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Advancing educational pedagogy for sustainability: Developing and implementing programs to transform behaviors

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Achieving a sustainable future requires that individuals adopt sustainable behaviors, which are often learned and cemented at a young age. Yet, traditional education efforts have been inadequate in fostering transformative change, in part because many programs focus on fact-heavy, teacher-centered techniques while neglecting the practices that behavioral and sustainability scholars highlight as central to creating change. To address this gap, the present research integrates three critical yet mostly disparate bodies of research— educational pedagogy, behavior change, and sustainability competencies. This interdisciplinary approach to education was implemented and evaluated with a small group of students during an intensive summer program and year-long case study. The curriculum focused on food and waste behaviors and utilized experiential, real-world, problem-based methods in order to increase competence in sustainability and promote pro-environmental actions. The impact of the program was assessed through surveys, interviews, videos, and participant observations. The data showed that significant changes in knowledge and behaviors were achieved, while suggesting that social knowledge in terms of food is more resistant to change as compared to that of waste. Throughout the year, students maintained significant behavior changes in terms of their waste decisions; however, sustainable food behaviors were more resistant to long-term change due to the students' social and cultural environment. This article will detail the education program and assessment techniques while highlighting each student's unique characteristics, barriers to change, and motivations for action.

Keywords: sustainability education, transformative change, pro-environmental actions, sustainability competencies, environmentally responsible consumption

Introduction

Many scholars and practitioners are counting on education to lead us towards sustainability. Unfortunately research indicates that our current education system may be doing the opposite (Rowe, 2007; Sterling, 2001; Orr, 1991). Traditional methods of lecture and assessment oversimplify complex issues and trade-offs into right or wrong answers, while emphasizing individual achievement at the cost of positive societal outcomes. All too often, students are asked to absorb pre-packaged information presented by their teachers, even though research indicates that didactic, teacher-centered education results in reduced cognitive and behavioral outcomes

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(Duerden & Witt, 2010; Segalas, et al., 2010). Educating for sustainability requires that students develop the skills to be change agents and grapple with real-world challenges through explorations that engage multiple ways of knowing and move beyond facts as the central form of knowledge.

In order to build competence in sustainability[1] and promote sustainable change, this research integrates three critical yet mostly disparate bodies of research— *educational pedagogy*, *behavior change*, and *sustainability competencies*. In order to test the impact of the behavior change techniques, sustainability practices, and curricula in fostering long-term sustainable change, I developed and implemented a two-week long education program for Phoenix-area middle and high school students called *Progressing towards Sustainability*[1]. This program focused on fostering transformative action through targeting diverse domains of knowledge (declarative, procedural, effectiveness, and social) in regards to food and waste behaviors. I collected extensive data throughout the 2-week program, and continued to collect data regarding students' knowledge and actions throughout the course of one year (June 2011- June 2012). Through the assistance of grants, the summer program was free of charge for the students and was advertised by the education department's staff to groups focused on mentoring low-income, minorities, and potential first-generation college students. In addition to the grants for the summer program, the year-long case study was funded by a CAP LTER grant which enabled me to provide stipends and supplies for the students who conducted interviews with their household members and peers (that did not participate in the program) as part of my research throughout the year.

During the 2-week education program and year-long case study, I focused on addressing; 1) How and to what degree does enhancing declarative, procedural, effectiveness, and social knowledge influence sustainable behavior change? And 2) How and to what degree is that behavior change sustained overtime and what were the barriers and constraints to implementing and maintaining the change? Few environmental education programs evaluate both knowledge and behaviors; therefore, the relationship between potential antecedents (knowledge in each domain) and of actual performance (behaviors) is still poorly understood, especially in relation to the motivations and barriers to sustained change (Duerden & Witt, 2010).

The education program focused on promoting a suite of actions specifically regarding food and waste decisions that could reduce students' overall environmental impact. A number of studies have established the importance of environmentally responsible consumption to sustainability, especially in regards to individual dietary habits (Gossard & York, 2003; Heller & Keoleian, 2003) and waste behaviors (Barr & Gilg, 2005; Granzin & Olsen, 1991). Hence, this study proceeds on the assumption that individual food and waste choices are critical components in progressing towards sustainability. The summer program focused on widely accepted sustainable waste practices, including waste reduction, reuse, and recovery (recycling and composting) (Barr & Gilg, 2005) and food practices, including purchasing and consuming food that is organic and locally grown, fresh (rather than packaged/processed), animal friendly, and largely plant-based (i.e. reduced meat consumption) (Bissonnette & Contento, 2001; Gossard & York, 2003; Tanner & Cast, 2003; Vermeir & Verbeke, 2004).

Middle school and high school students generally have some control over their food (Bisonnette & Contento, 2001) and waste behaviors (Cherif, 1995) but their specific home and school context, in large part, determines which strategies for behavior change will be most successful. Students selected specific strategies for changing their own food and waste behaviors while considering any personal constraints or barriers to change. Providing choice allows students to focus on behaviors that resonate with them and has been shown to increase learning outcomes and youths' confidence (Patall, Cooper, & Robinson, 2008). Similarly, self-determination theory posits the need for choice so that students select behaviors they perceive as

do-able and relevant to their specific environment (Cordova & Lepper, 1996; Patall, Cooper, & Robinson, 2008). Other researchers have found that by successfully implementing one or two sustainable food or waste strategies of their choosing, students are more likely to adopt other, similar strategies in the future, thus increasing the ultimate impact of the education program (Thøgersen, 2004).

Conceptual Approach

In the following section, I briefly review key concepts that underlie my approach to educating for sustainability. I begin by focusing on four domains of knowledge that integrate technical (declarative & procedural) and subjective (effectiveness & social) knowledge in a systematic way that targets barriers to behavior change while providing the skills and confidence to take action (Frisk & Larson, 2011; Kaiser & Fuhrer, 2003). Next, in order to inform the curriculum, I discuss four sustainability competencies that emphasize the complexities of action and change within interconnected social and ecological systems (Cortese, 2003; Wiek, Withycombe, & Redman, 2011). I conclude by addressing education pedagogy in order to highlight the importance of how we teach, not just what we teach. Throughout, I provide examples of how knowledge domains, competencies, and pedagogy can be applied to educating on food and waste sustainability.

Approach to Knowledge Domains

This research focuses on prominent behavioral theories and related studies in order to inform the relationship between education and action while considering four different domains of knowledge: declarative, procedural, effectiveness, and social knowledge (Kaiser & Fuhrer 2003). Declarative knowledge refers to traditional social/ecological information, procedural is defined as 'how-to' knowledge, effectiveness knowledge encompasses perceptions about desirability and the capacity to participate in various behaviors, and social knowledge consists of views regarding what is commonly done and judgments of the behavior in a given social or cultural environment (Frisk & Larson, 2011). While the knowledge domains are insufficient individually to explain the motivations behind people's actions, they collectively provide an overarching framework for synthesizing various schools of thought in the behavioral sciences.

Declarative (ecological) knowledge consists of information about how ecosystems function and how people interact with and impact the environment through their actions and decisions. The linear Information Deficit Model (IDM) model emphasizes declarative knowledge, claiming that more environmental knowledge leads to awareness and concern for the environment, and ultimately, to pro-environmental behaviors (Kollmuss & Agyeman, 2002). Psychologists and others have refuted this simplistic assumption, noting that changing behavior is very difficult and information on its own is insufficient to drive change, though the lack of declarative knowledge can form a barrier to changing behaviors (Kollmuss & Agyeman, 2002; Monroe, 2003; Trumbo & O'Keefe, 2001; McKenzie-Mohr & Smith, 1999). Although it is least effective in promoting pro-environmental behaviors, declarative knowledge has been the central focus of most educational programs (Pooley & O'Connor, 2000; Simmons & Volk, 2002). In terms of food, declarative knowledge includes information such as the amount of water it takes to produce a beef patty or the requirements for achieving organic certification.

Procedural knowledge encompasses 'how-to' information that builds an individual's capacity for action and correlates closely with situational and structural factors that may facilitate or constrain individual action (Kaiser & Fuhrer, 2003; Monroe, 2003). Information about how to participate in decision-making processes as well as knowledge about incentives and restrictions are critical to enhancing procedural knowledge and reducing the barriers to action. For recycling,

procedural knowledge would include understanding the how-to's of the local recycling system; some places have curb-side pick-up while others may not and some places may recycle only #1 plastic where as others recycle #1-7.

Third, effectiveness (impact) knowledge is the domain encompassing the individuals' perceptions of whether a certain behavior is worthwhile and desirable (Kaiser & Fuhrer, 2003; Monroe, 2003). Stern's (2000) Value-Belief-Norm (VBN) model of pro-ecological behavior highlights two key determinants relating to effectiveness knowledge; the first is the perceived consequences of behaviors, and the second is beliefs about who is responsible for environmental outcomes. These factors relate to a person's "locus of control," which represents the confidence individuals have in their ability to bring about impactful change through their personal actions (Hines, Hungerford, & Tomera, 1986; Kollmuss & Agyeman, 2002; Monroe, 2003). In terms of waste behaviors, such as composting, greater effectiveness knowledge would reinforce the students' confidence about their ability to implement and maintain a composting system while also highlighting that composting is impactful, and worthwhile.

The final domain, social knowledge, includes an individual's information regarding the motives and intentions of other people as well as perceptions about expectations in terms of perceived desirability of particular actions or decisions (Kollmuss & Agyeman, 2002), which are often described as norms (Trumbo & O'Keefe, 2001; Stern, 2000). Cialdini (2007) breaks norms into two different categories; descriptive norms refer to perceptions of what is commonly done and injunctive norms refer to what is approved of or disapproved of by others. The influence social knowledge has upon behaviors is in part dependent upon the individual's need for social approval and awareness of norms. The importance of social norms as a predictor of behavior is especially critical in a normative field such as sustainability, where societal values are central in guiding what we ought to sustain and how. In order to foster positive social norms regarding sustainable food behaviors, for instance, students could share publicly one sustainable food choice they made recently and be applauded by their peers and teachers for said behavior.

Approach to Sustainability Competences

Competencies refer to concepts and skills that enable students to understand and resolve complex sustainability problems and tasks (Frisk & Larson, 2011). After reviewing the literature on sustainability competencies (Church & Skelton, 2010; Cortese, 2003; de Haan, 2006; Nolet, 2009; Sipos, Battisti, & Grimm, 2008; Wiek, et al., 2011), I focus on four competencies: (1) systems thinking and an understanding of interconnectedness, (2) long-term, foresighted reasoning and strategizing, (3) stakeholder engagement and group collaboration, and (4) action-orientation and change-agent skills. These competencies were selected for their dominance in the literature and relevance to fostering transformative action and empowering students to be change agents in this transition to sustainability. In the sections that follow, I briefly describe each competency as it relates to broad concepts of sustainability as well as classroom specific approaches.

