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Measuring the Effectiveness of Education for Sustainable Development Interventions for Effecting Change in Knowledge, Attitude and Behaviors toward Sustainable Development

Christopher Robin Wilson
University of South Carolina - Columbia

MEASURING THE EFFECTIVENESS OF EDUCATION FOR SUSTAINABLE DEVELOPMENT INTERVENTIONS FOR EFFECTING CHANGE IN KNOWLEDGE, ATTITUDE AND BEHAVIORS TOWARD SUSTAINABLE DEVELOPMENT

by

Christopher Robin Wilson

Bachelor of Science
Clemson University, 2000

Master of Engineering
University of South Carolina, 2003

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Accepted by:

Walter Peters, Major Professor

William Ranson, Committee Member

Jamil Khan, Committee Member

Jason Murray, Committee Member

Lacy Ford, Vice Provost and Dean of Graduate Studies

DEDICATION

I have always been fortunate to work for people I respect, but truly Mr. Radhakrishnan Jayaraman's constant encouragement, wealth of patience and the strength of his decency has been a long term lesson on sustainability.

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ABSTRACT

The question addressed by this study is whether an intervention involving a brief, focused seminar providing Sustainability Fundamental education can affect change in sustainability-centric behavior via measured change in attitude toward sustainability and/or change knowledge of sustainability fundamentals.

This study focused on applying and extending lessons from a previous exploration of the relationships between sustainable behavior and both attitude toward sustainability and knowledge of sustainability. The test involved determining whether brief, science-based sustainability fundamentals seminars are an effective intervention for affecting the favorable sustainable behavior of practicing engineers, defined as professionals engaged in engineering post-completion of their formal studies, in comparison to non-engineers.

The principle assumption of this project is that members of the engineering community at-large, have had limited or no direct experience with formal education for sustainable development, typically due to completing their education prior to the incorporation of education for sustainable development as an academic focus area.

The first part of this two-part study involved completing a cross-sectional survey to establish control group data for developing a representative understanding of the general community's knowledge of sustainability concepts, attitudes toward sustainability, and sustainable behaviors. The survey method involved collecting

anonymous input from self-electing participants associated with a candidate pool targeted for regional control and demographic representation.

The second part of the study involved delivering Sustainability Fundamentals seminars to a representative test group who completed both pre & post-seminar surveys to measure the seminars impact on knowledge of sustainability concepts, attitudes toward sustainability, and sustainable behaviors.

The principal goal of the study was to determine whether Sustainability Fundamentals seminars are an effective intervention for impacting knowledge, attitude and favorable behavior toward sustainability. A practical goal of this study was to further develop the sustainability metrics necessary to measure favorable sustainability behavior and both attitudes toward sustainability and knowledge of sustainability.

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CHAPTER 1

INTRODUCTION

1.1 General Introduction to the Problem

The world's population is rapidly increasing at an exponential rate, and may exceed 9 Billion by 2050 (Geohive.com, 2013). Our globally expanding footprint presents a critical need for understanding the complex systems of natural, human, and capital resources that enable the economic opportunity that supports our continued population growth.

The exponential increase in population will bring a dramatic increase in resource demand and consumption. For example, by 2050 world food production will need to increase by 70% to support a population of 9 Billion (Food and Agriculture Organization of the United Nations [FAO], 2008).

Given these dramatic projections, there are strong arguments for achieving a balance in consumption of resources, specifically wherever current consumption is focused on commodities that are renewable on a geological time-line and current technology offers few or limited alternatives. Arguments for balanced or *sustainable* consumption can be complex and are often contested, with people of opposing philosophies, agendas or politics reaching different conclusions about both the meaning of sustainability and what is sustainable (Ott, 2003).

Common ground is often possible where the laws of physics provide order and reason for the discussion of sustainability and sustainable consumption. Modern societies typically turn to engineers to apply the laws of physics to develop and deploy the technology, systems and processes that provide the goods and services they consume. Through this process engineers play a significant part in society's natural, human and capital resource consumption, and ultimately hold significant potential for impacting sustainable consumption of resources.

1.2 A Brief History of the Problem

The general concepts of sustainability and sustainable development matured through political and economic processes, with efforts by the UN General Assembly between 1987 and 1992 that ultimately promoted the subject above environmentalism as a central argument about the use of resources. A UN report titled Agenda 21 was issued in 1992 at the Earth Summit in Rio de Janeiro; Agenda 21 fundamentally captures the effort to negotiate a single definition of sustainability and introduces initial ideas about education for sustainable development in Chapter 36, "Promoting Education, Public Awareness, and Training" (United Nations Conference on Environment & Development [UNCED], 1992).

Since the introduction of Agenda 21 two decades ago, education for sustainable development has grown through formal, non-formal and informal efforts. Education for sustainable development is often promoted by groups outside the education community in many places and formal academic programs have becoming more wide-spread over time (McKeown, 2002). Until recently many university students, including engineers

completed their formal education without an opportunity to study the fundamental concepts of sustainability. Therefore the engineering community at-large may possess an inconsistent understanding of the fundamental concepts of sustainability.

1.3 Research Objectives and Hypothesis

This study focused on applying and extending lessons from a previous exploration of relationships between attitude toward sustainability, knowledge of sustainability, and sustainable behavior (Michalos, 2009). The test involved determining whether Sustainability Fundamentals seminars are an effective intervention for affecting the Sustainable Behavior of practicing engineers* in comparison to non-engineers.

A principle assumption of this project is that an important portion of the engineering community at-large has had limited or no direct experience with formal education for sustainable development, because many practicing engineers completed their education prior to the widespread incorporation of education for sustainable development in university curriculum.

The question addressed by this study is whether brief, focused Sustainability Fundamentals seminars are an effective intervention for changing sustainability knowledge and/or attitudes toward sustainability, both of which have a previously tested correlation to sustainability-related behavior.

A principle goal of this study is to further develop previously tested sustainability metrics useful in measuring sustainability knowledge, attitudes toward sustainability and favorable sustainability related behavior, for the advancement of education for sustainable development

CHAPTER 2

LITERATURE REVIEW

2.1 Overview of Environmental Literacy

In "The Language of the Environment", Myerson and Rydin (1996) discuss the challenge of "environment" as not fitting the divisions of modern specialization. They argue that "environment" belongs to every discipline and to none. The media, for instance, is challenged by the boundaries between news areas and are not able to conveniently define issues as "environmental" although the "environment" is an inescapable aspect of all news. This inherent dichotomy is a fundamental challenge to the concept of modern discipline specialization and urges systematic thinking growth across disciplines.

In "A Primer for Environmental Literacy", Golley (1998) develops a concept of Environmental Literacy founded in a scientific approach to the natural world. Golley (1998) defines a literate person as understanding what is written and placing it into a context of meaning. Environmental Literacy requires observation and assessment of patterns in Nature to make generalizations using an organized mental construct. For Golley (1998), building Environmental Literacy means a balance of progressive discoveries and development with consideration for social and environmental needs across a stakeholder base

Golley (1998) creates a model of Environmental Literacy focused around a central conceptual base called a Foundation (Environmental) Concepts cluster. The

Foundation Concepts focus on developing a natural systems approach focused on defining and understanding the "environment" and coincident applications through the relationships associated with the interacting parts of the whole.

Milbrath (1996) progressively developed some key concepts in "Learning to Think Environmentally", which are represented as essential to creating a systemic approach to the "environment" that is grounded in a strong understanding of the *built* and natural worlds. According to Milbrath, an individual must understand that they have inherited beliefs from their social and cultural groups that both empower and deceive them. Once an individual recognizes the existence and source of these formative beliefs they can benefit from an enlightened perspective with regard to communication and observation.

From this, Milbrath (1996) disregards linear mechanical-style thinking as inadequate for Environmental Thinking, which requires people to think systemically. With systemic thinking established, Milbrath focuses on the difference between Development and Growth along with Sustainability and Sustainable Development, while also presenting natural diversity and the Tragedy of the Commons as fundamental concepts of Environmental Thinking.

2.2 Overview of Sustainability and Sustainable Development

Dresner's "The Principles of Sustainability" focuses on building a model of Sustainability divorced from ecology or the natural world (2003). Dresner presents Sustainability as a contextual blend of ethics, metaphysics, economics, political/social

science and 20th century history, which firmly grounds this ambiguous and often subverted subject as an anthropogenic construct.

Goudie's (2000) "The Human Impact on the Natural Environment" details the progressive impact of developing populations on the world, and bridges a broad spectrum of diverse disciplines to explain that man has "changed the planet from its pristine condition".

Ott (2003) defined an ethical idea of sustainability in his "The Case for Strong Sustainability", by stating:

> Sustainability means that present and future persons have the same right to find, on the average, equal opportunities for realizing their concepts of a good human life.

His view of sustainability centered on an obligation to future generations and considers intergenerational equity a given. This definition includes an objective, "a good human life", warranted by moral duty to and between generations.

Ott's simplified definition of sustainability allows for a view of sustainable development that strips away the contestability of development and incorporates technology and economic change. Ott defined as "development that reaches or maintains a sustainable state" (Ott, 2003).

2.3 Overview of the Natural Step

The Natural Step is an organization focused on promoting sustainability. The Natural Step organization developed a five part model called The Natural Step framework that

communicates a common understanding of ecological connections grounded in the fundamental principles of nature and science (Steade, 2004).

The Natural Step framework provides a roadmap for breaking down sustainability goals into actionable plans rooted in common sustainability principles. The Natural Step framework promotes a systems approach and grounds analysis in basic scientific principles.

Organizations use The Natural Step framework as a conceptual tool to evaluate current environmental and sustainability performance (Collins, 2009). Then they use the framework to establish and implement plans to manage their overall performance to meet their goals.

The Natural Step framework provides four root causes for environmental issues, or sustainability system conditions: extracting materials from the earth's crust at a rate higher than they are returned, increasing concentrations of synthetic materials in the natural environment, degrading the natural world, and systematically undermining people's ability to meet their needs (Collins, 2009).

The Natural Step framework offers a process approach that can be useful for tying together a number of the broadly available tools for environmental and sustainability management, such as: Life Cycle Analysis, ISO14001, LEED, etc. (The Natural Step, 2006). Each of these tools fits into one or more of the stages of The Natural Step frameworks five part model, which includes: a stage devoted to evaluating the system in question, a "Success" stage focused on developing a vision and goals for sustainable performance rooted in the Sustainability System Conditions, a strategy development

stage, an action stage, and a stage devoted to using tools and metrics to measure performance to goals (The Natural Step, 2006).

2.4 Overview of Education for Sustainability Goals

Since the Earth Summit in Rio de Janeiro in1992, where The Agenda 21 was released, there has been increased interest in the role of education for sustainability in changing attitudes toward sustainability and sustainable behavior of individuals. Chapter 36 of Agenda 21 specifically discusses focusing education on sustainable development (United Nations Conference on Environment & Development [UNCED], 1992).

In December 2002, the United Nations announced the UN Decade of Education for Sustainable Development, or DESD, from 2005- 2014. The UN proclamation stated that "education is an indispensable element for achieving sustainable development" (UN Decade for Education for (UN Decade for Sustainable Development [UNDESD], 2013).

The UN also designated UNESCO to lead the implementation of DESD. In their International Implementation Scheme for DESD, UNESCO provides a vision for education for sustainable development where everyone "has the opportunity to benefit from quality education and learn the values, behavior and lifestyles required for a sustainable future" (UN Educational, Scientific and Cultural Organization [UNESCO], 2005).

According to the UNESCO (2005), there are many challenges to implementing education for sustainable development, specifically the need to:

1. Integrate sustainable science and education;
2. Strengthen co-ordination and collaboration between different levels of education for sustainable development; and

3. Mitigate information and knowledge gaps between different parts of the world.

A key element in addressing these challenges in education for sustainability is the ability to assess whether changes in behavior are taking place as a result of education for sustainability efforts (UNDESD, 2013). Measuring behavioral change requires a basic understanding of change in knowledge of sustainability concepts and change in attitude toward sustainability.

