

# Engaging Elementary Students in Energy Sustainability: A Service-Learning Project by Pre-Service Elementary Teachers

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The United States (U.S.) has 4.3% of the world's population but uses 18% of the world's energy (United Nations, 2017; U.S. Energy Information Administration, 2017). Further, in 2016, only 12.8% of the energy used in the U.S. was renewable (solar, wind, or hydropower), highlighting the United States' dependence on non-renewable fossil fuels such as coal and petroleum (U.S. Energy Information Administration, 2018). Hence, it is crucial that we, as a country, consider how to best manage and conserve our limited natural resources to help sustain them for the next generation.

Energy sustainability education involves a two-pronged effort, focusing on both energy efficiency to slow demand, developing and utilizing renewable energy to produce power (Prindle, Eldridge, Eckhardt, & Frederick, 2007). Therefore, sustainability education is an important vehicle to educate both adults and children regarding the practical ways to sustain available resources. By heightening awareness of both group's energy use, alternatives, and practices to conserve they may become more conscious of their behaviour and actions, and even serve as agents of change in their communities (Percy-Smith & Burns, 2013).

## Statement of Purpose

The goal of the present study is to examine what both elementary school students and pre-service elementary teachers (PSETs) gain from a community-based service-learning project exploring energy efficiency and renewable energy production. In this study, energy sustainability education was integrated in a science methods class for elementary school educators. PSETs learned energy concepts first and undertook a community-based, service-learning project to teach elementary students about energy and ways of saving it. The present literature review will provide background on energy sustainability education and how community-based

## Abstract

Forty-one pre-service elementary teachers (PSETs) enrolled in a science methods course participated in a service-learning project on energy and sustainability. The goal was to help PSETs and elementary students to understand concepts regarding energy, energy saving, and sustainability through an on-campus Family Energy Day event for 65 elementary school students. PSETs participating in the service-learning project identified gains in science knowledge, an increased awareness of their own energy saving practices, the relevancy of the activities, and how the project helped shape their professional identity as strengths. Elementary students who participated also showed commitment to practicing a variety of energy saving habits which they were exposed to through the event. Strengths of the service-learning experience for both PSETs and elementary students included the opportunity to learn in an informal environment, the development and use of activities related to both groups' daily lives, and the opportunities the event presented for real-world application and reciprocal learning

service-learning experiences may help promote a deeper understanding of energy sources, concepts, and the real-world application of conservation practices.

### Energy Sustainability Education

Sustainability education efforts are designed to help us understand how to balance the resource needs of humans with the needs and constraints of the natural world so this generation and those that come after us can thrive (Environmental Protection Agency, 2018). Sustainability education can be seen as the intersection between knowledge acquisition and practice (Percy-Smith & Burns, 2013) and integrates multiple disciplines such as science, social science, economics, ethics, culture, and politics (Albe, 2013).

For energy education to be effective it should be meaningful to the context. Hence, place-based educational approaches, which focus on local issues and encourage collaboration between schools and communities to understand and solve problems using a project-based approach (Sobel, 2013; Smith, 2007; Smith & Sobel, 2010) are vital. In poor, rural northeastern areas, such as where this project took place, the average temperature in January is 20°F. Hence, understanding heating, energy use, insulation, and costs (financial and environmental) are ecologically valid concerns for students and their families in our community.

The timing of energy education developmentally is also important. The *Next Generation Science Standards* (NGSS) (NGSS Lead States, 2013) suggests that 4<sup>th</sup> grade is the optimal starting point for energy education. At this grade-level, students are expected to understand the transfer of energy, conservation of energy, and insulation. The NGSS also emphasizes the importance of STEM (science, technology, engineering and mathematics). Energy is an excellent exemplar of STEM education as its components are multifaceted and the issues surrounding require higher-order thinking and decision-making, both on a macro-level scale as well as in the context of the small decisions we make every day (National Research Council, 2012). A better understanding of energy, including its transfer, conservation, and insulation requires 4<sup>th</sup> graders to apply STEM concepts and to use the information to make informed decisions, possibly leading to sustainable energy use, reduced risks, and negative impacts on the environment (Department of Energy, 2012).

As science and society are interdependent, there are challenges in sustainability education for both children and adult learners. It has been suggested that sustainability education “does not define an object of teaching but a goal” (Albe, 2013, p. 188). Crompton and Thogersen (2009) argue if people just learn about sustainability but do not live a sustainable lifestyle, it only leads to simple changes which have little impact on the global issue of sustainability. Rachelson (2014) also suggests that personal attitudes rather than content knowledge are what move sustainability forward. Sterling (2001) points out what is needed is a “transformative” and not “transmissive” process; learning approaches that require a transformed educational paradigm can instill young people with a culture and consciousness for critical learning and action. Hence, sustainability education is difficult to achieve in practice. The traditional school curriculum emphasizes knowledge acquisition rather than practice; sustainability education however requires teachers to attend to socio-educative aims and socio-political actions which can be challenging to address in the current educational and political climate (Percy-Smith & Burns, 2013).

## Community-Based Experiential Science Education

While sustainability education has promise, especially during the elementary school years, many pre-service and new teachers struggle with how to approach the topic. Many future educators have their own negative attitudes about science (Raizen & Michelson, 1994), have experienced their own challenges in learning scientific content (Palmer, 2001), and report low self-efficacy and confidence in teaching scientific content (Enochs & Riggs, 1990; Harlow, 2012). Moreover, with the move towards more standardized testing in public schools, some have had more limited exposure to science education as their classroom experiences have focused around literacy and mathematics instruction (Milner, Sondergeld, Demir, Johnson, & Czerniak, 2012; Rivera Maulucci, 2010).