Systems thinking skills. The world is increasingly interconnected and decisions made in one region affect others in a complex array of local to global, human-environment interactions and impacts. Systems thinking skills are therefore essential for being aware of cascading effects, reducing unintended consequences, and assessing trade-offs. In applying systems thinking in the context of education for sustainable change, it is important not to just talk about interconnected global systems but also to delve into system linkages at the household, classroom, and school scale, these being systems that students impact and interact with regularly. Understanding patterns and interactions enables us to change system processes and components more effectively (Senge, 2006). For instance, students can select one food product from their household and talk

with their parents about what influenced their purchasing decision, then research where that food product originated, the nutritional value of the ingredients and how the life cycle of the product connects to the broader system dynamics.

Foresighted thinking and strategizing. Foresighted thinking entails an understanding that the actions we take today have consequences long into the future. Related ideas include long-term and future thinking, anticipatory competence, and intergenerational equity (de Haan, 2006; Gibson, 2006; MacKay & McKiernan, 2004; Wiek, et al., 2011). Foresighted thinking and strategizing inherently places a value on the future and promotes acting in a way that does not impede long-term sustainability or negatively impact future generations (Brundtland Commission, 1987). By engaging in group activities that ask students to share what they want for their future, individuals can explore their visions for a sustainable future in relation to the perspectives of others and to strategize about the decisions and actions that will lead to various future states. The commonly advocated approach to visioning includes four key steps: (1) describing the current state (2) understanding the possible scenarios of the future (based on past, present, and future trends), (3) envisioning an ideal future state (vision statement), and (4) developing strategies for getting from the current state to the envisioned state (action plan) (Project Learning Tree, 2006).

Stakeholder engagement and group collaboration. Sustainability requires collaboration in order to take into account diverse values and normative perspectives about how things ought to be (de Haan, 2006). Building competence in stakeholder engagement includes equipping students with the skills and resources to partake in collaborative decision making, mediate conflict among opposing perspectives, and negotiate diverse stakeholder interests while acknowledging different visions of the present, past and future. In order to promote open discussion that allows for diverse perspectives to be heard and acted upon, the classroom atmosphere should facilitate collaboration and community engagement while fostering interpersonal skills. When targeting long-term change in food and waste decisions, it is especially critical to engage members of students' households as key stakeholders involved in the decision making process. This can be done through assigning students to interview their parents or even just cook a meal with their parents and report on the cultural or familial significance of that meal.

Action orientation and change-agency. At its core, sustainability is a call for change from our current trajectory, in other words it is a call to action (Barr, 2003). Individual and collective action will be especially crucial in accomplishing the transformative change necessary to shift society away from patterns of over-consumption and inequity (de Haan, 2006). Equipping students with the skills and confidence to take action and become active participants in shaping their future is of prime importance to educating for sustainability. Nolet (2009) laments that action and transformative change are all too often left out of the education agenda, hence stalling reform while promoting the status quo. Progressing towards sustainability requires educating teachers and students for sustainability, not just about sustainability and in doing so they must move beyond information-based approaches and include action as a core competency (Nolet, 2009). Action-oriented education includes, for instance, students composting, recycling, and using of paper made from post-consumer as part of their everyday classroom operations.

Approach to Education Pedagogy

In a study on the effect of pedagogical approaches in sustainability courses, researchers found that multi-methodological, experiential, active learning approaches improved students' system thinking skills and cognitive understanding of sustainability (Segalàs, Ferrer-Balas, & Mulder, 2010). Even programs focused solely on cognitive outcomes can achieve higher order learning through novel education approaches that engage diverse domains of knowledge (Sipos, Battisti,

& Grimm, 2008). Due to their significance to cognitive understandings and skill-building for sustainability, I focus on three interconnected pedagogical methods: real-world learning, critical problem-solving, and experiential learning (Brundiers & Wiek, 2011; Hmelo-Silver, 2004; Segalàs, et al., 2010). Although I utilized a variety of other, more standard education approaches (such as collaborative learning), these three approaches to education are both distinctive and particularly critical when educating for sustainability.

Real-world learning. Real-world explorations incorporate authentic investigations with complex goals and provides opportunities for problem-solving while involving students' beliefs and values (Barab & Luehmann, 2003; Brundiers, Wiek, & Redman, 2010; Frisk & Larson, 2011; Segalàs, et al., 2010; Steiner & Posch, 2006). Debra Rowe writes, "by providing assignments that focus on solving real sustainability issues, educators can engage students and help institutions turn towards more sustainable behavioral and policy norms" (2007, pp. 324). Through real-world learning experiences students apply their classroom learning to study a sustainability issue and engage with people in the community (Brundiers et al., 2010). Real-world learning also enables students to apply theory to practice and builds interpersonal skills for engagement with stakeholders, both of which are critical for sustainability. Real-world learning modules are often place-based so that the curriculum engages in the context of the participants' own lives. Sterling notes that through place-based activities, "young people can gain confidence and a belief that they can make a difference, and their efforts can stimulate action by parents and the broader community" (2001, p. 68). By situating real-world learning modules in the local context, students will develop the knowledge and skills to be change agents in their own lives, homes, and schools.

Four methods provide real-world learning experiences to students: (1) bringing the real-world into classrooms (e.g. guest speakers), (2) visiting the real-world (e.g. field-trips), (3) simulating the real-world (e.g. role playing activities), and (4) engaging with the real-world (e.g. interviews with household members) (Brundiers, et al., 2010). When focusing on food systems, students can simulate the real-world by taking on the role of farmers, school principals, parents, students, and teachers in a debate involving improving school lunches. Through role-playing, the students advocate for the perspective of their interest group while working with the other groups to create a compromise amongst each stakeholder involved in the debate. Successful role-playing activities should be coupled with at least one other real-world experience; for instance, bringing in guest speaker to discuss school lunches with the students, or by having the students interview a person that represents one of the interest groups involved in the activity.

Critical Problem-Solving. The field of sustainability has emerged largely due to existing and anticipated complex problems, such as climate change, desertification, and environmental injustice (Wiek, et al., 2010). In order to better understand and hopefully solve these 'wicked' problems, sustainability scholars have focused on teaching approaches that are problem-driven and solution-oriented. Problem-based learning centers on a complex problem that does not have a single correct solution (Hmelo-Silver, 2004). The critical thinking and problem-solving process should be student-led, experiential, and collaborative in order to emphasize that there is more than one correct point of view when exploring problems. Although there should be debate about the solution(s), focusing on problems without discussing actionable solutions and strategies can leave students feeling disinterested (Scott, 2010). Rather than overwhelming students with a barrage of large-scale environmental catastrophes, students should focus on simple problems and solutions that promote individual agency and reduce the likelihood of distressing or distancing due to negative feelings (Kollmuss & Agyeman, 2002).

Good problem framing should be tangible, resonating with the students' lives, and the solution to the problem should be actionable. In Hmelo-Silver's research on problem-based lear-

ning (2004), she found that distant goals that seem insurmountable to the student can be disempowering. Research indicates that the problem chosen for the classroom should be focused around issues of a scale and complexity that will enable and empower the students to act (Hmelo-Silver 2004; Sterling, 2001). In my case study, I focused on problems associated with consumption and disposal of food and waste because there are multiple intervention points at the individual, household, and classroom scales at which students interact. Although many of the problems we explored, such as the accumulation of plastic debris in the environment (Thompson et al., 2004), have simple and achievable solutions, like using a reusable bag, bottle, and mug instead of the disposable alternatives, these issues are indicative of larger sustainability challenges. UNESCO chair, Dr. Arjen Wals notes, "The story of plastic in a sense captures the urgency, systemic nature, magnitude, uncertainty, ambiguity, complexity as well as the moral and ethical underpinnings of the sustainability challenge" (2010, p. 6). Connecting an individual scale solution, such as choosing reusable products over disposables, to larger systemic challenges allows students to feel empowered, while acknowledging the broader system and environment with which this problem was created and propagated.

Experiential (active) learning. Engaging students in active, applied learning not only increases their understanding of the content but also emphasizes the importance of action and engagement in their lives. Experiential learning provides direct experiences and contextualizes learning by applying knowledge to action. Sustainability scholars have pointed to experiential learning as a way to empower, engage, and motivate students while also breaking down the typical compartmentalization between action and education (Cortese, 2003; Sipos, et al., 2008). Additionally, direct experience is far more persuasive in developing pro-environmental behaviors as compared to indirect experiences (Duerden & Witt, 2010; Kollmuss & Agyeman, 2002). Developing sustainable operations within the classroom creates a context for conversations about sustainability, provides direct opportunities to engage in sustainable practices, and empowers students by equipping them with the skills to take action (Higgs & McMillan, 2006).

In providing direct experiences for students to practice sustainable behaviors in the classroom, teachers are able to also model sustainable behaviors. Researchers have found that inconsistency between the concepts being taught and the unsustainable behaviors that are demonstrated by instructors decreases both the likelihood of educational effectiveness and of transformative change (Huggs & McMillan, 2006). In addition to developing consistent intended messages about sustainability, building sustainability actions into the classroom is also essential for effectively integrating behavior change tools and knowledge domains. For instance, without actually having a composting bin in the classroom (or school) it is difficult to go beyond declarative knowledge in a unit about organic waste as many of the other domains require hands-on interactions. Building procedural knowledge about composting could include sorting the waste correctly into the various bins; effectiveness knowledge could be enhanced by measuring the amount of waste diverted from the landfill through composting; and social knowledge could be addressed through rewarding students for composting. Sustainability education researchers, Higgs and McMillan (2006, pp. 44), wrote, "carrying out sustainable behaviors is a necessary precondition to effective sustainability modeling," and modeling can strongly impact students' knowledge, skills, values, and actions.

Methods

Logic models create clear connections between planned work and intended results and therefore provide a clear organization for my methods (Kellogg Foundation, 1998). As seen in the logic model (Figure 1), the sustainability competencies informed my approach to pedagogy while each activity targeted various domains of knowledge. The following section begins with a brief

overview of education methods (Part I), then moves into the data collection and analytical approach used throughout the year (Part II). The education methods are organized by the program theme, sustainability competencies, and the data collection methods are organized by data type, quantitative then qualitative. Both the education and data collection methods focus on targeting and assessing the acquisition of knowledge domains and sustained behavior change.