2.5 Overview of Developing Sustainability Metrics

In 2007 the International Institute for Sustainable Development (IISD) began work with partners across Canada to execute two surveys designed to assess the level of awareness and understanding of sustainable development among citizens of Manitoba, British Columbia. The purpose of the data collection was to support an effort to establish a framework for assessing changes in levels of sustainability-related understanding and behavior over time (International Institute for Sustainable Development [IISD], 2009).

The ultimate purpose of the IISD team's exploratory study was to "lay the foundation for the development of standardized tests of people's knowledge, attitudes and behaviors concerning the basic themes of the DESD" (IISD, 2009). As such, the IISD team used "fifteen strategic perspectives and the connections between them" from the DESD framework as the underlying structure for their surveys focused on assessing behavior, knowledge and attitude toward sustainable development (IISD, 2009).

Ultimately, the IISD team generated a 47 question survey roughly focused evenly on testing participant attitude, knowledge and behavior toward sustainable development. 5000 surveys were distributed across Manitoba, and 506 completed surveys returned (IISD, 2009). The IISD team evaluated the data using both weighted and non-weighted

demographic information to develop indexes presenting the statistically significant associations.

The IISD study demonstrated that attitude toward sustainable development is "vastly more influential than education", age or knowledge for behavior favorable to sustainable development. Also, the highest level of general education is more important for explaining favorable sustainable development behavior than specific knowledge of sustainable development concepts (IISD, 2009).

Much of the IISD survey data did not offer sufficient discriminating power, but the general results of the exploratory study offered a promising direction for continued work.

2.6 Overview of Attitude-Action Gap

Newton and Meyer's 2013 paper "Exploring the Attitudes-Action Gap in Household Resource Consumption: Does 'Environmental Lifestyle' Segmentation Align with Consumer Behaviour?", presented their research into sustainable consumption based on a postal survey taken in June 2009 that collected data from 1250 participants in Melbourne, Australia.

Newton and Meyer's research demonstrated that different factors override attitudes, opinions and intentions as indicators of consumer behavior and there are often important gaps between sustainability intentions and sustainable behavior (2013).

For example, of the households surveyed by Newton and Meyer, only one-third indicated that they would voluntarily change their consumption behavior and bear the direct economic consequences. However, later when participant's actual consumption

behavior was evaluated, there was no difference in consumption levels across any of the groups (2013).

Newton and Meyer argue that the current social norms of modern society do not include fully materialized sustainability norms that would positively influence voluntary sustainable behavior at the individual and household level (2013). According to Newton and Meyer (2013) comfort, convenience and cost factors appear to drive habits and practices that promote consumption, and lead to the gap between intentions and action at both the individual and household level. According to Newton and Meyer, well in-grained social norms appear to cut across all segments of the population, including people self-reporting as having green attitudes, opinions and intentions.

Closing the gap between actual behavior and professed values and attitudes is an opportunity area for sustainability metrics.

2.7 Overview of Sustainable Behavior

In 2013, Tapia-Fonllem, Corral-Verdugo, Fraijo-Sing and Duron-Ramos said that in practical terms “Sustainable Behavior" is deliberate, purposeful and anticipatory action aimed at protecting both natural and human resources, and it is future-oriented, by definition, because it considers the needs of future generations while simultaneously addressing current needs. They applied that Sustainable Behavior definition as the foundation for their conservation psychology (CP) research paper, "Assessing Sustainable Behavior and its Correlates: A Measure of Pro-Ecological, Frugal, Altruistic and Equitable Actions".

The researchers surveyed 807 Mexican undergraduates, and evaluated a number of "psychological dimensions of sustainability", including: attitude, motives, beliefs, norms, and values. Tapia-Fonllem et al then compared those factors to three *human capacities*, knowledge, skills and aptitudes, and then looked at *psychological consequences* linked to sustainable actions, wellbeing and happiness (2013).

The goal of the research was to test a model of interrelations among proposed facets of sustainable behavior (pro-ecological, frugal, altruistic, and equitable actions) applying the following descriptions of each term:

- *Pro-ecological behaviors* are purposeful and effective actions that result in the conservation of natural resources, such as recycling, composting, water conservation, energy-saving behaviors, etc.
- *Frugality* is a sustainable lifestyle behavior referring to decreased level of consumption or austere behaviors intended tot diminish the impact of human behavior.
- *Altruism* is a tendency toward improving other people's well-being with little interest in personal gain. Altruism is also related to the consideration of future consequences and to personal responsibility.
- *Equity* refers to an intra- and inter-generational balance in current and future consumption among people who in-turn preserve their physical environment.

Researchers also tested the link between the Sustainable Behavior and Intention to Act in a Pro-Sustainable Way and the association between Sustainable Behavior and the reported happiness of study participants (Tapia-Fonllem et al, 2013).

Tapia-Fonllem et al developed a structural model that revealed a strong relationship between the four first-order factors and Sustainable Behavior (2013). The model demonstrated that people that demonstrate pro-ecological and frugal actions are also likely to engage in altruistic and equitable behaviors. Given this observation, it is reasonable to conclude that a person who demonstrates pro-sustainability behavior of one type will tend to act in an integrated sustainability focused manner.

The Tapia-Fonllem et al (2013) model also indicated that Sustainable Behavior is directly predicted by intention to act, which in turn is positively and significantly influenced by positive attitudes toward sustainability. Finally, Sustainable Behavior was a slight, but significant predictor of self-reported happiness.

The research by Tapia-Fonllem et al (2013) has two strong applications for the purposes of this study. First, it demonstrates the inter-connectivity of the different facets of Sustainable Behavior, with different sustainable actions likely to lead to other holistic, supportive and inter-related behaviors. Second, the link between Sustainable Behavior and both Intention to Act and Attitude toward Sustainability offers a foundation for the hypotheses that an education for sustainability intervention could impact sustainable behavior by driving a change in either attitude toward sustainability or knowledge of sustainability concepts.

2.8 Overview of Net Promoter Score

Frederick F. Reichheld, director emeritus and fellow at Boston-based strategy consultancy Bain & Co., is a respected authority on loyalty. Working with researchers at

Bain, Reichheld discovered that consumer loyalty can be a significant predictor of a company's growth (Reichheld, 2006).

Reichheld and Bain argue that there is a "Loyalty Acid Test" effective for predicting a company's growth potential. The test centers on asking customers a basic question regarding their potential to recommend a given company or service, for example, "How likely is it that you would recommend XYZ to a friend or colleague?" (Reichheld, 2006).

Customers are asked to rate this question on a scale of 0 to 10. Reichheld broke the responses into three categories: Promoter, Passive and Detractor. Promoters rate their willingness to recommend at 9 or 10; promoters are typically the most active customers and provide the most referral activity. Passives rate their willingness to recommend at 7 or 8, and Detractors score between 0 and 6. Passives are moderately active customers and provide moderate referrals, while Detractors represent the least active customers and offer the least referrals (Satmetrix, 2004).

Reichheld then aggregated individual customer data into a single indicator that predicted growth performance beyond the individual customer level. Reichheld determined the % of Promoters from the total population and generated a % Net Promoter by subtracting the % of Detractors from the % of Promoters (Reichheld, 2006). For most industries this growth projection technique has a correlation of .70 or higher, indicating that for most industries the "Recommend Question" is an effective aggregate loyalty indicator useful for gauging long-term growth (Satmetrix, 2004). This single question

method of measuring loyalty correlated to growth potential, and eclipsed customer satisfaction-related questions by r scores of 3X (Reichheld, 2004).

The strongest companies, with the best long-term growth potential, typically have the highest Net Promoter Score in their industry with the best scoring as high as +80%. Above average companies, those in the 75th percentile, will score approximately 35%; 50th percentile companies will have scores around 11%, and lower performing companies in the bottom 25th percentile of their industry will typically score -10% or lower, with the worst scores around 40% (Reichheld, 2004).

CHAPTER 3

METHODOLOGY & PROCEDURE

3.1 Purpose

This study tested whether brief, focused Sustainability Fundamentals seminars are effective as an education for sustainable development intervention for changing sustainability knowledge and/or attitudes toward sustainability, both of which have a previously tested correlation to sustainability-related behavior.

The research project itself involved multiple steps: conceptualization, operationalization, data collection, processing data, and data analysis. The following sections provide a detailed step-by-step description of each step of this project.

3.2 Conceptualization

This study applied Ott's ethical idea of sustainability as a limiting boundary condition to close debate on broader concepts, such as the applicability and general contestability of Sustainability and Sustainable Development. The goal of restricting the broader concepts was to enable a narrowly focused study based on Ott's view of sustainable development as "development that reaches or maintains a sustainable state"(Ott, 2003).

The Natural Step framework was selected to provide science-based, fundamentals focused discussion of Sustainability and Sustainable Development, in compliance with Ott's definition of sustainability (Steade, 2004). The Natural Step framework is rooted in

four sustainability system conditions: extracting materials from the earth's crust at a rate higher than they are returned, increasing concentrations of synthetic materials in the natural environment, degrading the natural world, and systematically undermining people's ability to meet their needs (Collins, 2009).

All people consume resources, but in most modern societies it generally falls to engineers to develop products and services to meet the consumption levels afforded by the available human, natural and capital resources. Given this key input at the sources of consumption, engineers must understand the Natural Step framework concepts key if society is to achieve sustainability. This has not always been the case, as will be demonstrated later, and is a direct reflection of the late incorporation of education for sustainable development or sustainability concepts into higher education programs.

Given the importance of education for sustainable development, the UN declared a Decade of Education for Sustainable Development in 2002, and through UNESCO issued an implementation scheme which generally states that everyone "should learn the values, behavior and lifestyle required for a sustainable future", which is the foundation for education for sustainable development (UN Educational, Scientific and Cultural Organization [UNESCO], 2005).

UNESCO defined three key challenges to implementing education for sustainable development: integrating sustainable science and education strengthen co-ordination and collaboration between different levels of education for sustainable development, mitigate information and knowledge gaps between different parts of the world (UNESCO, 2005).

A principle requirement of each of the challenges UNESCO identified is the ability to measure whether there has been an actual change in behavior due to the education for sustainable development efforts. To begin addressing this requirement, the International Institute of Sustainable Development performed two exploratory studies in Manitoba, British Columbia.

The IISD efforts were captured in a report published in 2009, which details their work focused on measuring Knowledge, Attitudes and Behaviors toward Sustainable Development. The IISD study provides key insights for an initial framework for metrics that connect attitude and knowledge of sustainability to sustainable behavior, and the IISD study provides a strong foundation for additional work.

The IISD study falls short of providing a scale that offers an elegant and simple predictor of future behavior, but did strongly indicate that attitude toward sustainable development was more influential than age, education or knowledge of sustainable subjects for favorable behavior toward sustainable development (IISD, 2009).

Industry offers growth focused metrics that measure loyalty as an indicator of attitude, and can be generally adapted to a range of fields. The Net Promoter Score, for instance uses aggregated customer input to calculate the ratio of customers that are highly likely to promote a product or service versus the customers that are likely to "sell against" a product or service (Satmetrix, 2004). The corresponding ratio of loyal customers to disloyal customers is an indication of the company's future growth potential.

3.3 Research Method

This study involved a two-step data collection process. The first part of the study involved testing a control group to develop a representative understanding of the general community's knowledge of sustainability concepts, attitudes toward sustainability, and sustainable behaviors. The survey process involved deploying on-line surveying tools to collect representative survey input from an anonymous, self-elected group of participant solicited to participate via their relationship with targeted organizations focused on engineering and education programs.

The second part of the study involved administering a paper pre-survey and post-survey to a representative Test Group solicited to attend a basic seminar on Sustainability Fundamentals via organizations focused on engineering.

