4.5 | 1.5 |
| 33 | 3.666667 | 3.666667 | 0 |
| 34 | 5 | 4.333333 | -0.66667 |
| 35 | 4 | 4.8 | 0.8 |
| 36 | 2.666667 | 3.833333 | 1.166667 |
| 37 | 4 | 3.833333 | -0.16667 |
| 38 | 4.5 | 4 | -0.5 |
| 39 | 4 | 4.833333 | 0.833333 |
| 40 | 3.8 | 4.833333 | 1.033333 |
| 41 | 3.5 | 3.333333 | -0.16667 |
| 42 | 3.166667 | 4.166667 | 1 |
| 43 | 4.333333 | 3.5 | -0.83333 |
| 44 | 3.166667 | 4.5 | 1.333333 |

| | | | |
|---|---|---|---|
| 45 | 3.833333 | 4.166667 | 0.333333 |
| 46 | 4.2 | 3.5 | -0.7 |
| 47 | 4.166667 | 4.166667 | 0 |
| 48 | 4.666667 | 3.333333 | -1.33333 |
| 49 | 4.5 | 3.666667 | -0.83333 |
| 50 | 4.6 | 4 | -0.6 |
| 51 | 3.833333 | 3.166667 | -0.66667 |
| 52 | 4.833333 | 5 | 0.166667 |
| 53 | 2.166667 | 4.4 | 2.233333 |
| 54 | 3 | 3 | 0 |
| 55 | 3.833333 | 4.333333 | 0.5 |
| 56 | 3.666667 | 4.5 | 0.833333 |
| 57 | 4.75 | 4.6 | -0.15 |
| 58 | 4.166667 | 2.666667 | -1.5 |
| 59 | 4.5 | 4.333333 | -0.16667 |

**Table G4:Data for the Attitude Section of the Before and After Surveys for Students Who Signed the Contract**

| student | before | after | difference |
|---|---|---|---|
| 1 | 6.5 | 6 | -0.5 |
| 2 | 5.333333 | 6 | 0.666667 |
| 3 | 5.5 | 5.166667 | -0.33333 |
| 4 | 4.166667 | 3.833333 | -0.33333 |
| 5 | 6 | 6.666667 | 0.666667 |
| 6 | 5 | 5.5 | 0.5 |
| 7 | 5.666667 | 6.333333 | 0.666667 |
| 8 | 5 | 5.166667 | 0.166667 |
| 9 | 4.333333 | 5.5 | 1.166667 |
| 10 | 5.166667 | 6 | 0.833333 |
| 11 | 4.833333 | 4.5 | -0.33333 |
| 12 | 6 | 5.666667 | -0.33333 |
| 13 | 5.833333 | 6.333333 | 0.5 |
| 14 | 4.666667 | 4.833333 | 0.166667 |
| 15 | 5 | 5.5 | 0.5 |
| 16 | 5 | 5.166667 | 0.166667 |

| | | | |
|---|---|---|---|
| 17 | 5.333333 | 5 | -0.33333 |
| 18 | 6.166667 | 6.666667 | 0.5 |
| 19 | 5.5 | 5 | -0.5 |
| 20 | 5.666667 | 5.333333 | -0.33333 |
| 21 | 5.166667 | 5.333333 | 0.166667 |
| 22 | 5.666667 | 5.5 | -0.16667 |
| 23 | 4.333333 | 5.5 | 1.166667 |
| 24 | 5.166667 | 5.666667 | 0.5 |
| 25 | 4.833333 | 4.5 | -0.33333 |
| 26 | 3.666667 | 4.833333 | 1.166667 |
| 27 | 4.166667 | 5 | 0.833333 |
| 28 | 5.5 | 6.333333 | 0.833333 |
| 29 | 4.333333 | 4.666667 | 0.333333 |
| 30 | 6 | 6 | 0 |
| 31 | 4.166667 | 3 | -1.16667 |
| 32 | 5.166667 | 5.166667 | 0 |
| 33 | 6.166667 | 6.666667 | 0.5 |
| 34 | 6.333333 | 6 | -0.33333 |
| 35 | 5 | 4.833333 | -0.16667 |
| 36 | 3.333333 | 4.166667 | 0.833333 |
| 37 | 3.666667 | 1.666667 | -2 |
| 38 | 6.5 | 5.833333 | -0.66667 |
| 39 | 5.5 | 5.166667 | -0.33333 |
| 40 | 6.166667 | 5.333333 | -0.83333 |
| 41 | 3.166667 | 3.5 | 0.333333 |
| 42 | 3.166667 | 4.166667 | 1 |
| 43 | 5.666667 | 6.166667 | 0.5 |
| 44 | 5.833333 | 6.5 | 0.666667 |
| 45 | 5.5 | 5.166667 | -0.33333 |
| 46 | 6 | 6.333333 | 0.333333 |
| 47 | 6.5 | 6.333333 | -0.16667 |
| 48 | 4.833333 | 5.5 | 0.666667 |
| 49 | 6.166667 | 6.666667 | 0.5 |
| 50 | 5.166667 | 5.333333 | 0.166667 |
| 51 | 5 | 5.666667 | 0.666667 |
| 52 | 6 | 5.5 | -0.5 |
| 53 | 3.666667 | 2.833333 | -0.83333 |
| 54 | 5.666667 | 5.833333 | 0.166667 |
| 55 | 5.333333 | 5.833333 | 0.5 |
| 56 | 4.166667 | 4.166667 | 0 |
| 57 | 3.5 | 4.166667 | 0.666667 |