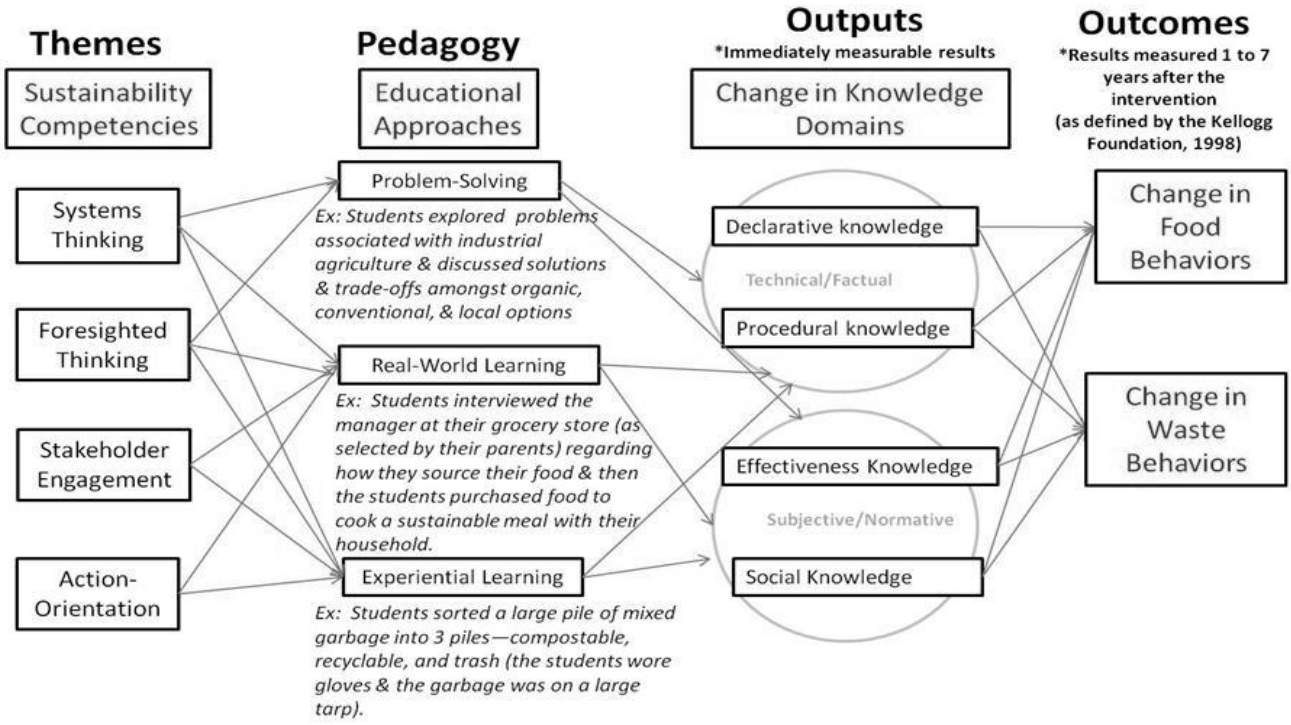

Figure 1. Approach for Targeting Behavior Change Outcomes

Part I: Sustainability Education Methods

The summer program was held during June 2011 at the School of Sustainability on the Arizona State University campus. There were 3 middle school students, 3 high school students, and 3 K-12 teachers in attendance throughout the two weeks. All six students described themselves as Hispanic or Latino and the highest level of education achieved by their parents/guardians was high school. Although I was not directly involved in recruiting students—staff in the education department recruited students for all twelve of the STEM summer programs—I was able to request the age, grade, and general demographic make-up of the student population I was interested in working with. With grant funding[2], I was able to target low-income youth and provide free tuition as well as sustainable lunches each day, light rail passes to and from the campus, and materials necessary for undertaking sustainable behaviors at home and school (e.g., reusable bags, composting & recycling bins, gift cards for purchasing sustainable food). This was the first university-based summer education program any of the students in my program had attended (they cited program fees and transportation as barriers to attending similar programs in the past).

This section is organized by the competencies since they provided the structure for what should be taught and how during the summer program (Figure 1). In providing a few specific examples and strategies from my education program, I highlight how the key sustainability competencies informed my approach to educating about sustainable food and waste strategies. Each competency was integrated into my education methodology during both the food-focused week (week one) and the waste-focused week (week two).

Educating for systems thinking. During the food-focused week, students explored their local food system by tracking what they ate, where their food comes from, and how it is produced. Foundational to this portion was the students 'interviewing' their household members as well as a manager at their local grocer, thereby also improving their interpersonal competency. The students began by examining their personal food choices (tracking their daily eating habits and household purchasing patterns) and then traced the connected system outwards (visiting and exploring the local grocery store), ultimately arriving at the broader implications (researching and engaging in life cycle analysis activities) of their individual food decisions on collective social and environmental change. By engaging students first in their personal motivations and decisions, I was able to frame the discussions and activities around their choices and preferences as well as values and norms, rather than beginning the education program with unfamiliar values and seemingly, insurmountable challenges associated with our complex, global food system.

While exploring the relationships between food miles, prices, and agricultural practices, complementary learning modules engaged students in issues of water quality, health and nutrition, labor practices, and equity. In one such activity, students were asked to engage in higher order learning by evaluating local, organic, and conventional food products based on economic, social, and environmental criteria. For this activity, actual products (e.g., different types of salsas) were used rather than creating hypothetical products/brands because it better prepares students for assessing the sustainability of their own food choices in the 'real-world.' The students discussed the (un)sustainable aspects of each product and worked together to design an ideal product that meets or exceeds the social, economic, and environmental sustainability criteria discussed in the lesson.

The goal of this activity was not simply identifying the 'right' product to purchase but rather fostering an understanding of how our food decisions are connected to social equity, access to economic opportunities, and environmental health locally and globally. The students mutually came to the conclusion that there are trade-offs associated with each product and that elements of uncertainty associated with the life cycle of products make the evaluation process more complex. Throughout the exploration of their local food system, students were also asked to reflect upon how they as individuals could progress to more sustainable food behaviors and to commit to trying various strategies during the course of the program and afterwards.

Educating for foresighted thinking. During my education program visioning exercises were used to engage students in foresighted thinking. Through the visioning activity, students reflected on and discussed social knowledge—including values and norms—surrounding their vision statements and action plans while also acknowledging their individual role in achieving that future. On the vision boards students crafted vision statements, wrote stories about the future they would like to see, drew and cut out pictures from magazines that represented that vision, and created personal action strategies that would contribute to achieving their vision. One group envisioned a future in which people have greater connections to their food and deeper relationships with the cultivation process. Their vision board included things such as school, community, and home gardening. In creating their personal action strategies, the students discussed the deliberate decisions and changes that would have to be made as well as the strategies and stages for implementation required to achieve their desired outcomes.

Visioning exercises are in part, about understanding the relationship between present actions and future consequences. Throughout the program, the students developed action plans and strategies for change so we used their previous selected actions as the entry point for the visioning exercise. The students were asked to connect their strategies and actions (e.g., eat less meat) to their broader long-term visions (e.g., cows return to grass ranging and are an integral part of improving soil quality and farm sustainability). We discussed several future scenarios along the continuum between an ideal food system and an unhealthy, unsustainable system. By building out several scenarios of the future, the students began to understand that the vision they were creating contained many components, beyond eating meat, including an array of actions, strategies, and decisions that led to a desirable or undesirable future. The final vision statement should tell a story of what the future should or could evolve to, while the strategies and action plans elaborate the specific individual and collective changes which would be needed in order to lead to achieving that vision. The students in the summer program created two vision boards; one group focused on the consumption and production of local, fresh, and organic food through the expansion of community gardens, farm to school programs, and farmers markets, while the other group focused on reforming the meat industry through reduced meat consumption, decreased confined animal factory operations, and an increase in pasture raised animals that have a natural, hormone free diet.

Educating for stakeholder engagement. My education program utilized collaborative learning techniques, group work, and stakeholder interviews in an effort to improve interpersonal skills and promote collaboration. During the summer program students were asked to go to their local grocery store with their parents to interview a manager about the selection (or lack of selection) of organic and sustainably sourced foods. Then they were asked to purchase sustainable foods (gift cards were provided), prepare a meal with their household members using that food, and interview their parents/guardians about how and why they currently make the food purchasing decisions they do. The students were asked to develop strategies with their household members based on what they learned during the program and what their household members' value when making food purchasing decisions. As part of their action plans, they were also asked to develop a strategy for sharing their experience throughout this food exploration with a peer outside of the program. Including key stakeholders in the students' action plans—that is, their household members, grocery store managers, and peers—not only fosters interpersonal skills but also, it was hoped, increases the likelihood of success after the program due to external support for the actions.

In addition to the outside of the classroom experiences, students had the opportunity to engage with stakeholders throughout our regular programming. We visited restaurants (e.g., Engrained—an ASU campus restaurant focused on locally grown and harvested food prepared to order), sampled food items from various local sources (e.g., farmers markets and community gardens), and talked with ASU's food service provider as well as the director of the Phoenix Public Market and Community Food Connections (a local non-profit focused on improving access to healthy food in underserved areas through expanding outlets for and production of local food). Engaging with local companies, non-profits, and change agents within the food industry provides students with multiple perspectives on food sourcing and purchasing while also being place-based and experiential. At the end of the week, we reflected upon the trade-offs involved in food purchasing decisions and the importance of including a broad array of individuals in developing strategies for a sustainable food future.

Educating for change-agency. In the summer program, action orientation was a dominant theme and was imbedded into my approach to teaching all of the sustainability competencies and knowledge domains. To address waste strategies through an action-oriented activity,

everyone brought in garbage from their homes which we displayed on a large tarp, and then the students sorted the garbage into compostable, recyclable, and landfilled trash piles. Once the piles were created, we asked them to look at the pile destined for the landfill and reflect on what they could do to reduce that pile through reuse and reduce strategies. We looked at the recyclable pile and identified which items were already made from post-consumer content and which of the recyclable products would mostly likely be up-cycled versus down-cycled. In exploring the compostable pile, the students reflected that the remains of healthy, nutritious things (fruit and vegetable scraps mainly) made up the majority of compostable items so there is clearly a link between eating healthy foods and composting waste. Rather than just talking about these issues in a hypothetical sense, the students collected their trash over the course of the program and physically sorted it while noting how they could change some of their currently unsustainable waste strategies.

As seen in Table 1, the education activities included eating, cooking, grocery shopping, sorting, building, and many other action-oriented lessons. Students individualized their action strategies and developed a personalized plan for achieving their goals, hence providing autonomy while simultaneously promoting action. Many of the action strategies were developed in conjunction with the students' household members. For instance, the students' guardians were sent home forms asking them which waste strategies they would be interested in doing: recycling, worm composting, or outdoor composting. They were asked to select one, more than one, or none and then check what materials they would allow their children to take home in order to implement the strategies. Providing students with a supportive environment for taking action is central to maintaining the change in the long-term and reducing the barriers to implementation.