3.4 Survey Instruments

This study applies lessons from the IISD study to develop a narrow survey instrument for use in determining the impact of seminars as an intervention on a small sub-group of the population. The IISD researchers used elements from the Framework for the UNDESD Implementation Scheme to generate a survey instrument with three sets of questions, 17 items focused on measuring knowledge of sustainable development and 15 each on measuring attitude and behavior (IISD, 2009). IISD tested their content via screening with 160 knowledge groups, which allowed them to cut their instruments down from an initial 90 item survey to the final 47 items (IISD, 2009).

Also, the IISD results indicated that a number of their survey instrument questions did not offer adequate discriminating power. Therefore, an effort was made to only carry

forward the questions from the IISD study that merited further evaluation. This included questions that had offered adequate sensitivity as sustainability metrics based on results from the IISD study, and a number of items, such as the question on Gender Equity, that left the IISD researchers seeking further information.

By evaluation, the IISD survey language was composed for British Columbia. All questions carried forward from the IISD survey were adjusted to better reflect the English standard for the United States.

While the IISD study focuses on finding a means of explaining sustainable behavior by measuring attitude and knowledge, the IISD study falls short of providing a scale that offers an elegant and simple predictor of likely behavior (IISD, 2009). So, in addition to directly carrying over questions from the IISD study, a number of new questions were generated.

Given the focus of DESD on measuring change in behavior, many of the new questions were crafted by adapting a standard loyalty-based business growth metric, Net Promoter Score, to a meet the indirect relational focus of a cross-sectional survey on sustainability and sustainable development.

In generating new questions, an effort was made to use the same strategic focus areas from the UNDESD implementation scheme as source material. All questions were evaluated and reviewed by data collection experts certified in Lean Six Sigma techniques and qualified as both Six Sigma Black Belts and Master Black Belts.

3.5 Survey Tools

Surveys were created using survey generation tools available via the SurveyGizmo.com service. SurveyGizmo.com provided access to an online survey portal via URL links that were emailed to prospective participants and participant groups. Refer to Figure 3.1 for an image of the on-line survey hosted at SurveyGizmo.com (SurveyGizmo.com, 2013).

The URL link to the survey portal was also hosted at the study website, SurveySustainability.com, to provide a central hub for study data, researcher contact information and to answer participant questions about the study. The website was created via Word Press, and hosted by a third party hosting supplier. Refer to Figure 3.2 for an image of the website homepage.

Completed survey datasets were stored at the SurveyGizmo.com site, which provided the required password protection requirements for the anonymous data provided by participants. Survey Gizmo provides basic reporting tools for dataset manipulation.

3.6 Seminars

The vehicle for the Test Group pre-survey and post-survey process was a 30 to 45 minute Sustainability Fundamentals seminar. In creating the Sustainability Fundamentals seminar, the main goal was to avoid the need to validate a new curriculum while maximizing the credibility of the seminar's content and message. Ultimately, the Natural Step's tried and tested science-based approach to explaining Sustainability was selected to form the core content for the seminar (Collins, 2009). Borrowing from the Natural Steps well developed content helped minimize the potential for presentation and content variability.

Only very limited, and widely accepted, material was added to the Natural Step seminar material, to enable smooth introduction to the content and to simplify transitions between content areas. Despite the use of the Natural Step content material, all source material used for the Sustainability Fundamental Seminars was additionally validated against widely available curriculum from similar courses to verify content applicability.

Once a draft seminar was crafted, it was presented to three Toastmaster International clubs, an organization focused on presentation skills development through constructive feedback. The Toastmaster International groups provided direct feedback on presentation flow, presentation style, survey methodology and survey content. The general feedback led to content editing for time and flow and presentation reference hand-outs were added. Also, survey formatting was improved to increase readability.

3.7 Population, Boundaries and Data Collection

The goal of the cross-sectional Test Group survey was to reach out to a target population of practicing engineers. For the purposes of this study, practicing engineers are considered study participants that have completed undergraduate and/or graduate engineering studies and have experience working in the engineering community at-large.

Practicing engineers were engaged via small groups for seminars on Sustainability Fundamentals. The small group sessions were arranged in advance with focal points or group leaders, and all of the sessions were hosted by community organizations, non-profit groups, and employer sponsored groups with large practicing engineer affiliations, such as ASME.

The Test Group survey process involved data collection both before and after a seminar designed to provide an education for sustainable development intervention. The data collection process involved a pre-seminar and post-seminar paper survey administered by the researcher in-person, with each participant participating in the consent process prior to completing a hand-written paper survey.

Most Test Group sessions included a small percentage of non-engineers. No effort was made to exclude the non-engineers, and the non-engineers were surveyed as part of the over-all process, but the contribution of their data is incidental.

The initial goal for establishing Control Group data was to implement a cross-sectional survey of a demographically representative sample of the general population in South Carolina. Upon close review of the IISD results that demonstrated education was the single highest predictor of sustainable behavior, and upon completion of initial test seminar surveys, a decision was made to target participant groups with potentially high levels of education to ensure that both the test and Control Group would match across this demographic.

Given the education consideration, Control Group survey participants were solicited from non-profit organizations with large volunteer groups from both the technology and education career fields, where education refers to both K-12 and higher education. Participants were solicited to participate in the survey process by representatives of the non-profit organizations they are affiliated with as volunteers.

Control Group survey data was collected through an on-line survey portal hosted through the company, SurveyGizmo.com. Given the potential for people with a high bias

for or against sustainability to be more likely to actively self-elect to participate, a general effort was made to alienate subject bias. The majority of participation requests were made via partnerships with non-profit organization focused on science, technology, engineering or math education who directly solicited their volunteers and membership to participate in return for a small monetary benefit t for each survey completed. The goal was to provide a primary motivation for participants to compensate for any other factors driving participation.

All Test Group sessions were sponsored by organizations based in South Carolina. The Control Group organizations only serve South Carolina. There was no effort made to limit either the Test Group or Control Group to only participants from South Carolina, but any participation by individuals from outside South Carolina was incidental.

3.8 Sustainability Promotion Score

For the purposes of this study, the practices of the Net Promoter Score will be adapted to measure behavior toward sustainability, with an appropriate adaptation of the methodology to accommodate the limitations of this process and the indirect customer relationship. With respect to the divergence from core Net Promoter Score practice, the methodology used in this study will be referenced as a Sustainability Promotion Score, fully recognizing the work of Reichhold et al as the basis for the effort (Reichheld, 2006).

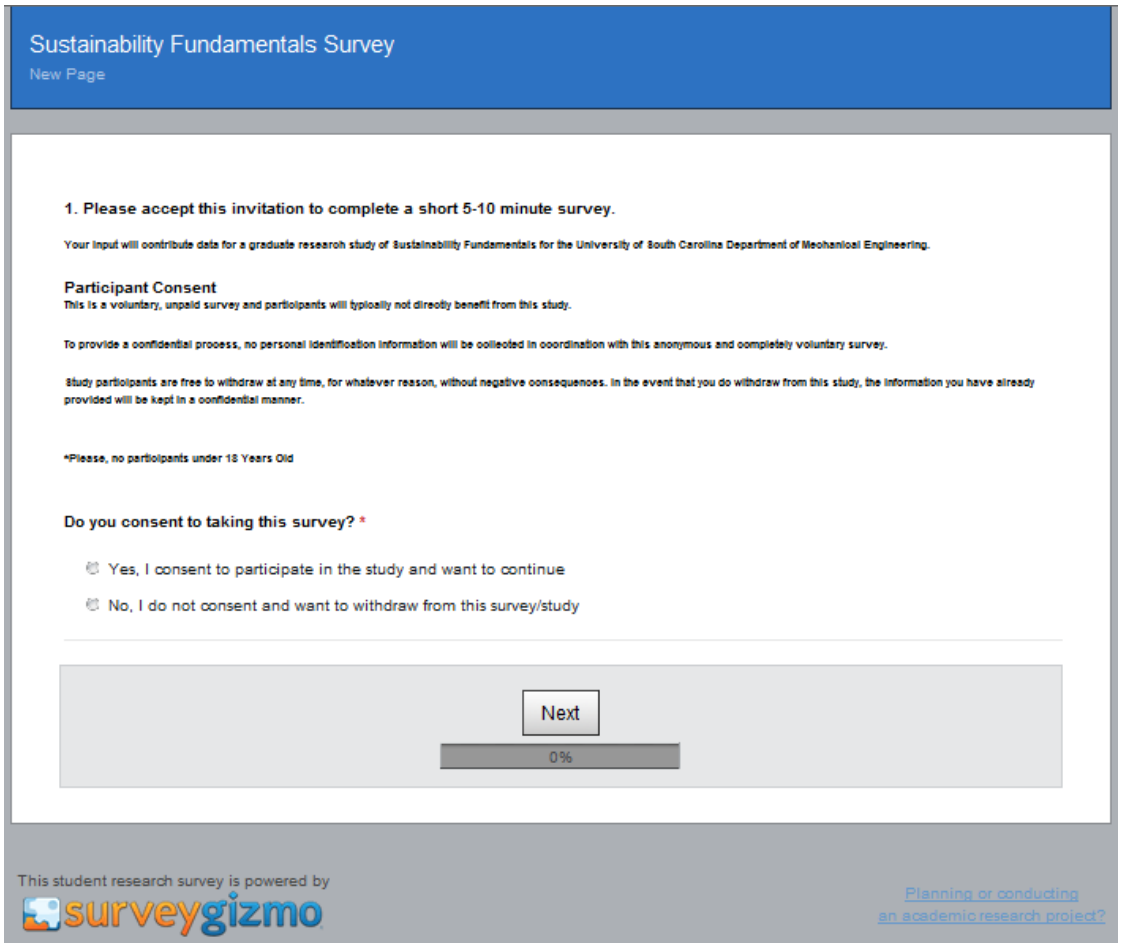

Figure 3.1On-line Research Survey Front-Page (SurveyGizmo.com, 2013)