| | | | |
|---|---|---|---|
| 58 | 6.333333 | 6.666667 | 0.333333 |
| 59 | 6 | 5.833333 | -0.16667 |

**Table G5: Behavior Score Data for Participants in the Control Group**

| Students | Before | After | Difference |
|---|---|---|---|
| 1 | 3 | 3 | 0 |
| 2 | 4.25 | 4 | -0.25 |
| 3 | 3.6 | 3.166667 | -0.43333 |
| 4 | 4.2 | 3.666667 | -0.53333 |
| 5 | 3.4 | 2.5 | -0.9 |
| 6 | 3.833333 | 3.833333 | 0 |
| 7 | 4.166667 | 4 | -0.16667 |
| 8 | 2.833333 | 3.833333 | 1 |
| 9 | 4.5 | 4.5 | 0 |
| 10 | 2.833333 | 2.666667 | -0.16667 |
| 11 | 4.5 | 4.5 | 0 |
| 12 | 4 | 3.333333 | -0.66667 |
| 13 | 3.75 | 4.2 | 0.45 |
| 14 | 4.666667 | 5 | 0.333333 |
| 15 | 3.5 | 3.5 | 0 |
| 16 | 3.8 | 4.166667 | 0.366667 |
| 17 | 4.4 | 4.4 | 0 |
| 18 | 3.5 | 4.333333 | 0.833333 |
| 19 | 4.5 | 4.833333 | 0.333333 |
| 20 | 3.8 | 3 | -0.8 |
| 21 | 3.333333 | 2.5 | -0.83333 |
| 22 | 3.666667 | 2.166667 | -1.5 |
| 23 | 3.333333 | 3.666667 | 0.333333 |
| 24 | 4.166667 | 3.5 | -0.66667 |

| | | | |
|---|---|---|---|
| 25 | 3.666667 | 2.833333 | -0.83333 |
| 26 | 4.333333 | 4.166667 | -0.16667 |
| 27 | 3.6 | 3.5 | -0.1 |
| 28 | 4.5 | 4.833333 | 0.333333 |
| 29 | 3 | 3 | 0 |
| 30 | 3.5 | 3.833333 | 0.333333 |
| 31 | 4.333333 | 4.166667 | -0.16667 |
| 32 | 4.5 | 4.333333 | -0.16667 |
| 33 | 3.666667 | 3.666667 | 0 |
| 34 | 4.666667 | 4.166667 | -0.5 |
| 35 | 4.666667 | 4.166667 | -0.5 |
| 36 | 3.833333 | 3.5 | -0.33333 |
| 37 | 4 | 4 | 0 |
| 38 | 4.5 | 4.333333 | -0.16667 |
| 39 | 3.666667 | 3.333333 | -0.33333 |
| 40 | 4.5 | 4.5 | 0 |
| 41 | 4 | 4.166667 | 0.166667 |
| 42 | 5 | 5 | 0 |
| 43 | 2.833333 | 3.166667 | 0.333333 |
| 44 | 4.333333 | 3.5 | -0.83333 |
| 45 | 4.833333 | 4.8 | -0.03333 |
| 46 | 4 | 3.833333 | -0.16667 |

**Table G6: Data for the Attitude Scores of Students in the Control Group**

| student | before | after | difference |
|---|---|---|---|
| 1 | 5 | 5.666667 | 0.666667 |
| 2 | 4.666667 | 5.666667 | 1 |
| 3 | 4.833333 | 4.666667 | -0.16667 |
| 4 | 4.833333 | 5.333333 | 0.5 |