Part II: Assessment Methods

To examine knowledge among the students, as well as the changes during and after the education program, I utilized a variety of approaches: pre- and post-surveys, observations (videos of every session and copies of students' journals and assignments), and interviews (see Figure 2). This mixed-method approach provided both qualitative and quantitative data that together create a more holistic picture of the impact of the intervention on student knowledge and behaviors. In addition to the data collected during the summer program, I continued to work with three of the six summer program participants through a CAP LTER grant[2]. The grant for the year-long case study compensated the students for taking time off from after-school jobs, which was especially critical for one of the students in particular who was an income provider for his household.

With the support of this grant, I was able to collect data on these three students' barriers, motivations, and social constraints to sustainable behavior change over the course of a year. In order to understand the students' change in relation to their context, each student interviewed five or six family members and/or friends, for a total of sixteen interviews amongst the three students. Although there are obvious limitations to working with only three students for the year-long research, collecting detailed data on each student enabled me to explore the underpinnings of sustainable change in the context of their lives and specific circumstances. By treating each student as an individual case for understanding the relationship between the education program, knowledge domains, and sustained behavior change, I aim to not just posit that change occurred but also to explain in what context and circumstances sustained behavior change was achieved.

Table 1. Action strategies and associated activities that target various knowledge domains

Food Related Strategies & Activities (Week 1)		
Action Strategies	Education Activities	Knowledge Domain & Justification
-Reduce meat consumption -Substitute chicken for beef >1/week - Commit to meat-free week each month -Eat a vegetarian meal >1/week (i.e. meatless Monday)	-Ate vegetarian lunches every day & shared recipes with students -Students prepared vegetarian meal with families & shared their meal plans & feelings with the group -Students brought in their favorite vegetarian snack to share with the class	Procedural & Social: Students observe their teachers & peers eating sustainable lunches while also developing their skills to cook at home. These activities also provide direct, real-world experiences.
-Choose local &organic products when possible -Purchase food from growers by shopping at farmer's markets	-Ate at restaurant focused on local, sustainable food production & spoke with chef and sustainability manager about the restaurants commitment to sustainability -Students created life cycle diagrams of organic, local, & conventional products & evaluated them based on sustainability criteria -Students spoke with the director of the largest farmers market in the city & ate lunch provided by the farmers market	Declarative, Effectiveness, & Social: Students learned about the classifications for food production & sourcing and experienced sustainable food in an accessible and deliciously prepared way. They spoke with food professionals about the positive aspects of using sustainable food in restaurants & purchasing at local farmers markets.
-Avoid highly processed foods -Choose fresh foods when possible	-Students brought in cereals & other breakfast items they typically eat & we analyzed the nutrition labels -Students kept food journals & shared their choices with the class	Declarative, Procedural & Effectiveness: Students learned how to read nutrition labels & through tracking their food they were able to reflect upon how & what they could change.
Waste Related Strategies & Activities (Week 2)		
Action Strategies	Education Activities	Knowledge Domain & Justification
-Use re-usable bags instead of disposable plastic -Choose products with less or no packaging	-Students used their reusable bags at their grocery store & reflected on the experience in journals & in class -Students selected products with little or no packaging at the grocery store & kept food/packaging waste for the sorting activity described below	Procedural & Effectiveness: The students learned how to reduce their waste through real-world, hands-on experience, which also increased their confidence to implement these strategies the future.
-Use a re-usable mug or water bottle instead of a disposable product	-Students received stars next to their names each day they remembered their reusable water bottle & were given prizes at for the most stars	Effectiveness & Social: Providing positive incentives and feedback can help foster positive attitudes about the behavior
-Recycle and sort your recyclables appropriately	-Students made signs for their new household recycling bins (for those that selected this strategy)	Procedural: The sign reminds students at the point of action to recycle & what they can recycle.
-Compost your organic materials	-Students sorted garbage into compostable, recyclable, and trash (landfill) -Students built composting bins (if that was one of their selected strategies)	Procedural, Effectiveness & Social: Students demonstrated they knew how to set-up & maintain a composting system. Students were able to promote composting as the norm in their homes.

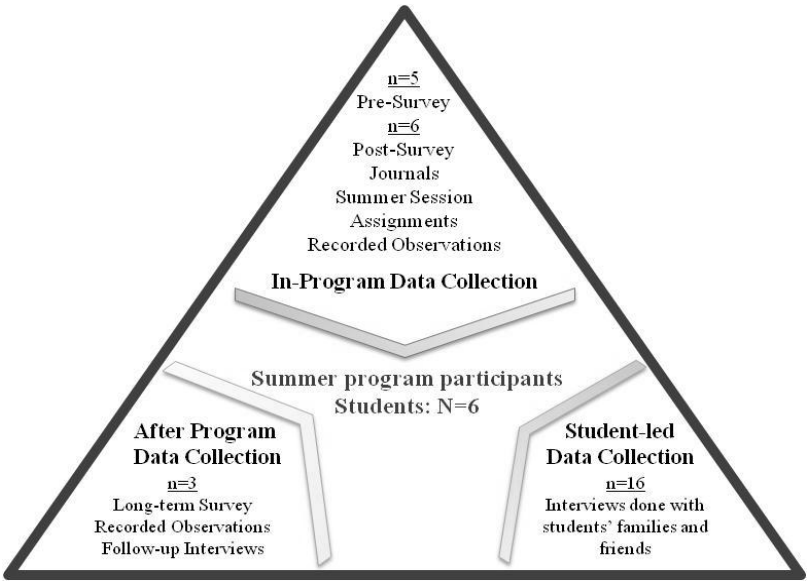

Figure 2. Triangulated Data Collection

The pre- and post-program surveys. The pre-program survey consisted of 106 questions, 19 of which were open-ended. The close-ended questions utilized a 5-point Likert Scale to assess knowledge in each of the four domains and to measure the frequency of food and waste behaviors (see Appendix for more information). The post-survey differed from the pre-survey in that it did not ask for demographic information (as these responses would not change over the course of two-weeks), the open-ended questions were adjusted to enable the participants to reflect upon what they enjoyed most/least about the program and the close-ended questions regarding behavior were changed from what they did over the past year (pre-survey) to what they plan to do during the upcoming year (post-survey).

The first step to analyzing the results of the survey was to standardize[3] the responses so that 5 always indicated the most sustainable response. Once the data were standardized, it was necessary to reorganize and group the data first by knowledge domain/behavior and then by food and waste. Two different approaches were taken for analyzing the results. First the whole groups' responses to each question were taken together and averaged for each domain and associated behaviors comparing responses in the pre- and post-surveys (Figure 3). This approach results in five pre-program averages and five post-program averages for both food and waste and allows for a comparison amongst the domains of knowledge (e.g., which domains changed the most/least due to the program). The other approach was to create an overall knowledge and behavior score for each student, pre- and post-program. This was done by averaging their responses for each knowledge and behavior domain, and then averaging those results together (this weighs each knowledge domain equally regardless of the number of questions). This method does not separate out the domains but rather gives one knowledge score for food and for waste and then compares that against the associated behavior scores. This enables a comparison of the participants' knowledge and behavior pre- and post-, visualizing the changes to knowledge and to behavior for each participant (Figure 4).

Mixed methods for participant observations. A variety of studies have suggested that utilizing the educator to observe student behaviors is an effective approach (Hay, Nelson, & Hay, 1977; Hay, Nelson, & Hay, 1980). During the summer program, I was the educator and due to the difficulty of recording observations while being the instructor, I employed a variety of different methods to ensure that critical information was not missed, including video recording, copying student journals, and taking field notes[4]. Also, given that behavior is such a central part of my research, I put up a poster in the room to record when students were 'caught behaving sustainably' and stickers were placed next to student's names when they brought their reusable bottles/bags/utensils to class and, recycled, composted, or otherwise publicly acted sustainably. The poster allowed me to build-in recording behaviors as part of the curriculum while positively reinforcing sustainable behaviors.

Many educational programs only collect data during and immediately following the intervention. Although that may effectively capture short-term results, in sustainability we are interested in fostering long-term change. Therefore, I contacted all of the participants and their parents six months after the program and asked if they could meet for a follow-up interview. Despite multiple contacts with each participant, I was only able to get fifty percent of the students (3 students) to participate in interviews as part of a semester long follow-up research program.

The three students that participated in the follow-up research were given stipends to compensate for their time and in return were asked to interview the six most influential people in their lives and develop and implement a sustainability campaign or project of their choosing in their school. The three high school students, myself, and an undergraduate sustainability student worked together to develop interview protocol to be used with selected family and friends. The final interview protocol consisted of 25 questions; 12 regarding waste behaviors (recycling, composting, and reuse) and 13 about food behaviors (purchasing and consumption of meat and organic, local, and processed foods). We met once a week during spring 2012 to discuss the interviews and the students' efforts to implement and maintain sustainable strategies at home and at school. During these weekly meetings I continued to collect data by taking notes, having an undergraduate sustainability student record the high school students' comments and actions, and by copying the students' journals and interviews. This data provides key insights on the barriers and constraints to change and has allowed for a more detailed analysis of the program's effectiveness.

Due to the intensive nature of the qualitative data collected on the three students that participated in the year-long follow-up, I focus my qualitative analysis on only those three participants. Following a case study approach, I document each student's knowledge and behaviors as well as their broader social situation in order to fully develop a holistic picture of the motivations, barriers, and environment surrounding and affecting un/sustainable choices.

Results

The following section will begin by detailing the results that were collected through the two-week summer program and then move into the results found over the course of the year-long follow-up, first detailing the quantitative results then the qualitative results. The anonymity of all participants in this study has been protected. As I describe each student's cultural and peer environment, journal contributions, interview, and survey results, I use a pseudonym that was chosen randomly.

Student Survey Results from Summer Program

Overall the students' sustainability knowledge (as measured by the survey) increased in all four knowledge domains in terms of both food and waste over the course of the program. On average, the students' pre-program knowledge regarding waste was greater than that of food in three of the four domain areas, with the exception being social knowledge (Figure 3). Although the average post-program scores for waste knowledge were high, the change between pre- and post-knowledge regarding food was greater, in part because students entered the program with less food knowledge. The highest average post-program knowledge score across all four domains for both food and waste was that of *food* declarative knowledge. In spite of the greater shift in food knowledge amongst three of the four domains, *waste* behaviors changed more than *food* behaviors. This may be due to the rigidity of social knowledge regarding food, with the post-program averages barely increasing from pre-program social knowledge averages. The change in social knowledge regarding waste choices was greater than for food, but still less than the shift in the other three domains of knowledge for waste. These survey results show that the outcome of behavior change in terms of *waste* was more successfully achieved than that of *food*, while the qualitative data suggests reasons for the resistance to change in terms of food behaviors.