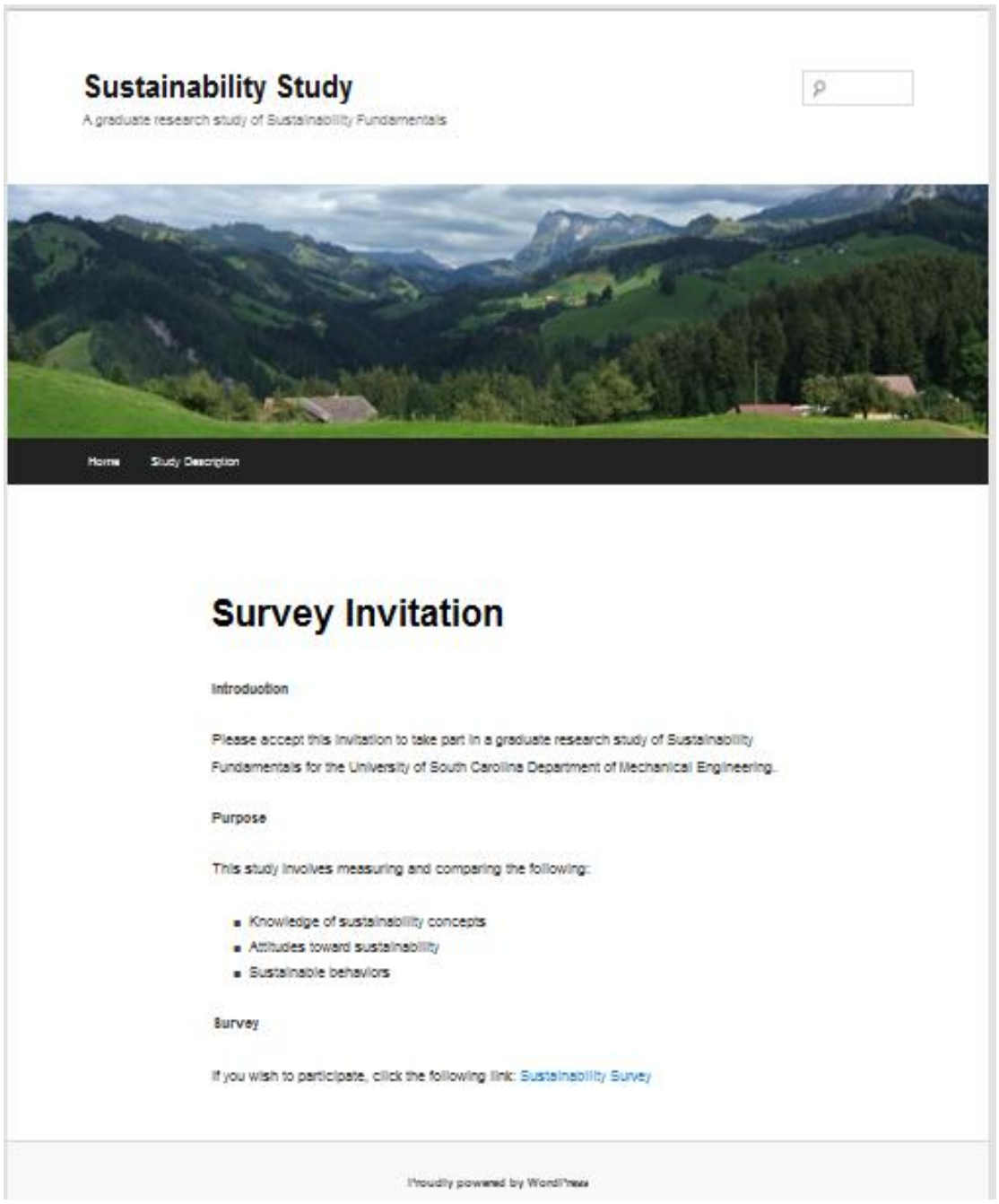

Figure 3.2 Research Study Website Homepage Hosted at SurveySustainability.com

CHAPTER 4

RESULTS

4.1 Data Evaluation

Datasets were evaluated using standard descriptive statistics and graphing techniques. Datasets were compiled and cross-tabulated against demographic variables to determine empirical relationships to correlate results across datasets for the Control Group and Test Group, refer to Figure 4.1 for a comparison of the survey processes for the Control Group and Test Groups.

Various tools were used to combine, evaluate and test the survey datasets, such as: standard word-processing and spreadsheet software. All survey data was aggregated to SurveyGizmo.com to maximize data security per the consent agreement and minimize effort for evaluating datasets. The Control Group data was automatically collected in SurveyGizmo.com when participants entered their data. Hardcopy data from the Test Group surveys was transcribed to SurveyGizmo.com.

4.2 Survey Participation

During testing, this research effort engaged 71 Control Group participants and 65 Test Group participants. With a confidence level of 95% and a confidence interval of 5%, the minimum population required to achieve broadly applicable statistical sample is 370 for each survey dataset. It was decided to close surveying to the survey to preserve the data

integrity of documentation collected, and keep survey size in perspective during analysis, results and conclusions phase of study.

4.3 Demographics

Both the Control Group and Test Group surveys presented participants with a series of demographic questions designed to provide discriminating power to the study while protecting the anonymity of the survey participants. Please refer to Table 4.1 for complete Survey Participant Demographics.

The Control Group and Test Group participant Age distribution was normally distributed, with both study groups clustered around the 35 to 55 year age categories, and the average age of all participants in the 45-55 year range.

The study participants were generally well educated, with less than 5% of Control Group participants holding less than a Bachelor's Degree and over 58% having a graduate or professional degree. The Test Group was equally as well educated, with 6% having a High School Diploma or Associates Degree, and 44% holding a graduate degree.

86% of the Control Group and 88% of the Test Group were employed full-time, with the remainder of each group either retired or re-employed retirees. Only 1 participant was unemployed, a Control Group contributor.

The Control Group Career Field was split into 26% Technical/Engineering and 64% in Education, either K-12 or Higher Education. The Test Group was focused mainly on practicing engineers, and 85% reported their career field as Technical/Engineering,

with 11% reporting working in Business/Clerical, although by observation the majority of those individuals were likely employed in support of a technical career field or business.

The Political Perspective of the Control Group was generally evenly distributed across the spectrum, from Left to Right, with limited representation at the far end of either side. The Political Perspective of the Test Group had a pronounced center-to-right skew, with only 27% of participants scoring left of center, but no participation at either far-side.

4.4 Pre-Seminar Self-Assessment of Sustainability Understanding

Each survey included a Self-Assessment of Sustainability Understanding question, "Rate your understanding of Sustainability" with a 1 to 10 scale and notes indicating that 1 indicated a limited understanding, 6 a moderate understanding and 10 an expert understanding of sustainability. The Control Group survey asked the question one time. The Test Group survey asked the question before and after the seminar as a Pre- and Post-Seminar Self-Assessment of Sustainability Understanding.

84.6% of the Control Group rated their understanding of sustainability at or above 6 on a scale of 1 to 10, with 38.1% rating their understanding at or above 8 on a scale of 1 to 10. The average Control Group rating was 6.6, or slightly greater than a Moderate level of understanding.

Prior to the Sustainability Fundamentals seminar, 6.2% of the Test Group rated their understanding of sustainability at or above 8 on a scale of 1 to 10, and 46.2% rated their understanding at or above 6 on a scale of 1 to 10. The average pre-seminar score was 4.6 with a 2.2 Standard Deviation and a maximum rating of 8.

After the Sustainability Fundamentals seminar, 84.5% of the Test Group rated their understanding of sustainability at or above 6 on a scale of 1 to 10. The average post-seminar self-assessment was 6.6, with a Standard Deviation of 1.4 and a maximum rating of 9. This corresponds to a 2 point average rating increase with a corresponding 1 point decrease in the standard deviation. Refer to Table 4.2 for a detailed illustration of the results from the Pre- and Post-Seminar Self-Assessment of Sustainability Understanding.

4.5 Pre-Seminar Self-Assessment of Sustainability Life-Style

As part of this study, participants were asked "How sustainably do you live?" and given a 1 to 10 scale with descriptors indicating low at 1, medium at 6 and very sustainable at 10. The Control Group was asked this question once and the Test Group received the question both before and after the seminar, as a Pre- & Post-Seminar Self-Assessment of Sustainability Life-Style.

The Control Group scores were evenly distributed around a medium "How sustainably do you live?" score average of 5.9 with a standard deviation of 1.5. The pre-seminar Test Group average scores were 4.7, with a 1.7 standard deviation. Post-seminar Test Group average scores were 5 with a standard deviation of 1.9. Neither Test Group score presented a normal distribution, while the Control Group score was normally distributed about the mid-point range. Refer to Table 4.3 for detailed results from the Pre-Seminar Self-Assessment of Sustainability Life-Style.

Analysis of the relationship between the Self-Assessment of each participant's Understanding of Sustainability and Sustainable Lifestyle revealed a modest Pearson's

correlation coefficient between the two questions, of r=.31 for the Test Group, and a relatively strong r=.48 for the Control Group and r-.48 for all the participants combined. For the Test group, Career Field and Political Perspective reflected modest correlations for Understanding of Sustainability, with modest r=-.29 and r=.22 respectively. These correlation results are fully illustrated in Table 4.7.

4.6 Pre-Seminar Assessment of Knowledge, Attitude and Behavior toward Sustainable Development

All Control Group and Test Group surveys provided a general assessment of knowledge, attitude and behavior toward sustainable development. The results of which were compiled into an index for comparison. Table 4.4 and Table 4.8 provide additional information about the results of each of the Pre-Seminar Assessment Knowledge, Attitude and Behavior toward Sustainability Development survey questions and corresponding correlation analysis.

The Behavior section consisted of seven questions offering a wide range of results, with an average 55.3% of the Control Group and average 52.8% of the Test Group providing a Yes answer for each question and a typical variation of 5.97% between the groups on each question.

Empirical analysis of the Behavior assessment questions presented only moderate relationships for the Test Group. The Education demographic provided the strongest correlation, with an r=0.32 Pearson correlation coefficient with question “Do you compost or participate in a municipal yard-waste recovery program”, and a Pearson correlation coefficient of r=0.27 between Education and “Do you Volunteer with Local

Charities". The third highest correlation was between Political Perspective and the question "Do you grow your own vegetables/fruit" which offered an r=-0.26 for the Test Group.

The six Knowledge questions averaged 77.8% and 80.8% True answers from the Control Group and the Test Group respectively, with a standard variation 6.48% variation between the groups. Empirical analysis of the Knowledge assessment questions demonstrated a moderate correlation of r=0.32 between Age and "Sustainable Activities require limited or no government subsidies" for the Test Group.

The six Attitude questions witnessed an 85.6% average True answer by the Control Group and an 89.3% average True answer by the Test Group, with 3.5% the average difference between the two group's answers. No Attitude section question presented strong correlation to any demographic or evaluative question.

The attitude section did not immediately appear to indicate adequate discriminating power. Questions from both the Behavior and Knowledge sections offered potential demonstrated variability and were assessed via cross-tabulation with demographic data.

4.7 Introduction to Post-Seminar Assessments

After seminars, Test Groups received a Post-Assessment broken into three segments for analysis purposes: *Post-Seminar Self-Assessment of Sustainability Understanding and Sustainability Life-Style, Post-Seminar Assessment of Knowledge, Attitude and Behavior toward Sustainable Development, and a Sustainability Promotion Score* testing both Knowledge and Attitude toward Sustainability. Control Group participants received a

two part assessment, excepting only the *Post-Seminar Self-Assessment of Sustainability Understanding and Sustainability Life-Style*.

4.8 Post-Seminar Self-Assessment of Sustainability Understanding and Life-Style

Per Table 4.2 and Table 4.10, the Test Group responded to Sustainability Fundamentals seminars by increasing their Self Assessed understanding of sustainability from an Average rating of 4.6 to 6.6, with a corresponding change in standard deviation from 2.2 to 1.4, respectively. The pre- and post-seminar assessments delivered correspondingly high correlation coefficient of r=0.62 for this study,

According to Table 4.2, Test Group self-assessment of the sustainability of their life-style increased a marginal 4.7 to 5, with a correspondingly high r=0.74 correlation coefficient in Table 4.9.

4.9 Post-Seminar Assessment of Knowledge, Attitude and Behavior toward Sustainable Development

The Post-Seminar Assessment questions were structured in standard question format and divided into Attitude and Knowledge questions. The questions of this section were generally structured to inform scoring of other sections of the study, and although they were individually limited in their discriminating capacity, with no stand-out correlations to specific demographics, the questions did offer limited correlations to other assessment questions as demonstrated in Table 4.10, and therefor offer additional insights into the survey results

The two Knowledge Assessment questions in the Post-Seminar Assessment provide additional information on peace and poverty. When asked "Can people live sustainably without peace" 34% of the Control Group and 28% of the Test Group answered "Yes", but no demographic comparison presented an empirically sound correlation coefficient. When asked "Do poverty levels influence the potential for a sustainable society" 85.7% of the Control Group and 92.2% of the Test Group indicated "Yes", and there were no corresponding demographic correlations, but the questions did highly correlate to the question "Poverty levels directly impact the potential for a sustainable society", which the Control Group scored at 70% and the Test Group scored at 78.3% in the Pre-Seminar Assessment.

The Post-Seminar Assessment included two questions focused on measuring attitude toward sustainability. The first question asked "Who has the most significant influence on sustainability in a society" and 74.3% of Control Group respondents selected Citizens with 78.1% of the Test group selected giving the same answer. Government, Business and Academia shared the remaining points.