| | | | |
|---|---|---|---|
| 5 | 3.666667 | 4.333333 | 0.666667 |
| 6 | 5.666667 | 4.666667 | -1 |
| 7 | 4.333333 | 5.5 | 1.166667 |
| 8 | 3.5 | 5.5 | 2 |
| 9 | 5.666667 | 6 | 0.333333 |
| 10 | 4.166667 | 4.833333 | 0.666667 |
| 11 | 5.166667 | 5 | -0.16667 |
| 12 | 5.833333 | 5.5 | -0.33333 |
| 13 | 5.666667 | 5.5 | -0.16667 |
| 14 | 5.166667 | 4.833333 | -0.33333 |
| 15 | 4.833333 | 4.333333 | -0.5 |
| 16 | 5.833333 | 6.166667 | 0.333333 |
| 17 | 4.166667 | 4.166667 | 0 |
| 18 | 5.666667 | 5.666667 | 0 |
| 19 | 6.166667 | 5.666667 | -0.5 |
| 20 | 5.5 | 5.166667 | -0.33333 |
| 21 | 5.166667 | 7 | 1.833333 |
| 22 | 4.333333 | 4.333333 | 0 |
| 23 | 6.333333 | 6.5 | 0.166667 |
| 24 | 4.5 | 4.666667 | 0.166667 |
| 25 | 3.833333 | 4.833333 | 1 |
| 26 | 5 | 5.666667 | 0.666667 |
| 27 | 4.5 | 4.5 | 0 |
| 28 | 5.5 | 5.833333 | 0.333333 |
| 29 | 4.666667 | 5.5 | 0.833333 |
| 30 | 5 | 5.5 | 0.5 |
| 31 | 5.333333 | 5.333333 | 0 |
| 32 | 6.833333 | 7 | 0.166667 |
| 33 | 6 | 5.666667 | -0.33333 |

| | | | |
|---|---|---|---|
| 34 | 6 | 5.833333 | -0.16667 |
| 35 | 4.333333 | 4.5 | 0.166667 |
| 36 | 5.166667 | 5.333333 | 0.166667 |
| 37 | 5.333333 | 5.833333 | 0.5 |
| 38 | 5.666667 | 6 | 0.333333 |
| 39 | 5.833333 | 5 | -0.83333 |
| 40 | 5 | 4.666667 | -0.33333 |
| 41 | 4.833333 | 5.333333 | 0.5 |
| 42 | 6.333333 | 6.5 | 0.166667 |
| 43 | 4.5 | 5.166667 | 0.666667 |
| 44 | 5.333333 | 5.166667 | -0.16667 |
| 45 | 5.166667 | 5 | -0.16667 |
| 46 | 5.166667 | 5.333333 | 0.166667 |

# Appendix H: Data from Class Observations

Table 19H - First visitation

| Professor | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **Class** | PSY 2406 | MA 1022 | PSY 1402 | ENV 1100 | CE 3050 | CE 3074 | EN 2231 | CS4341 |
| **Time** | 3:00 - 5:00 | 1:00 - 2:00 | 8:00 - 10:00 | 3:00 - 5:00 | 1:00 - 2:00 | 9:00 - 10:00 | 9:00 - 11:00 | 9:00 - 10:00 |
| **Group** | Control | Experimental | Experimental | Experimental | Control | Control | Control | Control |
| **Reusable Watterbottles For** | 6 | 0 | 2 | 5 | 2 | 7 | 2 | 0 |
| **Reusable Water bottles Against** | 3 | 3 | 3 | 6 | 2 | 2 | 2 | 0 |
| **Reusable Water bottles Score** | 3 | -3 | -1 | -1 | 0 | 5 | 0 | 0 |
| **Recycling For** | 0 | 0 | 0 | 1 | 1 | 0 | - | 0 |
| **Recycling Against** | 1 | 1 | 2 | 0 | 0 | 0 | - | 0 |
| **Recycling Score** | -1 | -1 | -2 | 1 | 1 | 0 | - | 0 |
| **Both sides of paper For** | - | - | - | - | 7 | 6 | - | 0 |
| **Both sides of paper Against** | - | - | - | - | 1 | 0 | - | 0 |
| **Both sides of paper Score** | - | - | - | - | 6 | 6 | - | 0 |
| **Turn off lights For** | - | - | - | - | - | - | - | - |
| **Turn off lights Against** | - | - | - | - | - | - | - | - |
| **Turn off lights Score** | - | - | - | - | - | - | - | - |
| **Unnecessary elevator for** | - | - | - | 4 | - | - | 10 | 2 |
| **elevator** | - | - | - | 6 | - | - | 1 | 0 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **against** | | | | | | | | |
| **elevator score** | - | - | - | -2 | - | - | 9 | 2 |
| **Electronic for** | 21 | 29 | 28 | 35 | 14 | 20 | 13 | 5 |
| **electronic against** | 3 (not inc cellphones) | 2 (not inc cellphones) | 1 (not inc cellphones) | 2 (not inc cellphones) | 7 (inc cellphones) | 4 (not inc cellphones) | 2 (not inc cellphones) | 19 ( not inc cellphones) |
| **electronic score** | 18 | 27 | 27 | 33 | 7 | 16 | 11 | -14 |
| **Total number of students** | 24 | 31 | 29 | 37 | 21 | 24 | 15 | 24 (?) |
| **Professor: Whiteboard** | No | No | No | Yes | No | Both | Yes | No |
| **Only use needed lights** | No | No | No | Debatable | Yes | No | No | Yes |
| **Environmental Examples** | No | - | Yes | Yes | No | - | No | No |
| **Comments** | - | No recycling bin | - | It's an environmental class so of course they will use environmental examples | -Turned off unneeded lights upon entry - Power points had a lot of facts/tables/charts etc., whiteboards wouldn't be applicable / practical - No examples so no chance for environmental example - Used blackboards a for a few graphs etc. | Used both blackboard and power points Only one switch in room which controlled all lights | Didn't need lights but environmental examples are difficult. Neither of the electronic people used it for very long, just a few minutes | No one took notes. This is a computer based course |