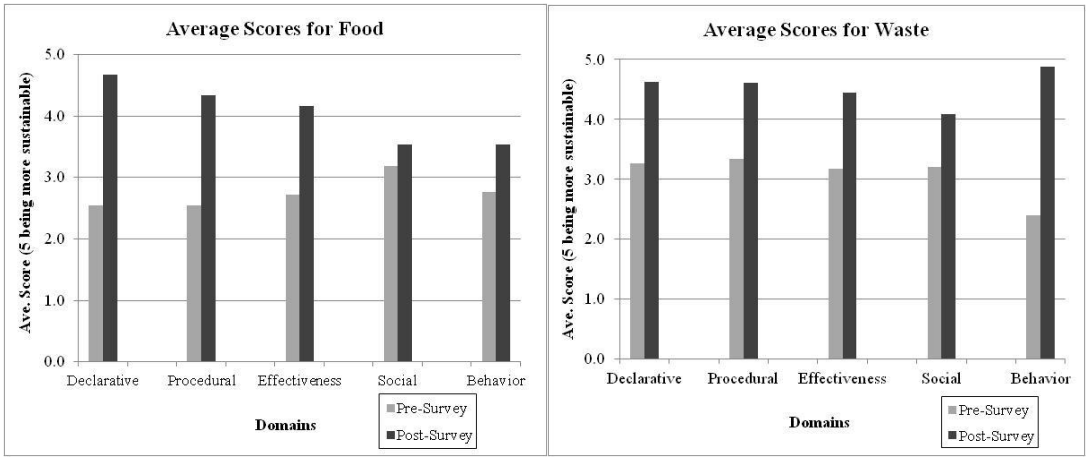

Figure 3. Average Food and Waste Scores for Each Domain and Associated Behaviors

From Figure 4, one can see that the students were grouped in the pre-survey and that the responses on average changed similarly for each student so that they ended up grouped after the summer program as well. One of the 6 students did not take the pre-program survey because the coordinators of the STEM education program brought him to the wrong program on the first day, so his data is not included in the graph below. The behavior scores for the pre-program survey represent the behaviors they reported engaging in previous to entering the program and the behavior scores in the post-program survey represent the sustainable behaviors they intended to engage in after the program. For each student their score in the knowledge domains increased to an average of between 4 and 5 for both food and waste. In spite of the knowledge scores being comparable (as seen on the x-axis on Figure 4) the change in behaviors was very different for food and waste. The students scored virtually as high as possible for the *waste* behaviors they planned to take up after the summer program, whereas their intended *food* behaviors averaged only slightly more sustainable than from before the program.

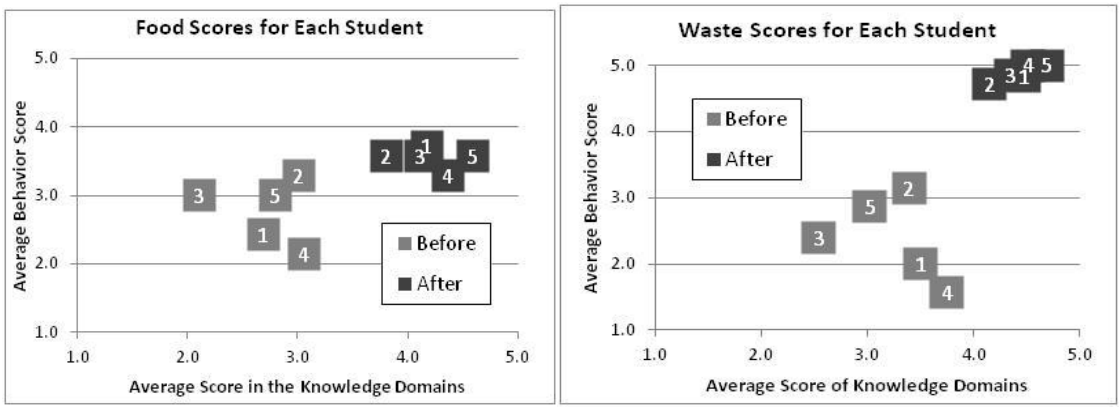

Figure 4. Food and Waste Scores Before and After the Program for Each Student

Year-long Case Study Survey Results

In order to better represent the long-term behavior change that occurred, I focus on a couple of specific food and waste behaviors amongst the three students that I studied over the course of a year. In Table 2, the survey results compare the pre-program survey, post-program survey, and the long-term follow-up survey[5] for reuse (reusing bottles/bags/napkins) behaviors, meat consumption, and organic food purchasing. These results demonstrated that long-term change did occur but behaviors did not change as much as expressed intentions (in the pre-survey) indicated they would. The long-term survey also shows that the sustainable waste behaviors are done more frequently, many done on a daily basis or every time the opportunity arises, as compared to the sustainable food behaviors that are done on a weekly to monthly basis for all three students.

Qualitative results for year-long case study. For the three students, who were involved in this project over a year, I have detailed qualitative data regarding their families' and friends' behaviors, values, and attitudes as well as their own knowledge and behaviors. In the section that follows, I will explain how and why the students changed (or didn't) given particular motivations and constraints associated with the various behaviors.

Student 1: John. John is a high school student at one of the large public schools where he is in an advanced track because of his academic aptitude. He does not live with his father and his mother has passed away so he has taken on many of the tasks that adults often perform in a household, such as purchasing food and taking out garbage. John shares his house with his older brother, sister-in law, niece, and younger brother. Although his independence affords him greater agency, it also presents unique barriers associated with being a high school student and running a household simultaneously. John participates in a mentor program and his mentor is a professor in the School of Sustainability. John's mentor composts, recycles, and partakes in many reuse behaviors but he is less engaged in sustainable food behaviors. John's mentor, brothers, and friends all commented that they eat meat every day and don't regularly purchase local or organic food because of convenience or cost. Of the six people that John interviewed, three of them currently live in his household and those three are the ones whose behavior shifted most due to John's participation in the program (see Figure 5).

Table 2. Examples of Changes in Participant Reported Behaviors

		Student 1 (John)	**Student 2 (Jane)**	**Student 3 (Jill)**
Use reusable, washable napkins instead of paper ones?	Pre:	Weekly	Never	Never
	Post:	Daily	Weekly	Daily
	Long-term:	Daily	Monthly	Monthly
Use cloth or other reusable bags at stores (instead of plastic/paper bags given at checkout)	Pre:	Weekly	Never	Never
	Post:	Daily	Daily	Daily
	Long-term:	Weekly (every time we go to a store)	Daily	Monthly
Reuse my water bottle	Pre:	Monthl	Weekly	Never
	Post:	Daily	Daily	Daily
	Long-term:	Weekly	Daily	Daily
Eat meals with no meat (chicken, beef, pork, etc.) at all.	Pre:	Monthly	Monthly	Never
	Post:	Monthly	Daily	Monthly
	Long-term:	Weekly	Monthly	Monthly
Buy organic foods over non-organic ones.	Pre:	Monthly	Yearly	Never
	Post:	Weekly	Monthly	Weekly
	Long-term:	Monthly	Monthly	Weekly

John's waste behavior changed significantly in the long-term due to the summer program. Before the summer program, John's household did not recycle. On John's pre-program survey, he wrote that his neighborhood did not have curbside recycling; this demonstrated a lack of procedural knowledge because his neighborhood did have curbside recycling. I looked up his neighborhood on the City of Phoenix website and we discussed his neighborhood's recycling program. Some of his family members do not have residency paperwork and they were concerned about calling the city to ask for a bin. In order to overcome this barrier, I called the city and asked to have a recycling bin delivered to their house (before for program was over the bin had arrived). In addition to the curbside bin, John was given a recycling bin for inside their house and he created signs for the bins so that his household members would know how to appropriately sort recyclables, again demonstrating enhanced procedural knowledge. In the post-program and long-term surveys, John noted that his neighborhood does have curbside recycling and that he has been recycling at home on a daily basis.

Eight months later, John noted that "recycling has been the easiest sustainability action to maintain since the summer program because the recycling bin at home makes it more convenient." In addition to recycling, John's household also began composting and was still composting regularly, one year after the program. The education program has changed not only John's behavior but also that of his other household members (see Figure 5). As a leader in the household, John has taught the other members of his household how to recycle and compost. Additionally, he implemented a recycling project in his school in which he placed 11 new recycling bins (purchased with the CAP LTER grant) throughout his school with signs explaining what can/not be recycled. His confidence to create positive change as well as his capacity to implement

change over the long-term demonstrates enhanced effectiveness knowledge in regards to sustainable waste behaviors.

John's favorite activities during the summer program and spring meetings were all related to food sustainability. He noted that his favorite homework assignment during the summer program was buying sustainable food at a store and his favorite in-class activity was eating at a sustainable restaurant (the students were served food every day so this was not simply because he was given lunch). A year after the program, he commented on the restaurant's local and organic food selection, and highlighted a tour of the campus garden as one of the most fascinating parts of the program. Even though he was able to recall information (declarative & procedural knowledge) about pesticides and synthetic fertilizers used in non-organic agriculture and facts about water-use and beef, as well as the economic benefits of local food, he did not feel confident in his ability to initiate significant food changes in his household (effectiveness knowledge) and the norm in his household is to choose food by cost (social knowledge). Although any measurable change in food decisions is difficult to fully decipher, John reflected that he chooses vegetables over chips when he has the option and since the program has visited a local farmers market a number of times with his brother's girlfriend and his mentor. Food behaviors may be more resistant to change than waste behaviors but the summer program spurred small changes that could lead to more transformative change in John's future.

John's transformation goes beyond recycling, composting, and eating vegetables. Through this program he was empowered to create change in his home and school, becoming a leader for sustainability. However, John's greatest transformation is in his hopes for the future. During the program we had many professionals in sustainability speak to the students about their careers and the passion they have for what they do. This seemed to resonate strongly with John because he is now planning on pursuing a career in sustainability, specifically sustainable design and architecture. Before the program, he noted that he did not even know what sustainability was, now he wants to pursue it in college and thereafter.

Student 2: Jane. Jane is a sophomore at a private high school. Jane and her sister both participated in the summer program and follow-up research. Jane's household consists of her mother, sister, brother, grandmother and grandfather. Jane's mother works full-time and supports her daughters in all their athletic and academic opportunities. Jane plays sports year-round and is active in many school clubs, making time a big barrier for many activities such as spending a Sunday at the local farmers market or even cooking dinner at home.

Jane's favorite activities during the summer program were separating the trash into recycling, compostable, and landfilled and for homework she enjoyed tracking her trash. Her favorite products she received during the summer program were the reusable water bottle and compost bins. One year after the program she noted that recycling was the easiest sustainability action to maintain and that having a bin inside for sorting trash in the kitchen was very convenient. Prior to the summer program, her family had to walk outside to the curbside bin to throw away any recyclable item but through the Neely Grant[6] their household was given an indoor recycling bin so they only had to take the recycling out once a week. The indoor bin enabled Jane to overcome the perceived inconvenience of recycling. Jane commented that she feels she has influenced her mom to behave more sustainability because now "my mother is always throwing things in the recycle bin instead of the trash." The only member of her household that Jane formally interviewed was her grandmother and the interview indicates that she changed her grandmother's waste behaviors significantly. Jane's grandmother is thrifty and likes the idea of using less, hence he has been a big supporter of Jane's efforts to reuse products and reduce consumption.