The second Post-Seminar Assessment Attitude-focused question asked "What is the biggest barrier to sustainability for the US"? Of the available responses, the Control Group preferred "Apathy and Disinterest, with 23.9%, and the Test Group selected "Consumption Levels" with 26.6% of their input.

4.10 Post-Seminar Assessment of Sustainability Promoter Score

The principle section of the Post-Seminar Assessment consisted of a section designed to adapt methods from the Net Promoter Score loyalty metric to test sustainability focus

areas divided into 14 question of Knowledge of sustainability and 26 questions covering Attitude toward sustainability. Refer to Table 4.5 and Table 4.6 for complete data.

By observation, many of the questions offered promisingly positive promotion and correspondingly, some questions indicated strong detractor status. There was broad variability between the Control Group and Test Group submissions. An effort was made to use additional evaluation and comparisons to interpret and validate participant input.

On the Attitude SPS Post-Assessment, the Control Group averaged an 11% score and the Test Group average was 10%. On the Knowledge SPS evaluation the Control Group scored -14% and the Test Group provided a 5% average score.

The Knowledge SPS Post-Assessment only provided one strongly supported focus area; *Natural Resource Protection* received a strong rank, with the Test Group providing a 51% score and the Control Group providing a 54% score. The strongest demographic correlation for Natural Resource Protection was Age, with an r=-0.26 for the Test Group. Reference Table 4.11 for complete SPS demographic correlations.

The weakest Knowledge Assessment focus area was *Limiting Government Subsidies*, with a -40% Test Group Score and a -57% Control Group score, and an r=0.33 and r-0.36 for both Age and Political Perspective.

Both *Open & Free Markets* and *Property Rights* received divergent scores, with the Test Group providing a 5% and 3% score respectively and the Control Group providing -33% and -43% respectively, with both questions sharing an average correlation coefficient of r=0.2 for the demographic Age.

The Attitude SPS Post-Assessment provided many strongly supported focus areas; with *Energy Efficiency* receiving the highest score at 55% and 55% with the Test Group and Control Group, respectively, and it held an r=-0.3 Pearson correlation coefficient with Age for the Test Group. Protecting Biodiversity received the lowest score of the group with a reasonable correlation coefficient, with an r=-0.3 when compared to Political Perspective.

It is notable that both the Test Group and the Control Group gave Gender Equity scores in the -60s, reflecting the poor support reported in the IISD report (IISD, 2009).

4.11 Comparison of Sustainability Promoter Score by Political Perspective Demographic

Given that prominent Sustainability Promoter Scores correlating strongly to Political Perspective, the data set was evaluated versus Political Perspective, with the results presented in Tables 4.12 and Tables 4.13.

The Control Group and Test Group gave practical sustainability efforts, such as Energy Efficiency and Natural Resource Protection, top Sustainability Promoter Scores. Both received +50% scores with each participant group.

Eliminating Tariffs, Limiting Government Subsidies and Gender Equity received the lowest SPS scores across the political spectrum for both participant groups. The scores for these groups were less than -40% for all questions.

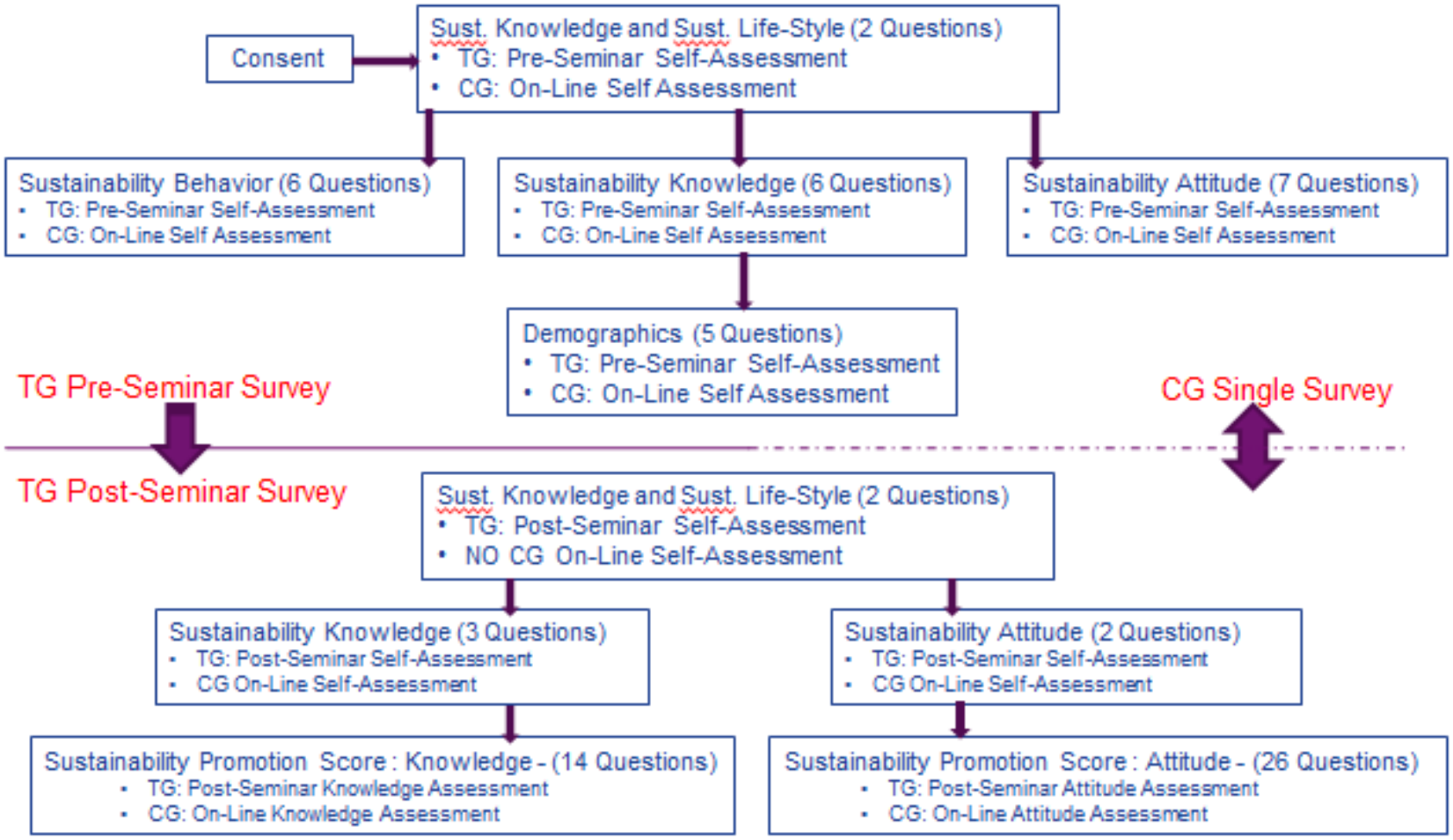

Figure 4.1 Comparisons of Survey Processes for Control Group and Test Groups

Table 4.1 Test Group and Control Group Participant Demographics

Demographics	Control Group (No Seminar)		Test Group (Seminar Surveys)		Combined Data	
Category	Count	%	Count	%	Count	%
Age						
<18	0	0%	0	0%	0	0%
18-25	3	4%	5	8%	8	6%
25-35	9	13%	7	11%	16	12%
35-45	21	30%	12	19%	33	24%
45-55	23	32%	23	35%	46	34%
55-65	12	17%	12	19%	24	18%
65-75	3	4%	5	8%	8	6%
75	0	0%	1	2%	1	1%
Education						
Not a HS-Graduate	0	0%	0	0%	0	0%
GED	0	0%	0	0%	0	0%
HS Graduate	1	1%	2	3%	3	2%
Associates Degree	3	4%	2	3%	5	4%
Bachelors Degree	26	37%	32	50%	58	43%
Masters Degree	34	48%	21	33%	55	41%
PhD	5	7%	6	9%	11	8%
Professional Degree	2	3%	1	2%	3	2%
Other	0	0%	0	0%	0	0%
Employment						
Employed full time	61	86%	57	88%	118	87%
Employed part time	2	3%	2	3%	4	3%
Unemployed	1	1%	0	0%	1	1%
Retired	2	3%	5	8%	7	5%
Retired, re-emp. full time	1	1%	0	0%	1	1%
Retired, re-emp. part time	3	4%	1	2%	4	3%
Other	1	1%	0	0%	1	1%
Career Field						
Technical/Engineering	18	26%	55	85%	73	54%
Business/Clerical	1	1%	7	11%	8	6%
Food Service	1	1%	0	0%	1	1%
Medical	1	1%	0	0%	1	1%
Construction (non-engr)	0	0%	0	0%	0	0%
Education	45	64%	3	5%	48	36%
Other	4	6%	0	0%	4	3%
Political Perspective						
No political position	10	14%	7	11%	17	13%
Far-Left	3	4%	0	0%	3	2%
Left	12	17%	7	11%	19	14%
Moderate-Left	11	16%	3	5%	14	10%
Center	11	16%	15	23%	26	19%
Moderate-Right	14	20%	19	29%	33	24%
Right	9	13%	14	22%	23	17%
Far-Right	1	1%	0	0%	1	1%

Table 4.2 Pre- and Post-Seminar Self-Assessment of Sustainability Understanding

Rate your understanding of sustainability.	Online Survey Control Group (No Seminar)		Seminar Surveys Test Group (Pre-Seminar)		Seminar Surveys Test Group (Post-Seminar)	
Value	**Count**	**Percent**	**Count**	**Percent**	**Count**	**Percent**
1. None	2	2.8%	2	3.1%	0	0.0%
2. Limited	2	2.8%	20	30.8%	1	1.5%
3	1	1.4%	4	6.2%	2	3.1%
4	3	4.2%	3	4.6%	3	4.6%
5	3	4.2%	6	9.2%	4	6.2%
6. Moderate	23	32.4%	13	20.0%	19	29.2%
7	10	14.1%	13	20.0%	14	21.5%
8	19	26.8%	4	6.2%	21	32.3%
9	6	8.5%	0	0.0%	1	1.5%
10. Expert	2	2.8%	0	0.0%	0	0.0%
Statistics						
Total Responses	71		65		65	
Sum	470		297		429	
Avg.	6.6		4.6		6.6	
StdDev	1.9		2.2		1.4	
Min	1		1		2	
Max	10		8		9	

Table 4.3 Pre- and Post-Seminar Self-Assessment of Sustainability Life-Style

How sustainably do you live?	Online Survey Control Group (No Seminar)		Seminar Surveys Test Group (Pre-Seminar)		Seminar Surveys Test Group (Post-Seminar)	
Value	Count	Percent	Count	Percent	Count	Percent
1. None	0	0.0%	2	3.1%	1	1.5%
2. Low	2	2.8%	5	7.7%	6	9.2%
3	1	1.4%	7	10.8%	10	15.4%
4	9	12.7%	19	29.2%	9	13.9%
5	12	16.9%	6	9.2%	8	12.3%
6. Medium	26	36.6%	21	32.3%	20	30.8%
7	11	15.5%	1	1.5%	5	7.7%
8	8	11.3%	3	4.6%	4	6.2%
9	0	0.0%	1	1.5%	2	3.1%
10. Very Sustainably	2	2.8%	0	0.0%	0	0.0%
Statistics						
Total Responses	71		65		65	
Sum	420		305		324	
Avg.	5.9		4.7		5	
StdDev	1.5		1.7		1.9	
Min	2		1		1	
Max	10		9		9	

Table 4.4 Assessment of Knowledge, Attitude and Behavior toward Sustainable Development