Table 20H Second Visitation

| Professor | 1 | 2 | 3 | 4 | 5 | 5 | 6 | 7 |
|---|---|---|---|---|---|---|---|---|
| **Class** | PSY 2406 | MA 1022 | PSY 1402 | ENV 1100 | CE 3050 | CE 3074 | EN 2231 | CS4341 |
| **Time** | 3:00 - 5:00 | 1:00 - 2:00 | 8:00 - 10:00 | 3:00 - 5:00 | 1:00 - 2:00 | 9:00 - 10:00 | 9:00 - 11:00 | 9:00 - 10:00 |
| **Group** | Control | Experimental | Experimental | Experimental | Control | Control | Control | Control |
| **Reusable Watterbottles For** | 8 | 1 | 5 | 6 | 3 | 4 | 6 | 1 |
| **Reusable Water bottles Against** | 3 | 3 | 3 | 3 | 1 | 3 | 0 | 3 |
| **Reusable Water bottles Score** | 5 | -2 | 2 | 3 | 2 | 1 | 6 | -2 |
| **Recycling For** | 0 | 0 | 1 | - | 1 | - | 0 | 1 |
| **Recycling Against** | 0 | 0 | 0 | - | 0 | - | 0 | 0 |
| **Recycling Score** | 0 | 0 | 1 | - | 1 | - | 0 | 1 |
| **Both sides of paper For** | - | 0 | 7 | 3 | - | 1 | 3 | N/A |
| **Both sides of paper Against** | - | 0 | 0 | 2 | - | 1 | 0 | N/A |
| **Both sides of paper Score** | - | 0 | 7 | 1 | - | 0 | 3 | N/A |
| **Turn off lights For** | - | - | - | - | - | - | - | - |
| **Turn off lights Against** | - | - | - | - | - | - | - | - |
| **Turn off lights Score** | - | - | - | - | - | - | - | - |
| **Unnecessary elevator for** | - | 0 | - | 0 | N/A | N/A | 14 | 13 |
| **elevator against** | - | 0 | - | 3 | N/A | N/A | 0 | 1 |
| **elevator score** | - | 0 | - | -3 | N/A | N/A | 14 | 12 |
| **Electronic for** | 20 | Computer : 32 Phone : 25 | 26 | 35 | 14 | 19 | 14 | 19 |
| **electronic against** | 4 | Computer: 0 Phone: 7 | 1 | 4 | 5 | 3 | 0 | 4 |
| **electronic score** | 16 | Computer: 32 Phone 18 | 25 | 31 | 11 | 16 | 14 | 15 |
| **Total** | 24 | 32 | 27 | 39 | 19 | 24 | 14 | 23 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **number of students** | | | | | | | | |
| **Professor: Whiteboard** | No | No | No | No | No | No | Yes | No |
| **Only use needed lights** | Yes | No | No | No | Yes | Yes | No | No |
| **Environmental Examples** | No | No | No | Yes | No | Yes | No | No |
| **Comments** | Professor had a reusable water bottle - No recycling bin - Handed out handouts, but asked them back to recycle. | Elevator use was N/A | 1. First floor classroom 2. Used power point 3. Had PC on when using her own MacBook 4. Had all lights on when it was bright on the back rows 5. No environmental examples | Environmental Class - Student power point examples so no whiteboard possible - There was a presentation on bottled water | - | Used screen to show video - Used 2/3rds of the lights - Enviromental examples used - Printed hand-outs double sided - Turned off computer screen etc. when leaving | 1. All students sat in the first 2 rows, but all lights were on. 2. curtains were completely down 3. She told the class that an IQP member is observing their behavior 4. only used screen when needed 5. no electronics (probably) because the prof. discouraged laptop etc. at the beginning of the class | Cloudy day |

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