As a result of the summer program, Jane experimented with being a vegetarian for the remainder of the summer (2 ½ months). As noted previously, when teachers model sustainable

behaviors, students often attempt to mimic that behavior. I am a vegetarian and after Jane observed me eat vegetarian food every day during the two week program, she wanted to experiment with this diet herself. I provided her with over a dozen vegetarian recipes and she successfully ate vegetarian for 2 ½ months. When school started, she noted that she started to feel light-headed and sick so she went back to integrating meat into her diet. In order to make such an extreme shift in diet, she probably needed greater procedural knowledge in regards to cooking and eating vegetarian, especially in the school environment where there are limited options. One of the key nutrition elements for vegetarians is being aware of different forms of protein. In Jane's interviews it was clear that her friends and family had no idea that non-meat items could contain protein, again demonstrating a lack of procedural knowledge. Meat-less meal preparation was a small part of the program because I was focusing on meat-less Mondays and other small, incremental changes, rather than the radical shift that Jane attempted. Although the change ultimately didn't last, she was proud of trying and I did not want to discourage her attempt. However, this case does demonstrate the value of gradual change over time. One year after the program, Jane reflected that she would still enjoy eating more vegetarian meals and she feels her approach to food has been transformed.

In reflecting on her overall transformation during the last year, Jane remarked, "I have learned to value my waste, food consumption, and myself as a sustainability promoter." Through this program, Jane developed a way to speak to her classmates about sustainability in a way that readily resonates with them. She attends a Catholic high school and used values presented by their religion to integrate concepts of social justice and environmental conservation (protecting the creatures that God created). This religious approach is very different from those taken by the other students and demonstrates the autonomy each student had to view sustainability through the lens of their own values. By framing sustainability in a personally relevant way, Jane gained confidence. She said that, "the most important quality I received from this program was courage" and she used that courage to be a sustainability leader at school and home.

Student 3: Jill. Jane's younger sister, Jill, also participated in the summer program and extensive follow-up. Jill attends the same private Catholic school as her sister and is equally as busy with sports and clubs. Jill interviewed her mother, grandfather, and three friends from school.

After the summer program was over, Jill continued, for 5 weeks, to track how many disposable plastic water bottles she used. Over that time period, she purchased 4 disposable water bottles. Prior to the summer program she used reusable water bottles during sports practice/games (her entire team had decorated reusable bottles with their jersey numbers on them) but purchased disposable water bottles every day at lunch. Since the summer program, Jill has become very interested in promoting the use of reusable water bottles at her school. She spoke to her principal about selling reusable water bottles with their school logo and promoting their use over the disposable bottles. Although this project was a great idea, it was logistically very difficult because the school makes money from selling the disposable water bottles. Despite the set-back in creating change at the school-wide level, Jill felt positive about the impact she had on her friends' and family's waste behaviors, noting that more of her friends use reusable water bottles now and her household composts, recycles, and uses reusable napkins (see Figure 5).

Jill's favorite lesson during the program was evaluating local, organic, and conventional salsa brands based on sustainability criteria. Through this activity, as well as others, Jill gained procedural knowledge regarding how to identify local, organic, and conventional foods, as well at the significance of these labels. However, Jill commented that it was difficult to explain the criteria and labeling to her family. During Jill's interviews a couple of her respondents said they ate local and organic but the later questions regarding what that meant were not answered in a

way that supports their claim. For instance, her grandfather said that yes, he eats organic but when asked to distinguish between organic food and processed food, he could not. Jill's mother also had some difficulty distinguishing between locally produced food and food from multi-national corporations. Jill's mom said that she buys local and when asked where, she said at her grocery store (a large chain), noting that local food is everywhere in the store so it is easy to purchase. However, her grocery store does not stock local food, so it is likely that she was not sufficiently familiar with the food system. The interviews Jill conducted highlight that even though her household members intended to purchase sustainable food, their lack of procedural knowledge was clearly a barrier in doing so.

In contrast to Jane's personal transformation and John's professional sustainability aspirations, Jill's change seems less profound. The difficulty in evaluating Jill's transformation is that Jane is the leader of the two sisters so many of Jill's behavioral changes could be attributed to Jane's leadership. Yet, Jill went from not knowing what sustainability meant to trying to implement a school-wide sustainability campaign. Jill also started to speak to more of her friends about sustainability and was very excited when two of them were interested and engaged in the topic. She also said that she has started to pack a lunch for school so that she can eat a meatless lunch a couple of days a week. Although it is difficult to tease apart the causal reasons for the change, Jill's knowledge, values, and behaviors did change over the course of the year.

The graphs in Figure 5 represent the change that occurred amongst John's six interviewees (3 of which were household members), Jane's five interviewees (3 friends, 1 friends' parent, & her grandmother), and Jill's five interviewees (her mother, grandfather, and 3 friends). As seen in Figure 5, the majority of the family and friends interviewed began to recycle after the intervention, even though only 19% recycled prior to the program. Although the interviewees had heard of recycling and many sometimes participated in recycling, only one of the interviewees knew what composting was prior to the program and yet an astonishing 38% of those interviewed composted after the program. Although the changes in food behaviors were less drastic, change did occur, with 56% of interviewees remarking that they do or sometimes do purchase organic foods, which is up from 31% prior to the program. By supporting the students through this interview process, they were able to further develop their interpersonal competency and create an approach for speaking with their friends about sustainability while also building their confidence as agents of change in their homes and schools.

Discussion

The results from the summer program and year-long case study demonstrate that not only do different types of knowledge impact behavior to varying degrees but also that food and waste behaviors have different sets of barriers and constraints that impact whether the intended behavior changes are implemented and maintained over time. Herein, I will discuss the results as they relate to the research questions; 1) How and to what degree does enhancing declarative, procedural, effectiveness, and social knowledge influence sustainable behavior change? And 2) How and to what degree is that change sustained overtime and what were the barriers and constraints to implementing and maintaining the change?

Relationship between Knowledge and Behaviors

Although the convergence of all four knowledge domains appears to lead to sustained behavior change, each knowledge domain influences behavior change differently.

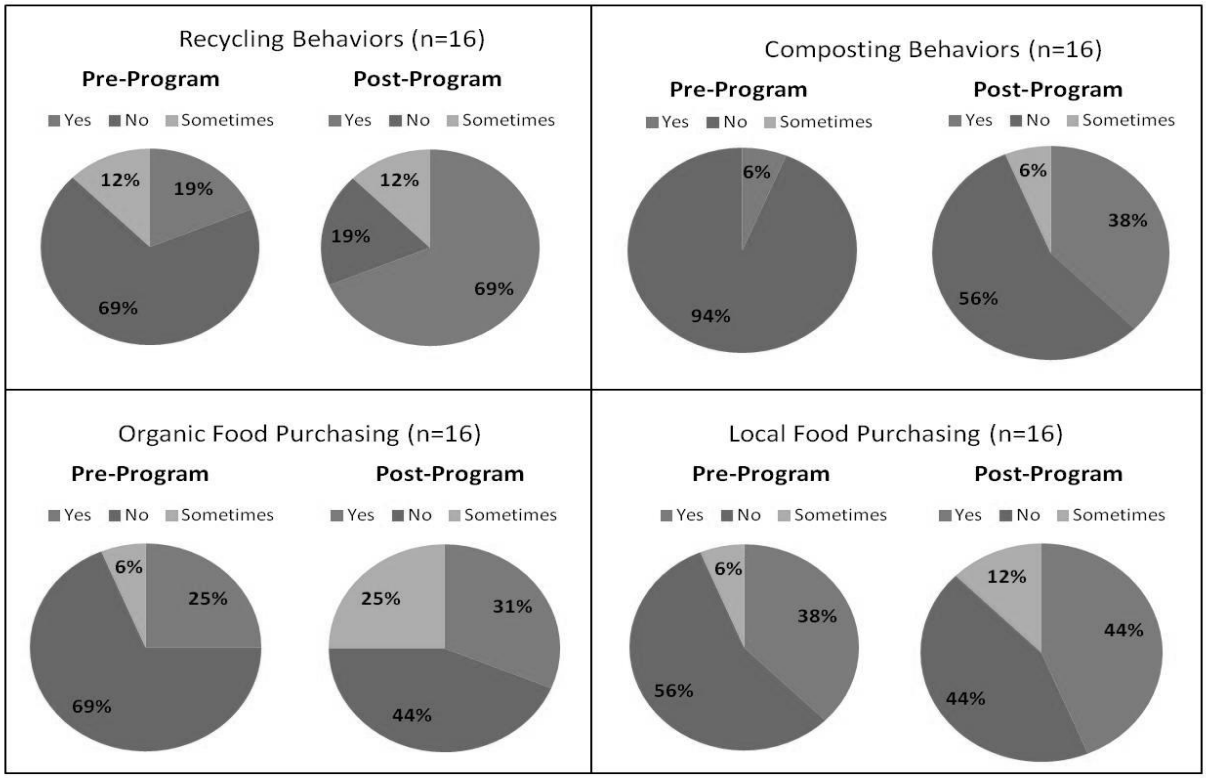

Figure 5. Behavior Change in Students' Friends and Family

Throughout this section I will discuss each knowledge domain as it relates to my findings, while also proposing justifications based on other research. While the relationship between declarative knowledge and behavior change appears to be weak, certain types of declarative knowledge appealed to students' emotions. Although upon leaving the summer program, the highest level of knowledge, as measured by the survey, was attained in regards to food declarative knowledge, but the food behaviors themselves were rather resistant to change. John in particular retained much of the food declarative knowledge months after the summer program, especially in regards to the ecological footprint of meat consumption, yet he was the least interested amongst the group in adopting a lower meat diet. This could be because the declarative knowledge presented during the summer program fostered a greater emotional response amongst the female participants since other researchers have found that women react more emotionally to environmental problems, which coupled with an internal locus of control (or enhanced effectiveness knowledge) will likely to lead to acting pro-environmentally (Kollmus & Agyeman, 2002). Jane, for instance, felt a sense of sadness about how animals are treated in confined animal factory operations and was angered that living creatures could be treated so inhumanely, so she did not want to use her purchasing power to support system that she didn't approve of. Although this type of emotional response to declarative information can be useful, this declarative knowledge alone is not sufficient in fostering change but rather one part of the broader knowledge that is needed. There are also concerns about creating a sense of guilt and helplessness in students that leads to emotionally distancing or resignation when students are

constantly exposed to sad or painful information (Kollmus & Agyeman, 2002). Therefore, tangible solutions and positive actions should be coupled with declarative knowledge on environmental degradation and social injustice. In particular, coupling procedural knowledge regarding actionable solutions to sustainability challenges can aid in alleviating students' sense of helplessness.