				Control Group (No Seminar)		Test Group (Seminar Surveys)		Var
Assessment	Survey Question	Value	#	Count	Percent	Count	Percent	Percent
Behavior	9. Have you taken a course in which Sustainability or Sustainable Development was discussed?	Yes	B9	16	22.5%	16	24.6%	-2.1%
Behavior	10. Do you purposefully adjust your personal life-style to reduce waste?	Yes	B10	63	88.7%	48	73.9%	14.8%
Behavior	11. Do you compost or participate in a municipal yard-waste recovery program?	Yes	B11	33	46.5%	31	47.7%	-1.2%
Behavior	12. Do you recycle at home?	Yes	B12	56	78.9%	45	69.2%	9.7%
Behavior	13. Do you volunteer with local charities?	Yes	B13	49	69.0%	46	69.7%	-0.7%
Behavior	14. Do you grow your own vegetables/fruit?	Yes	B14	36	50.7%	30	45.5%	5.2%
Behavior	15. Do you substitute walking or biking for driving?	Yes	B15	22	31.0%	25	39.1%	-8.1%
Knowledge	16. Sustainability is an ecological, economic and social issue.	True	K16	68	95.8%	63	95.5%	0.3%
Knowledge	17. Open and Free-markets are important in a Sustainable society.	True	K17	60	85.7%	62	95.4%	-9.7%
Knowledge	18. Sustainability relies on transparency in government, business and between	True	K18	59	84.3%	57	89.1%	-4.8%
Knowledge	19. Sustainable initiatives must provide a positive Return on Investment (ROI).	True	K19	47	66.2%	37	56.1%	10.1%
Knowledge	20. Sustainable activities require limited or no government subsidies.	True	K20	30	42.9%	35	54.70%	-11.8%
Knowledge	21. Respect for individual property rights is important for sustainable communities.	True	K21	65	91.6%	60	93.80%	-2.2%
Attitude	22. Companies that are sustainable are more likely to be profitable.	True	A2	44	62.0%	51	81.00%	-19.0%
Attitude	23. Present generations should pass-down a community at least as healthy, diverse, and productive as it is today.	True	A23	69	97.2%	66	100.00%	-2.8%
Attitude	24. Over-use of natural resources is a threat to the well-being of future generations.	True	A2	67	94.4%	59	90.80%	3.6%
Attitude	25. Children should learn the knowledge and skills for sustainable living.	True	A2	70	98.6%	64	97.00%	1.6%
Attitude	26. Poverty levels directly impact the potential for a sustainable society.	True	A2	49	70.0%	47	78.30%	-8.3%
Attitude	27. Sustainability in a given location may be defined by a different level of consumption and comfort than other locations due to differences in costs, proximity, and/or access to resources.	True	A27	65	91.6%	57	87.70%	3.9%

Table 4.5 Post-Seminar Assessment of Sustainability Promoter Score, Knowledge Evaluation

Rate each item's relative importance to achieving sustainability? (0 is No/Low Importance & 10 is High)										
Survey	Q#	#	Category	Responses	Det	Pass	Pro		SPS	Var
CG	36	K1	Economic development	70	33%	34%	33%		0%	
TG	36	K1	Economic development	64	25%	36%	39%		14%	14%
CG	38	K10	Eliminating Tariffs	71	66%	24%	10%		-56%	
TG	38	K10	Eliminating Tariffs	61	52%	36%	11%		-41%	15%
CG	30	K10	Poverty Reduction	71	42%	32%	25%		-17%	
TG	30	K10	Poverty Reduction	64	41%	33%	27%		-14%	3%
CG	36	K2	Social development	70	23%	44%	33%		10%	
TG	36	K2	Social development	64	22%	36%	42%		20%	10%
CG	30	K3	Population Growth	71	28%	27%	45%		17%	
TG	30	K3	Population Growth	64	27%	23%	50%		23%	7%
CG	30	K5	Open & Free Markets	71	49%	34%	17%		-32%	
TG	30	K5	Open & Free Markets	63	28%	38%	33%		5%	37%
CG	30	K6	Property Rights	71	62%	18%	20%		-42%	
TG	30	K6	Property Rights	64	33%	31%	36%		3%	45%
CG	36	K7	Generational equity	70	57%	31%	11%		-46%	
TG	36	K7	Generational equity	63	48%	37%	16%		-32%	14%
CG	38	K7	Limiting Govt. Subsidies	71	68%	21%	11%		-56%	
TG	38	K7	Limiting Govt. Subsidies	63	57%	25%	17%		-40%	17%
CG	38	K8	Return on Investment	71	37%	30%	34%		-3%	
TG	38	K8	Return on Investment	63	13%	27%	60%		48%	50%
CG	38	K9	Govt & Bus. Transparency	71	38%	24%	38%		0%	
TG	38	K9	Govt & Bus. Transparency	63	24%	32%	44%		21%	21%
CG	36	K9	Natural resource protection	70	11%	23%	66%		54%	
TG	36	K9	Natural resource protection	65	15%	18%	66%		51%	-4%

Table 4.6 Post-Seminar Assessment of Sustainability Promoter Score, Attitude Evaluation

Rate each item's relative importance to achieving sustainability? (0 is No/Low Importance & 10 is High Importance)										
				Responses						
Survey	Q	#	Category	Tot	Det	Pass	Pro		SPS	Var
Online	30	A1	Politics	71	45%	21%	34%		-11%	
Seminar	30	A1	Politics	64	39%	28%	33%		-6%	5%
Online	38	A1	Sustainability education	71	14%	20%	66%		52%	
Seminar	38	A1	Sustainability education	64	20%	30%	50%		30%	-22%
Online	36	A10	Peace	70	40%	26%	34%		-6%	
Seminar	36	A10	Peace	63	24%	27%	49%		25%	31%
Online	30	A2	Consumption Habits	71	11%	24%	65%		54%	
Seminar	30	A2	Consumption Habits	63	17%	19%	63%		46%	-7%
Online	38	A2	Environmental regulation	71	27%	37%	37%		10%	
Seminar	38	A2	Environmental regulation	61	36%	33%	31%		-5%	-15%
Online	36	A3	Corp. Social Responsibility	70	21%	27%	51%		30%	
Seminar	36	A3	Corp. Social Responsibility	65	31%	37%	32%		2%	-28%
Online	38	A3	Energy efficiency	71	7%	30%	63%		56%	
Seminar	38	A3	Energy efficiency	64	11%	23%	66%		55%	-2%
Online	38	A4	Citizenship education	71	30%	25%	45%		15%	
Seminar	38	A4	Citizenship education	64	30%	28%	42%		13%	-3%
Online	36	A4	Gender equity	70	74%	16%	10%		-64%	
Seminar	36	A4	Gender equity	64	72%	17%	11%		-61%	3%
Online	30	A4	Technology & Innovation	71	15%	45%	39%		24%	
Seminar	30	A4	Technology & Innovation	63	25%	25%	49%		24%	0%
Online	36	A5	Social justice	70	67%	16%	17%		-50%	
Seminar	36	A5	Social justice	64	45%	31%	23%		-22%	28%
Online	38	A5	Taxes on polluters	71	45%	28%	27%		-18%	
Seminar	38	A5	Taxes on polluters	62	35%	27%	37%		2%	20%
Online	38	A6	Discouraging disposables	71	32%	31%	37%		4%	
Seminar	38	A6	Discouraging disposables	63	44%	27%	29%		-16%	-20%
Online	36	A6	Protecting biodiversity	70	31%	29%	40%		9%	
Seminar	36	A6	Protecting biodiversity	64	34%	42%	23%		-11%	-20%
Online	30	A7	Industrial Technology	71	24%	41%	35%		11%	
Seminar	30	A7	Industrial Technology	64	22%	30%	48%		27%	15%
Online	36	A8	Cultural traditions	70	43%	33%	19%		-30%	
Seminar	36	A8	Cultural traditions	65	52%	18%	29%		-23%	7%
Online	30	A8	Water Usage	71	10%	28%	62%		52%	
Seminar	30	A8	Water Usage	64	14%	17%	69%		55%	3%
Online	30	A9	Agricultural practices	71	11%	25%	63%		52%	
Seminar	30	A9	Agricultural practices	64	14%	28%	58%		44%	-8%

Table 4.7 Pre-Seminar Self-Assessment of Sustainability Understanding and Sustainability Life-Style Demographic Correlations

Cat A	Q A	Cat B	Q B	CG Corr	TG Corr	CG+TG Corr	Std Dev	Avg
Post Self	How sustainably do you live?	Demo	Age		0.2	0.2	1.9	5.0
Post Self	Rate your understanding of sustainability:	Demo	Career Field		-0.2	-0.2	1.4	6.6
Post Self	Rate your understanding of sustainability:	Demo	Education		-0.2	-0.2	1.4	6.6
Pre Self	How sustainably do you live?	Demo	Career Field	0.1	-0.2	0.2	1.7	5.3
Pre Self	Rate your understanding of sustainability:	Demo	Career Field	-0.1	-0.3	0.2	2.3	5.7
Pre Self	Rate your understanding of sustainability:	Demo	Political Perspective	0.2	-0.2	-0.1	2.3	5.7

Table 4.8 Pre-Seminar Assessment of Knowledge, Attitude and Behavior toward Sustainable Development Demographic Correlations

Cat A	Q A	Cat B	Q B	CG Corr	TG Corr	CG+TG Corr	TG Std Dev	TG Avg
Demo	Age	B	Do you compost or participate in a municipal yard-waste recovery program?	0.3	0.2	0.2	1.28	4.6
Demo	Age	B	Do you recycle at home?	0.3	0.2	0.2	1.28	4.6
Demo	Age	B	Have you taken a course in which Sustainability or Sustainable Development was discussed?	-0.1	-0.2	-0.2	1.28	4.6
Demo	Education	B	Do you compost or participate in a municipal yard-waste recovery program?	-0.2	0.3	0.1	1.28	5.5
Demo	Education	B	Do you volunteer with local charities?	-0.1	0.3	0.1	0.86	5.5
Demo	Political Perspective	B	Do you grow your own vegetables/fruit?	0.1	-0.3	-0.1	0.86	4.7
Pre Self	Rate your understanding of sustainability:	B	Have you taken a course in which Sustainability or Sustainable Development was discussed?	0.1	0.2	0.1	1.93	5.7
Demo	Age	K	Sustainable activities require limited or no government subsidies.	0.4	0.3	0.3	2.29	4.6

Table 4.9 Post-Seminar Self-Assessment of Sustainability Understanding and Sustainability Life-Style Demographic Correlations

Cat A	Q A	Cat B	Q B	CG Corr	TG Corr	CG+TG Corr	TG Std Dev	TG Avg
Pre Self	How sustainably do you live?	Post Self	How sustainably do you live?		0.7	0.7	1.7	5.3
Pre Self	How sustainably do you live?	Post Self	Rate your understanding of sustainability:		0.3	0.3	1.7	5.3
Pre Self	Rate your understanding of sustainability:	Post Self	How sustainably do you live?		0.4	0.4	2.3	5.7
Pre Self	Rate your understanding of sustainability:	Post Self	Rate your understanding of sustainability:		0.6	0.6	2.3	5.7

Table 4.10 Post-Seminar Assessment of Knowledge, Attitude and Behavior toward Sustainable Development Demographic Correlations

Cat A	Q A	Cat B	Q B	CG Corr	TG Corr	CG+TG Corr	TG Std Dev	TG Avg
A	What is the biggest barrier to sustainability for the US?	Demo	Age	0.2	0.1	0.3	2.1	3.9
A	What is the biggest barrier to sustainability for the US?	Demo	Political Perspective	0.3	0.1	0.3	2.1	3.9
K	Can people live sustainably without peace?	Demo	Career Field	0.2	0.1	0.1	0.5	0.3
K	Do poverty levels influence the potential for a sustainable society?	Demo	Education	0.2	0.2	0.1	0.3	0.9

Table 4.11 Sustainability Promotion Score - Knowledge & Attitude Demographic Correlations

Cat A	Q A	Cat B	Q B	CG SPS	TG SPS	CG + TG SPS	CG Corr	TG Corr	CG+TG Corr	Std Dev	Avg
A	3. Energy efficiency	Demo	Education	56%	55%	55%		-0.24	-0.06	1.81	9
K	8. Water Usage	Demo	Education	50%	55%	52%		-0.22	-0.15	1.87	9
K	9. Natural resource protection	Demo	Age	54%	51%	52%	-0.04	-0.26	-0.16	1.99	9
K	8. Return on Investment	Demo	Political Perspective	-3%	48%	21%		0.18	0.13	2.49	8
A	9. Agricultural practices	Demo	Education	51%	44%	48%		-0.19	-0.16	1.96	9
A	1. Sustainability education	Demo	Education	51%	30%	41%		-0.20	-0.15	2.05	8
A	7. Industrial Technology	Demo	Education	11%	27%	18%		-0.19	-0.15	1.87	8
A	10. Peace	Demo	Age	-7%	25%	8%	0.17	-0.19	0.01	2.75	7
A	4. Technology & Innovation	Demo	Political Perspective	22%	24%	23%		0.21	0.02	1.87	8
K	3. Population Growth	Demo	Education	15%	23%	19%		-0.21	-0.04	2.38	8
K	5. Open & Free Markets	Demo	Age	-33%	5%	-16%	0.15	0.21	0.19	2.20	7
K	6. Property Rights	Demo	Age	-43%	3%	-21%	0.15	0.19	0.19	2.56	7
A	5. Taxes on polluters	Demo	Age	-18%	2%	-9%	0.02	-0.36	-0.16	2.67	7
A	3. Corporate social responsibility	Demo	Education	30%	2%	16%		-0.34	-0.18	2.03	8
A	2. Environmental regulation	Demo	Age	10%	-5%	3%	0.01	-0.37	-0.19	2.24	7
A	6. Protecting biodiversity	Demo	Age	8%	-11%	-1%	0.04	-0.20	-0.09	2.35	7
A	6. Protecting biodiversity	Demo	Education	8%	-11%	-1%		0.24	0.09	2.35	7
A	6. Protecting biodiversity	Demo	Political Perspective	8%	-11%	-1%		-0.23	-0.26	2.35	7
K	10. Poverty Reduction	Demo	Age	-17%	-14%	-15%	0.16	0.19	0.17	2.55	7
K	7. Limiting Government Subsidies	Demo	Age	-57%	-40%	-49%	0.00	0.33	0.18	2.58	6
K	7. Limiting Government Subsidies	Demo	Political Perspective	-57%	-40%	-49%		0.36	0.19	2.58	6

Table 4.12 Control Group Sustainability Promotion Score - Knowledge & Attitude vs. Political Demographics

Question Type	Question	No political position	Left	Moderate-Left	Center	Moderate-Right	Right	Average SPS
Attitudes	Energy Efficiency	80%	73%	55%	64%	29%	40%	56%
Knowledge	Natural Resource	80%	80%	45%	73%	36%	0%	54%
Attitudes	Consumption Habits	50%	67%	36%	55%	71%	30%	54%
Attitudes	Agricultural Practices	70%	40%	36%	73%	64%	30%	52%
Attitudes	Sustainability Education	50%	67%	45%	55%	64%	20%	52%
Attitudes	Water Usage	80%	60%	55%	73%	50%	-10%	52%
Attitudes	Corporate Social Responsibility	70%	67%	9%	9%	21%	-11%	30%
Attitudes	Technology & Innovation	50%	27%	0%	9%	14%	50%	24%
Knowledge	Population Growth	40%	27%	45%	0%	7%	-20%	17%
Attitudes	Citizenship Education	0%	13%	36%	18%	29%	-10%	15%
Attitudes	Industrial Technology	30%	27%	0%	-18%	0%	30%	11%
Knowledge	Social Development	60%	27%	-36%	9%	29%	-44%	10%
Attitudes	Environmental Regulation	20%	33%	36%	-18%	-14%	0%	10%
Attitudes	Protecting Biodiversity	20%	47%	9%	-9%	7%	-44%	9%
Attitudes	Discouraging Disposables	0%	33%	27%	-18%	7%	-40%	4%
Knowledge	Economic Development	30%	-7%	-36%	0%	14%	0%	0%
Knowledge	Government & Business Transparency	0%	7%	-9%	-9%	14%	-10%	0%
Knowledge	Return on Investment	40%	-40%	0%	-9%	-29%	50%	-3%
Attitudes	Peace	60%	27%	-18%	-18%	-29%	-67%	-6%
Attitudes	Politics	-30%	0%	0%	-45%	0%	0%	-11%
Knowledge	Poverty Reduction	-20%	-7%	0%	-36%	-14%	-30%	-17%
Attitudes	Taxes on Polluters	-20%	13%	-18%	-27%	-36%	-30%	-18%
Attitudes	Cultural Traditions	-30%	-20%	-18%	-27%	-21%	-78%	-30%
Knowledge	Open & Free Markets	-30%	-67%	-36%	-45%	0%	-10%	-32%
Knowledge	Property Rights	-20%	-93%	-73%	-55%	-7%	10%	-42%
Knowledge	Generational Equity	-40%	-40%	-9%	-55%	-57%	-78%	-46%
Attitudes	Social Justice	-40%	-27%	-18%	-64%	-64%	-100%	-50%
Knowledge	Eliminating Tariffs	-60%	-87%	-73%	-45%	-36%	-30%	-56%
Knowledge	Limiting Government Subsidies	-40%	-87%	-55%	-27%	-71%	-40%	-56%
Attitudes	Gender Equity	-60%	-60%	-36%	-73%	-71%	-89%	-64%

Table 4.13 Test Group Sustainability Promotion Score - Knowledge & Attitude vs. Political Demographics

Question Type	Question	No political position	Left	Moderate-Left	Center	Moderate-Right	Right	Average SPS
Attitudes	Energy efficiency	86%	14%	67%	47%	72%	43%	55%
Attitudes	Water Usage	86%	29%	0%	50%	67%	50%	54%
Knowledge	Natural resource protection	43%	86%	67%	40%	61%	43%	53%
Attitudes	Politics	86%	33%	-33%	64%	67%	14%	48%
Knowledge	Return on Investment	67%	-57%	100%	40%	67%	64%	48%
Attitudes	Agricultural practices	43%	0%	0%	50%	72%	43%	46%
Attitudes	Sustainability education	29%	14%	0%	40%	33%	29%	30%
Attitudes	Peace	50%	-43%	0%	13%	50%	46%	27%
Attitudes	Industrial Technology	71%	-14%	-100%	50%	22%	36%	27%
Attitudes	Tech & Innovation	0%	29%	-100%	38%	39%	36%	26%
Attitudes	Consumption Habits	29%	29%	33%	21%	44%	0%	25%
Knowledge	Population Growth	29%	29%	33%	21%	44%	0%	25%
Knowledge	Social development	29%	0%	0%	36%	28%	14%	22%
Knowledge	Government and Business Transparency	50%	0%	-33%	7%	39%	21%	21%
Knowledge	Economic development	29%	14%	-67%	29%	28%	0%	16%
Attitudes	Citizenship education	57%	-29%	33%	0%	22%	7%	13%
Knowledge	Open & Free Markets	67%	-29%	-67%	-29%	17%	21%	3%
Attitudes	Corporate social responsibility	14%	14%	33%	-27%	28%	-14%	3%
Attitudes	Taxes on polluters	40%	29%	67%	-20%	11%	-29%	2%
Knowledge	Property Rights	29%	-57%	-33%	0%	11%	14%	2%
Attitudes	Environmental regulation	60%	-14%	-33%	-14%	17%	-36%	-5%
Attitudes	Protecting biodiversity	29%	0%	-67%	-7%	-11%	-21%	-10%
Knowledge	Poverty Reduction	0%	-29%	-100%	-21%	-6%	7%	-13%
Attitudes	Discouraging disposables	33%	-29%	-33%	-27%	-11%	-21%	-16%
Attitudes	Social justice	33%	-71%	-100%	-40%	28%	-43%	-21%
Attitudes	Cultural traditions	-14%	-71%	0%	-20%	-6%	-36%	-23%
Knowledge	Generational equity	-20%	-86%	-100%	-33%	-22%	0%	-31%
Knowledge	Limiting Government Subsidies	-83%	-71%	0%	-40%	-39%	-14%	-40%
Knowledge	Eliminating Tariffs	-20%	-83%	-67%	-40%	-33%	-36%	-41%
Attitudes	Gender equity	0%	-100%	-100%	-53%	-39%	-93%	-60%

CHAPTER 5

DISCUSSION

5.1 Discussion

The study demographic data presents a positive framework for considering the remainder of the test data.

Both test groups present a well-balanced age profile, with a normal distribution focused on the age ranges associated with working professionals. Study participants were well educated, a general requirement for practicing engineer and a positively representative skew to the Control Group. Nearly 5 out of 6 of the study participants were employed full-time, again providing a strong representation of both the practicing engineering community and the general population. The Control Group split across engineering and education, offering a general opportunity to contrast perspectives across fields, while the Test Group nearly all worked in engineering.

The Control Group split into balanced scores across each political perspective, from *No Political Position to Far-Left or Far-Right*. Alternatively, the Test Group was clustered in a non-normal distribution skewed around the *Moderate-Right* political perspective, indicating a right-of-center tendency in the engineering profession compared to an normal distribution across a more balanced representation of the general public.

In the Self-Assessment of Sustainability Understanding, participants were asked to rate their understanding of sustainability with a range from 0 to 10, with 10 indicating expert understanding. The Test Group average self-rating was a 4.6 before the seminar and 6.6 afterwards, while the Control Group self-rated at 6.6. When asked "How Sustainably do you Live?" on a 0 to 10 scale, with 10 indicating Very Sustainably. The Control Group self-rated an average score of 5.9, while the Test Group score was 4.7 before the seminar and 5.0 afterwards, effectively the same score. Given the stability of the Test Group life-style self-assessment, the 2 point improvement in self-assessed sustainability knowledge represents positive seminar impact.

The Pre-Seminar Assessment of Knowledge, Attitude and Behavior toward Sustainable Development presented contrasting results. Most of the variation between the Test Group and Control Group throughout this assessment was statistically negligible, although the directionality offers some value.

The Behavior Assessment offered one question with a definitive difference between the Test Group and the Control Group, "Do you purposefully adjust your personal life-style to reduce waste?" The Attitude Assessment also offered a single question with discriminating value, "Companies that are sustainable are more likely to be profitable." The limited discriminating capacity of this section indicates this section of the survey is a candidate for further improvement.

During the Post-Seminar Assessment of Knowledge, Attitude and Behavior toward Sustainable Development offered limited discriminating capacity, but were directionally indicative given the relationships with non-demographic data.

The Knowledge Post-Assessment presented +50% scores for *Natural Resource Protection*. First, nearly every participant was unanimous in selecting Energy Efficiency as the most important element in achieving sustainability in society.

Second, nearly every participant indicated strong positive support for Education for Sustainability.

Third, the span between the Control Group and Test Group SPS scores was 51% when participants were asked whether Return on Investment is important to achieving sustainability, with the Test Group indicating 48% and the Control Group giving a -3%. Evaluating this significant difference by Political Perspective revealed small but potentially relevant differences. The Control Group scores were widely distributed, with low scores in the Left through Moderate categories and High scores in the Right and No Political View categories. Alternatively, the Test Group SPS was consistently high with a single outlier, the self-identified Left category, which rated Return on Investment a -57%, indicating nearly zero support for ROI as a key element of in achieving Sustainability in Society.

There are several potential explanations for the difference in scores, a convenient explanation for the purposes of this study would be that attending a sustainability seminar provides attendees with background understanding of the importance of Return on Investment as a principle driver in the programmatic success of Sustainability initiatives, which would possibly explain the Test Group's more positive attitude across various political perspectives. Given the previously observed limits to the discriminating capacity of the various questions and incomplete ability to make correlations with

demographics, this question, among others, stands more as an opportunity for further evaluation than a resolved issue.