Although procedural knowledge is essential in equipping students with the skills to take decisive action, there seems to be a gap between perceived procedural knowledge and actual procedural knowledge. While this gap is not apparent in the student participants themselves, it is clear that the students' family and friends lack procedural knowledge in spite of their confidence that they are fully informed. In particular, the family members of Jane and Jill commented that they knew what organic food is and even purchased organic food on occasion yet upon further questioning they were under the misconception that organic food was simply whole, unprocessed food rather than food produced without the use synthetic pesticides and fertilizers or growth hormones. There is great promise for programs that focus on procedural knowledge not only because there is a deficit in that type of knowledge but also because students seem to enjoy the hands-on activities focused on procedural knowledge. Activities focused on procedural knowledge, such as sorting trash into landfill, recycle, and compost piles, are not only hands-on and provide direct experience but they were amongst the students' favorite activities. Developing classroom operations that enhance procedural knowledge, for instance classroom composting and recycling, enables students to participate in alternative waste strategies while building sustainable habits.

The results regarding effectiveness knowledge demonstrate the importance of targeting all four domains. The students reflected that they had the ability to change their behaviors because they were equipped with the skills to do so through activities focused on enhancing procedural knowledge. In addition to coupling procedural knowledge with effectiveness knowledge, students also need to be informed about how their actions connect to the broader system in order to assess the consequences of changing a certain behavior (e.g., declarative knowledge regarding systems interactions). Effectiveness knowledge was also largely tied to social knowledge in that students perceive a behavior as desirable and worth the sacrifice if it is generally accepted in their social environment. In the classroom, we made an effort to positively reinforce behaviors like using a reusable water bottle; therefore it was no surprise that the students responded that using a reusable water bottle was both convenient and desirable. While the program did enhance their effectiveness knowledge, as shown by their sense of responsibility to create change in their school and homes, their confidence to act seems to be tied to enhanced knowledge in other domains.

My research indicates that of the four knowledge domains, social knowledge is the most resistant to change. Additionally, the less social knowledge changes during an education program would appear to predict less change in the corresponding behaviors afterward. The students' post-program survey showed enhanced declarative, procedural, and effectiveness food knowledge. Yet, the rigidity in social knowledge seems to have resulted in only small relative changes in food behaviors as compared to the substantial and maintained behavior change in terms of sustainable waste strategies. The data also suggests that social norms surrounding food are far more engrained than those surrounding waste. These results are in line with established research on Cultural Cognition Theory (CCT). CCT posits that individuals tend to form perceptions of societal risks that cohere with values characteristic of groups with which they identify and the knowledge they gain is interpreted through their cultural philosophies (Kahan et al., 2012). During the case study, the high school students reflected on their interviews noting that their family and friends were resistant to changing their food behaviors, making a change in their own behavior more difficult given their social context. Furthermore, a recent survey of

students in Sweden found that social knowledge was a barrier to pro-environmental behavior change given the cultural environment of materialism and consumption (Kim, 2012).

In order to effectively promote sustainability as the social norm, there must be change agents leading the way and charting alternatives to the unsustainable status quo. Successful diffusion of sustainability behaviors requires that social knowledge becomes a tool for change rather than a barrier. Work by Rogers (2003) suggests that once 16% of a given community adopts a desired behavior, also known as "the tipping point" (Gladwell, 2000), diffusion of that behavior is more likely to occur; especially when the opinion leaders have already adopted said behavior. In creating programs that promote sustainability as desirable, it may be advantageous to target the peer or community leaders as the early adopters of the sustainable behaviors in order focus on achieving the necessary tipping point for the change to become self-sustaining. By getting the leaders to model sustainable behaviors and positively reinforce those behaviors in others, there is great potential is utilizing social knowledge as a motivation tool rather than a barrier.

Barriers and Constraints to Change

While this research focuses equally on food and waste behaviors, the barriers and constraints associated with food behavior change are very different than those associated with waste behavior change. In the following section I am going to describe specific barriers associated with local and organic purchasing and reduced meat consumption versus those associated with composting and recycling. These behaviors are indicative of the depth with which food behaviors are embedded in complex social structures and in comparison, the relative ease with which waste behaviors were changed and maintained.

Food systems are incredibly complex and tied to an array of political, cultural, and social structures and ideals. In addition to being complex, the food system from seed to table has undergone tremendous change over the last forty years, including changes in the size of farms, the average age of farmers and growth in biotechnology as well as organic industries (Heller & Keoleina, 2002). The substantial changes in the production, processing, and consumption of food products over the last couple of decades makes discussing food choices across generations far more difficult. For instance, Jill and Jane live with their grandfather, whom lived on a small farm when he was young. Upon discussing problems associated with conventional agriculture, particularly in terms of how pesticides impact workers and consumers health, their grandfather responded that he lived on a conventional farm from the 1930s until the 1960s and has eaten conventional food products his entire life and is doing just fine. However, the conventional food system of the 1930s is incredibly different than the industrialized system we have today. Jill and Jane's Grandfather experienced pre-Green revolution agriculture, in which the primary source nutrients were manure rather than synthetic fertilizer, and farms were more often run by families rather than corporations and the top 5 seed companies didn't control 75% of the vegetable seeds sold in the world (Heller & Keoleina, 2002). The changing food system presents a barrier to sustainable food purchasing because the term organic is 'new' and 'radical' to many older generations that still hold tightly to their perceptions of the conventional family farm.

The barriers to sustainable food purchasing varied in John's household from those in Jill and Jane's. A number of John's interviewees, such as his mentor and his brother's girlfriend, were interested in purchasing more organic food in the future but were highly resistant to the idea of reduced meat consumption. John noted that while he likes rice and beans, any real dinner includes meat, typically in the form of hotdogs or beef. Part of this perception may come from the social norm that men need to eat more meat than women (Gossard & York, 2003). Not only is John a male but he is also in a male dominated household (his mother passed away and he has only male siblings). A recent survey found that in fact, men do consume more meat than women

and they also consume more beef than women (Gossard & York, 2003). In addition to the masculinity factor associated with meat consumption, John's social structure falls into many other categories that are indicative of greater meat and beef consumption.

The Gossard and York study (2003) found that Hispanics eat more meat than non-Hispanics (John is Hispanic), people that have laborer occupations eat more meat than professionals or people in the service industry (John's family members are landscapers), and people with more education eat less meat and total beef (the highest level of education completed by his father and eldest brother is middle school). John's social structure represents a barrier to reducing his meat consumption and his resistance to change exemplifies how deeply entrenched dietary habits are within complex, social forces. When working with a target population that has a predilection to higher meat and beef consumption, the depth of transformation that is needed to successfully change their dietary habits may be greater than can be achieved in the course of a two-week or even one year program.

The barriers to changing the students' waste behaviors were less entrenched than those associated with their food behaviors. Often odor is cited as a barrier to composting and one that both Jill and Jane noted in their pre-program survey. However, by having a bin in our classroom their perception about odor was changed with both girls eagerly reassuring their family members that composting isn't smelly. The openness to changing their opinions about composting is indicative of the ease with which waste behaviors were changed as compared to food behaviors. While Jill and Jane's grandfather pushed back against the idea of purchasing organic or local food products, he was eager for the girls to engage in waste reduction strategies. He was so interested in composting that he brought home food waste from the restaurant he works at part-time. Jill and Jane's grandfather enjoys gardening was excited to get 'free' fertilizer through composting. Their grandmother also noted that she liked the idea of 'wasting less' by reusing things that would otherwise be sent to the landfill. Other researchers have found that people that value frugality (i.e. wasting less) are more likely to participate in waste reduction and recovery strategies (DeYoung, 1986). The American ideals associated with frugality and by extension sustainable waste practices resonated with Jill and Jane's grandparents and resulted in a supportive social context for these changes. John's household also found composting to be a beneficial habit given that they could use their finished soil in their landscaping jobs. Unlike Jill and Jane's household, John's household chose not to compost their food waste but to focus on composting their landscaping waste.

A number of researchers have found that one of the biggest barriers to recycling is convenience (Barr & Gilg, 2005; McCarty & Shrum, 2001). My research indicates that it is not just the convenience of having curbside recycling program but also having an indoor recycling bin that is placed next to each trash can that will lead to higher rates of recycling. The students in my summer program all lived in neighborhoods with curbside recycling (even if they were unaware of this fact), yet they all remarked that their households rarely recycled. When we discussed why, a number of the students noted that it is so hot outside and they didn't want to walk out to the bin each time they had a soda or used a piece of paper. In order to overcome this barrier, each student was provided with an indoor recycling bin (purchased at Office Max with Neely Grant funds) so they only had to take the recycling out once a week rather than every single time they used a recyclable product. Supplying households with indoor bins seems like a simple solution that reduces barriers recycling associated with convenience, yet it is not a part of our current recycling program.

In addition to social constructs associated with frugality or masculinity, other researchers have found that the ambiguity associated with the 'right' choice may lead to reduced participation in pro-environmental behaviors (Monroe, 2003). The goal of the waste behaviors targeted in this

program was simple; reduce the amount of waste sent to the landfill. While that simple goal leads to many cascading effects, such as reduced greenhouse gas emissions, the goal is clear and the suggested actions have direct consequences (i.e. using reusable bags at grocery stores results in a reduction of plastic disposable bag consumption). On the other hand, there is a myriad of intended outcomes associated with sustainable food purchasing and consumption, such as improved water quality, improved soil quality, healthier working conditions, reduced obesity, reduced resource consumption, enhanced biodiversity, enhanced sense of community and increased access to healthy food products. Given the wide range and scope of goals, it is difficult for an individual to choose which food item is the 'right' choice especially given the trade-offs associated with each product. For instance, purchasing organic products is associated with improving water quality due to reduced use of harmful pesticides, while purchasing a local product at a farmers market may lead to an enhanced sense of community; who can say which of these two options is the 'right' choice? Although researchers are studying the life cycle of food products (Heller & Keoleian, 2003) and examining the environmental impact of meat-heavy diets (Gossard & York, 2003; Pimental & Pimental, 2003), much of this information has yet to reach the general consumer. In contrast, recycling programs are ubiquitous throughout schools (Cherif, 1995) and communities (Gamba & Osdamp, 1994) and reusable bag programs exist at places like Target, CVS (Horovitz, 2009) and Walmart (Walmart Stores Inc., 2012). The uncertainty associated with choosing sustainable food products, the opaqueness of the food industry and the complexity of the social structures influencing dietary habits combine to make food behaviors more resistant to change than waste behaviors.