5.2 Conclusions

As indicated in Newton and Meyer's research quoted in Chapter 2, there is often an action-intention gap driven more by societal norms and pressures than the values and attitudes of a given person or household. This means any improvement in Sustainable Behavior will require initiatives focused on long-term, self-sustaining efforts that will last for successive generations to enable generational roll-over and incorporation into social norms.

Also, the research by Tapia-Fonllem et al (2013) showed that sustainable behavior is strongly interconnected, and that once someone is engaged in one form of Sustainable Behavior that is likely to lead to other holistic, supportive and inter-related behaviors. Tapia-Fonllem et al presented a strong relationship between intent to act, attitude and sustainable behavior, which correlates with the IISD connection between attitude toward sustainability and subsequent positive behavior toward sustainability.

The results presented herein demonstrate that a limited education for sustainability intervention can be impactful, and given the previously tested relationships between attitude and behavior, a brief education for sustainability intervention may offer a meaningful Return on Investment with respect to Sustainable Behavior.

As research continues to expose the links between Sustainability Behavior drivers, it becomes more and more important to have clearly actionable metrics to drive focused strategy level decisions. This study adapted Frederick F. Reichheld's customer

loyalty metric, the Net Promoter Score, to create a Sustainability Promoter Score to determine areas of Sustainability that have the highest and lowest likelihood for growth. The opportunity here is in deploying a metric that allows stake-holders to identify high growth potential sustainability focus areas, such as Energy Efficiency and Natural Resource Protection, where they can drive concerted efforts to gain the most direct and indirect Sustainability Behavior gains.

Deploying simple metrics like Sustainability Promoter Score to help target high growth potential areas of sustainability for concerted, programmatic focus will open the door to an organic improvement in the social awareness of sustainability concepts. Building societal awareness and societal familiarity with sustainability concepts will in-turn open pathways for developing sustainability norms within society that will close the awareness-action gap defined by Newton & Meyer (2013). Given the interconnectedness of Sustainable Behavior demonstrated by Tapia-Fonllem et al (2013), support will grow for all aspects of Sustainability over time.

The combination of targeted sustainability metrics and education interventions, like Sustainability Fundamentals seminars, may help focus limited resources to achieve the most sustainability behavior gain across all facets of sustainability.

5.3 Research Challenges

This study focused on collecting data by surveys. The Control Group consisted of members of organizations targeted to assist in soliciting participants using a fund-raising element for the organization to help address participant bias. The Test Group consisted of participants who were members of organizations that were specifically targeted to

participate in this study because of the demographic diversity of their organizations, the likelihood of their willingness to host Sustainability Fundamental seminars and the relative potential that their employees or members would participate in an academic research study.

Recruiting potential survey participants and "selling" Sustainability Fundamentals seminar presented a number of problems.

First, this self-funded research program was resource constrained. This limited access to purchased email lists which impacted the researcher's ability to use standard email-enabled direct contact surveying techniques to directly reach a randomized list of respondents.

Similarly, a direct mail process would need to reach out to a minimum of 4000 households to achieve the survey goal of 370 completed surveys. The approximate estimated cost for a direct mail program was $3500 to $5000, and again the researcher would need access to an appropriately resourced mailing list.

It is possible to contact a randomized list of participants by phone, but the time and expertise associated with phone surveying precluded the use of this method.

Given the costs of traditional survey methods, the researcher substituted on-line survey methods and an organic survey promotion approach focused on partnering with organizations with amenable demographics. The tools required to facilitate this method required the researcher to develop skills in web-site design and other online processes, all resource intensive exercises with respect to time, resources and general costs.

Overall the partnering survey approach was less costly, but resulted in a protracted testing period that ultimately resulted in limited survey results.

Second, the effort associated with cold contacting organizations to "sell" free Sustainable Fundamental seminars and coordinate multiple scheduled opportunities was labor intensive. The lead generation process involved intensive research and resources to network with contacts within potential organizations willing to champion the seminars and participation in the study. The effort to arrange seminars was compounded because the seminar and research study involves a controversial subject, sustainability.

5.4 Future Research

This study extended previous tests of the relationship between attitude toward sustainability, knowledge of sustainability and favorable sustainability behavior by applying previous lessons learned with adaptations for advancing the study.

It is recommended that future researchers simplify the data collection process and focus on employing standard practices in psychometric survey development to improve the survey architecture and elevate the discriminating ability of the various survey elements.

Given the general success of the Sustainability Fundamental seminars and the potential opportunity afforded by the Sustainability Promoter Score approach, it is recommended that future researchers identify clear areas of focus and then partner directly with community organizations such as Toastmasters International or STEM Education organizations such as FIRST to host and schedule sessions as a direct service to members and to minimize the sales and marketing aspect of this study.

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APPENDIX A – SUSTAINABILITY FUNDAMENTALS SEMINAR: PRESENTATION OUTLINE

The following is the Sustainability Fundamentals seminars outline:

Sustainability Fundamentals (Duration: 30-45 Minutes)

- Introduction: Instructions: Consent Form, and Pre-Seminar Survey
- Seminar
    - What is Sustainability
    - Why Sustainability
    - Limits to Achieving Sustainability
    - Current Tools….etc.
    - Ways to Achieve Sustainability
    - The Natural Step
        - Basic Science
        - Complex Systems
        - Vision & Goals
        - Strategy
        - Actions & Toolbox
        - ABCD Process
    - Summary & Post Seminar Survey
- Q&A

APPENDIX B – SUSTAINABILITY FUNDAMENTALS PRE AND POST SEMINAR SURVEY QUESTIONS

This list of questions was used to collect input from study participants. Post Survey Question 1 and 2 of were excluded from the control group surveys.

Pre-Seminar Survey

A. Rate your understanding of sustainability:
    1. None
    2. Limited
    3. 3
    4. 4
    5. 5
    6. Moderate
    7. 7
    8. 8
    9. 9
    10. Expert

B. How *sustainably* do you live?
    1. None
    2. Low
    3. 3
    4. 4
    5. 5
    6. Medium
    7. 7
    8. 8
    9. 9
    10. Very Sustainably

C. Do you purposefully adjust your personal life-style to reduce waste?
    1. Yes
    2. N

D. Have you taken a course in which Sustainability or Sustainable Development was discussed?
    1. Yes
    2. No

E. Do you compost or participate in a municipal yard-waste recovery program?
    1. Yes
    2. No

F. Do you recycle at home?
    1. Yes
    2. No

G. Do you volunteer with local non-profit organizations?
    1. Yes
    2. No

H. Do you grow your own vegetables/fruit?
    1. Yes
    2. No

I. Do you substitute walking or biking for driving?
    1. Yes
    2. No

J. Sustainability is an ecological, economic and social issue.
    1. True
    2. False

K. Open and Free-markets are important in a Sustainable society.
    1. True
    2. False

L. Sustainability relies on transparency in government, business and between people.
    1. True
    2. False

M. Sustainable initiatives must provide a positive Return on Investment (ROI).
    1. True
    2. False

N. Sustainable activities require limited or no government subsidies.
    1. True
    2. False

O. Respect for individual property rights is important for sustainable communities.
    1. True
    2. False

P. Companies that are sustainable are more likely to be profitable.
    1. True
    2. False

Q. Present generations should pass-down a community at least as healthy, diverse, and productive as it is today.
    1. True
    2. False

R. Over-use of natural resources is a threat to the well-being of future generations.
    1. True
    2. False

S. Children should learn the knowledge and skills for sustainable living.
    1. True
    2. False

T. Poverty levels directly impact the potential for a sustainable society.
    1. True
    2. False

U. Sustainability in a given location may be defined by a different level of consumption and comfort than other locations due to differences in costs, proximity, and/or access to resources.
    1. True
    2. False

V. What career field or type of work do you do?

1. Technical/Engineering
2. Business/Clerical
3. Food Service
4. Medical
5. Construction (non-engineering)
6. Education
7. Other:_____

W. Describe your employment status:

1. Employed full time
2. Employed part time
3. Unemployed
4. Retired
5. Retired, re-employed full time
6. Retired, re-employed part time
7. Other:_____

X. Describe your education (Circle all that apply):

1. Not a HS-Graduate
2. GED
3. HS Graduate
4. Associates Degree
5. Bachelors Degree
6. Masters Degree
7. PhD
8. Professional Degree
9. Other:_____

Y. Choose your age group:

1. <18
2. 18-25
3. 25-35
4. 35-45
5. 45-55
6. 55-65
7. 65-75
8. +75

Z. What is your political perspective:
    1. No political position
    2. Far-Left
    3. Left
    4. Moderate-Left
    5. Center
    6. Moderate-Right
    7. Right
    8. Far-Right

Post-Seminar Survey

1. Rate your understanding of sustainability:
    1. None
    2. Limited
    3. 3
    4. 4
    5. 5
    6. Moderate
    7. 7
    8. 8
    9. 9
    10. Expert

2. How sustainably do you live?
    1. None
    2. Low
    3. 3
    4. 4
    5. 5
    6. Medium
    7. 7
    8. 8
    9. 9
    10. Very Sustainably

3. Evaluate the following issues, and rate each item's importance to achieving sustainability in the United States (Circle the level of impact on each line)?
    1. Politics: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    2. Consumption Habits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    3. Population Growth: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    4. Technology & Innovation: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    5. Open & Free Markets: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    6. Property Rights: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    7. Industrial Technology: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    8. Water Usage: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    9. Agricultural Practices: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    10. Poverty Reduction: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

4. Is a sustainable society possible?
    1. Yes
    2. No

5. Evaluate the following issues, and rate each item's importance to achieving sustainability in the World (Circle the level of impact on each line)?
    1. Politics: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    2. Consumption Habits: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    3. Population Growth: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    4. Technology & Innovation: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    5. Open & Free Markets: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    6. Property Rights: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    7. Industrial Technology: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    8. Water Usage: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    9. Agricultural practices: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    10. Poverty Reduction: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

6. Evaluate the following Energy sources, and rate them according to their importance to society (Circle the level of importance on each line)?
    1. Oil: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    2. Natural Gas: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    3. Coal: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    4. Nuclear: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    5. Photosynthesis: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    6. Wind: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    7. Solar: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    8. Wave Power: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    9. Hydro: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    10. Diesel Fuel: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

7. Can people live sustainably without peace?
    1. Yes
    2. No

8. Who has the most significant influence on sustainability in a society?
    1. Government
    2. Business
    3. Academia
    4. Citizens

9. Evaluate the following issues, and rate each item's relative importance to achieving sustainability in the World (Circle the level of impact on each line)?
    1. Economic development: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    2. Social development: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    3. Corporate social responsibility: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    4. Gender equity: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    5. Social justice: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    6. Protecting biodiversity: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    7. Generational equity: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    8. Cultural traditions: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    9. Natural resource protection: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    10. Peace: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

10. Do poverty levels influence the potential for a sustainable society?
    1. Yes
    2. No

11. Evaluate the following sustainability drivers, and rate each item's relative importance to achieving sustainability in the World (Circle the level of impact on each line)?
    1. Sustainability education: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    2. Environmental regulation: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    3. Energy efficiency: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    4. Citizenship education: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    5. Taxes on polluters: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    6. Discouraging disposables: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    7. Limiting Government Subsidies: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    8. Return on Investment: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    9. Government and Business Transparency: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
    10. Eliminating Tariffs: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

12. What is the biggest barrier to achieving *sustainability* in the US? (Pick one)
    1. Consumption levels
    2. Politics
    3. Business Interests
    4. Apathy and disinterest
    5. Lack of understanding
    6. Costs
    7. Government involvement
    8. Poor options for sustainable goods
    9. Other (please explain)_____