While this research was itself amply funded, it must be acknowledged that there are typically financial barriers to change for both institutions (such as public schools) and individuals (particularly lower-income individuals as were targeted by this study). Through multiple grants, we were able to overcome the cost barrier and provide scholarships as well as purchase a number of sustainable materials and food products. Other researchers have found that lower-income youth are rarely afforded the opportunity to attend summer education programs and more than half of the achievement gap between lower- and higher-income youth can be explained by this unequal access to summer learning opportunities (Alexander, et al., 2007). Hence, targeting lower-income youth during summer programs, such as this, is crucial, albeit more difficult due to financial barriers.

Conclusions

This research focused on developing an education program that targeted specific behaviors through a structured approach to curriculum, which incorporated sustainability competencies and behavioral theory to target long-term uptake of sustainable behaviors by the student participants and their network. While there were only a small number of participants with whom to assess this approach to curriculum development and practice, evaluations of the outputs and outcomes suggest a strong potential to the approach elaborated here. In terms of outputs, the program was successful, with all participants showing dramatic improvement in the targeted knowledge domains for food and waste. In evaluating long-term change through the course of a year, there were clear and substantial changes among participants which appear to be durable and may lay the foundation for continued change by the participants into the future.

The data collected through the students' interviews with 5-6 influential people in their lives demonstrates that behavior change is easier to maintain if the students' social context changes in order to accommodate that new behavior. The households of all three students involved in the one-year case study, adopted sustainable waste behaviors, including composting and recycling.

When the students reflected on which behaviors were easiest to maintain, they all explained that the easiest behaviors to maintain were the ones their household members were participating in. In the case of Jane, she attempted a dramatic change in her food behaviors, going vegetarian, but because her school and household did not support that practice, it was impossible for her to maintain. This demonstrates the two-way flow of behavior change; students can change the behaviors of their friends and household members, in turn making those behaviors easier to maintain in the long-term (as seen in waste behaviors) or household members and peers can be resistant to change, making behavior change more difficult for the student to maintain (as seen in food behaviors).

Another interesting finding is that the students' favorite lessons do not necessarily correlate with their most significant behavior changes. Both Jill and John commented that their favorite lessons during the two-week program were associated with the food unit. Yet both only negligibly changed their food behaviors. This finding highlights the need to move beyond just curriculum add-ons when educating for sustainability because curriculum alone is insufficient in motivating change. Sustainable behaviors need to be incorporated into the classroom, incentivized and modeled by the teachers, not just discussed in fun, hands-on activities. This is not to belittle the importance of developing engaging sustainability lessons, but rather to emphasize that the lessons, themselves, are one of the handful of methods for targeting change in the classroom.

This research highlights the importance of social context in maintaining behavior change. Schools can lead the way towards sustainability by providing a supportive atmosphere for sustainable behaviors. All too often, educators leave it up to the parents/guardians of the students to take action and model sustainable behaviors, yet youth typically spend more awake hours at school than at home so the classroom activities play a vital role in building sustainable habits and change. UNESCO declared, "education is the most effective means that society possesses for confronting the challenges of the future" (UNESCO, 1997) but the challenges of the future cannot be met without a broad shift to more sustainable behaviors. Sustainable behaviors and actions must be incorporated into our educational strategy and our education strategy has to go beyond technical, information-based knowledge. If schools create a culture in which unsustainable lifestyles are propagated as the norm, then even if the students have pro-environmental attitudes and abundant knowledge, pro-environmental behavior is unlikely to occur (Kollmuss & Agyeman, 2002).

While I have been critical of information-focused approaches to educating for sustainability, it is certainly important to equip students with the ability to gather data and marshal arguments in favor of a more sustainable lifestyle. Unlike many research articles focused on behavior change, the ultimate goal of this research was not just to promote sustainable behaviors but also to enhance competence in sustainability. Successful sustainability change agents should not only demonstrate sustainable behaviors but they should also be capable of communicating the importance of environmentally responsible consumption in terms of sustainability. By enhancing their knowledge and skills, the students that participated in the year-long case study have taken on the roles of opinion leaders in regards to sustainability knowledge, become early adopters of sustainable behaviors, and change agents in their households and schools.

Starting with a small sample enabled me to delve into the lives of these students for a full year, something that is not commonly done as part of the evaluation of education programs. The next step is to increase the number of student participants making up the research sample. In increasing the sample size it will be crucial to expand demographically beyond lower-income,

minority youth in order to assure the robustness of findings amongst diverse populations (and perhaps identify differences in optimal approaches).

In addition to diversifying the sample, the behaviors targeted should also be expanded. Environmental educators work in many different behavioral spheres, such as water and energy conservation, yet there are few programs that utilize psychological knowledge when developing their curriculum and classroom operations. Hence, a behavior-based education approach should be used in environmental education programs that target other behaviors such as transportation, water consumption, and civic engagement. It will also be critical to collaborate and test the strategies discussed here with K-12 teachers and environmental educators in order to refine the approach so that it is possible to be disseminated in shorter teacher training seminars.

Notes

1. This summer program was supported by the Neely Charitable Foundation Food and Agriculture Sustainability Research Grant program managed by the School of Sustainability, ASU's School of Sustainability, STEM College for Kids (run through the Mary Lou Fulton Teachers College), and the NSF Graduate STEM Fellows in K-12 Education Program (GK-12).

2. National Science Foundation Grant, BCS 1026865, Central Arizona-Phoenix Long-Term Ecological Research (CAP LTER).

3. Standardization was accomplished by taking those questions where a response of 1 was considered most sustainable and reverse coding it so that 1 became 5. The responses to the surveys were therefore standardized so that the score of '5' on the graphs always represents the highest level of sustainability knowledge or behavior.

4. In order to directly record the students' behavior, I had a video recorder set up in the back of the classroom. I took notes regarding interesting comments and behaviors (field observations) as well as writing reflections at the end of each day. The students were asked to journal at home and take notes throughout the program in their own notebooks, and I copied their notebooks, with their permission, at the end of the program. I made copies of many of the student worksheets, such as their commitment pledges and action plans.

5. The question format varied only in the time frame that the questions were referring to. For the pre-survey, students were asked about their behaviors over the past year; in the post-survey they were asked about what they plan to do over the next year (intentions); and in the long-term follow-up survey, students were asked about what they actually did over the past seven months.

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Appendix

Developing the Pre- and Post-Survey

On both the pre- and post- survey the scales were designed so that the most sustainable response varied between the right and left side of the scale. Rotating the direction of the ordinal scale so that no single direction always represents a positive response can help reduce the incidence of respondents sticking to one side of the scale due to perceived social desirability (Fink, 1995). The surveys were taken in-class during the summer program so that students could ask questions and to ensure that they took their time and focused on providing honest and complete responses. The pre-survey was taken at the beginning of the first day of the summer program and the post-survey was taken on the last day of the summer program.

Content and Construct Validity

In developing the survey instruments, several steps were taken before implementing it with the target population (Fink & Litwin, 1995). First, validity was evaluated. In order to effectively assess content validity, I revised my survey extensively based on input from other researchers. My target population for this survey was high/middle school students; therefore, I also asked a colleague of mine if his son, who is in high school, could take my survey. Together, father and son discussed the questions and responses, and provided me in-depth feedback.

Construct validity also requires that survey participants respond similarly to several questions measuring the same thing or closely related things. For my survey, I developed several questions to measure each knowledge domain with regard to both food and waste as well as several questions related behaviors (see Table 3). Food sustainability is more complex than waste behaviors generally; therefore there are more questions for each domain regarding food. For social knowledge, I included a set of questions regarding personal perception (e.g. 'I prefer,' 'I enjoy') and the perception of others (e.g. 'My family thinks,' 'My friends enjoy'). When determining construct validity the two different types of social knowledge should be separated for both food and waste.

Table 3. Number of Questions & Formats Used Per Domain

Domain	# of Food Questions	# of Waste Questions	Question Format	Scale: 5-point Likert Scale
Declarative	18	7	How familiar are you with the following terms and concepts?	Never heard of (1) to Heard of and know a lot about (5)
			How would you rate your knowledge about?	Poor (1) to Excellent (5)
			How would you rate your agreement with the following statements?	Strongly Agree (1) to Strongly Disagree (5)
Procedural	7	4	How would you rate your knowledge about?	Poor (1) to Excellent (5)
			How would you rate your agreement with the following statements?	Strongly Agree (1) to Strongly Disagree (5)
Effectiveness	11	7	How would you rate your ability to?	Poor (1) to Excellent (5)
			How would you rate your agreement with the following statements?	Strongly Agree (1) to Strongly Disagree (5)
Social	9 (5 personal/ 4 others)	7 (3 personal/ 4 others)	How would you rate your awareness of?	Poor (1) to Excellent (5)
			How would you rate your agreement with the following statements?	Strongly Agree (1) to Strongly Disagree (5)
Behavior	7	7	Over the last year/over the next year/over the last seven months… How often have you made the following choice?	Never (1) to Daily (5)
Total	52	32		

In developing related questions in order to verify construct validity, I utilized Thogerson's (2004) categorization of related environmentally responsible behaviors. Behavior categories refer to single acts that are similar in at least one of the following elements: action, context, time, and target (Fishbein & Ajzen, 1975; Thøgersen, 2004). For recycling behaviors, questions asked about recycling glass, paper, aluminum, and plastic as well as composting of organic materials. In addition to recycling and composting, I also asked about reusing products and reducing waste because these are important for reducing the amount of waste produced and disposed in landfills or other means (see Table 4 for example questions). The questions regarding environmentally responsible food behaviors encompassed purchasing organic or local products, reduced meat consumption and selecting whole foods over processed foods. The food questions covered skills and knowledge regarding reading labels and interpreting designations such as USDA organic and Fair-trade, while also contrasting that with the conventional methods of production, including issues like pesticide use and confined factory animal operations.

Table 4. Example Survey Questions and Associated Knowledge Domains

Knowledge Domains	Example Questions—Likert Scale—Strongly Agree to Strongly Disagree, 5-point scale
Declarative	Food: The majority of farms in the United States are family-run and operated. Eating lower on the food chain (eating plants instead of meat) results in lower environmental impacts. Waste Most plastic bottles are recycled in the U.S. Food that is thrown away is a very small part of the amount of waste produced in the U.S.
Procedural	Food There are places to purchase organic food in my neighborhood or nearby. There is a specific labeling system in the U.S. for organic foods. Waste My food scraps can be composted instead of thrown away. My neighborhood has curbside recycling.
Effectiveness	Food I can make choices about what I eat to lower my impacts on the environment. I would enjoy eating more vegetarian (meat free) meals. Waste I can make choices about products I buy to reduce the amount of waste I create. Using a reusable water bottle is inconvenient.
Social	Food My friends think it is cool to be a vegetarian (in other words, to not eat meat). I prefer to simply enjoy what I eat without worrying about the consequences. Waste My friends think using a reusable water bottle is cool. I prefer to use disposable products rather than reusable products.