Research on the use of service- and community-based learning indicates it is an effective complement to traditional instructional methods in teacher education (Billig & Freeman, 2010; Castellan, 2012; Chambers & Lavery, 2012). Efforts such as the Serve America Act (2009) have heightened interest in service-learning as a part of teacher preparation efforts (Pritchard & Whitehead, 2004; Stringfellow & Edmonds-Behrend, 2013).

Experimental research does indicate that integrating service-learning and community-based experiences into teacher education can have many benefits including increasing pre-service teachers' personal self-efficacy, content knowledge, and awareness of inquiry-based science teaching methods (Cone, 2009 & 2012). Using everyday science experiences as the basis of science instruction has been shown to improve students' attitudes about science and the relevance of it in their everyday lives (Kim, Yoon, Young & Song, 2012; Percy-Smith & Burns, 2013). Sustainability education research shows that using hands-on activities to promote energy saving and sustainability are effective in helping children to develop conceptual knowledge, positive attitudes, and behaviors (Lee, Lin, Guu, & Chang, 2013). Evans (2012) states that service-learning that "help(s) students make leaps from comprehension to praxis, . . . is an important aspect of the critical pedagogy of sustainability" (p.237).

## The Current Project: Family Energy Day, A Service-Learning Project

Family Energy Day was designed as a service-learning, community-based project; a collaboration between a local elementary school and a university's teacher education program in a rural community in northern New England. A field trip was planned, implemented, and facilitated by PSETs enrolled in a science methods course. PSETs learned energy concepts in the course, designed hands-on science activities to teach energy concepts and sustainability practices to fourth grade students from a local elementary school, and planned and implemented the school's field trip to campus. The elementary school, located close to campus, serves as a frequent partner for practicum and student teaching placements. The school, while not racially or ethnically diverse, serves students with other challenges. Fifty-eight percent of students receive free and reduced rate lunch and a 22% receive special education services. Per pupil expenditures for the district are also lower than the state average.

The project was conceived as one which would be mutually beneficial to both the elementary school and the university. The elementary school would receive access to a low-cost field trip and new ideas regarding how to introduce energy and sustainability concepts to their students. For the university, the experience would enable PSETs to obtain more teaching and field experience prior to their student

teaching experience. As a result of participating in the Family Energy Day, it was hoped that both PSETs and elementary students would:

1. Understand sources of energy and related energy concepts including the seven fundamental concepts of energy (energy as following laws, underlying physical and biological processes, as a source of power, factors important to energy decisions and choices) (DOE, 2012).
2. Learn the best way to save energy.
3. Apply energy knowledge they learned in their daily lives.

The project was carried out in three phases.

### **Phase I: College Classroom Work with PSETs**

The first phase of the project was centered in the college classroom. PSETs worked to consolidate their energy knowledge, considering topics such as exploring what energy is, how it is transferred, the difference between kinetic and potential energy, and heat and temperature. They also considered the topic of energy as a local and community concern, both now and in the future. Students completed a pre- and post-assessment quiz on energy concepts and hands-on activities to consolidate their knowledge. One of the authors also came to talk to the class to discuss service-learning and working with children through community-based, informal learning experiences.

### **Phase II: Activity Development and Peer Teaching**

The second phase of the project focused on the development of teaching pedagogy and lesson for the event which was called Family Energy Day. The goal of the event was to help elementary students understand what energy is and increase awareness of simple ways of saving energy which could be applied in their home and family contexts to save money and resources. The PSETs had the option of choosing their own activity or an activity from a Family Energy guidebook written by the state science organization. Eight activities were developed, 4 with the goal of teaching energy concepts and 4 focused on sustainability and energy-saving practices (Table 1). Each activity was also tied to a piece of children's literature. In the development of the activities, PSETs demonstrated their activities to their peers for feedback, comments, and refinement prior to the event.

Table 1. Hands-on Activities Offered at the Eight Stations and Expected Learning Outcomes

Type of Activity	Activity Title	Description	Expected Learning Outcomes
Energy Knowledge	Puzzled about Power	Using the <i>Alternative Energy Conversion Kit</i> , students experiment with the different form of energy – solar, mechanical, sound, and wind and how energy from one form is converted to the other.	People can harness natural resources, e.g. sun and wind energy to make them into usable energy. Further discussion may lead to understanding renewable and non-renewable energy and the effects on the environment.
	A Centsible Battery	A light bulb is connected to a stack of pennies that have copper on one side and zinc on the other. Cardboard pieces are placed in between which are dampened by salt-vinegar solution.	The light bulb is lit because of the flow of electricity which is the movement of electrons.
	Ice Melting Blocks, So Cool it's Hot	Ice cubes are placed separately on two black blocks – one is made of aluminium and the other is polystyrene. The ice cube that is placed on the aluminium block melts faster than the other that is placed on polystyrene block.	This activity demonstrates conduction of heat and that metal is a good conductor.
	Energy Toy Box	Students are given several toys (energy ball, yo-yo, spinning top, mood ring, pop-up toy etc.) to play with. Afterwards, they are asked why the toys work and what kind of energy each toy illustrated.	Students learn about different form of energy and energy is changed from one form to the other.
Sustainability	Is it Drafty in Here? Making a Draft Finder	Students are instructed to make a draft finder by sticking strips of toilet paper on a pencil. Students then go around the room to hunt for drafts.	Heat energy in the house is lost because of drafts. PSETs will discuss with the students ways of stopping the drafts, such as sealing holes and leaks, and using weather stripping.
	Doing the Job for Less	Three types of 60 Watt of light bulbs – incandescent, compact florescent and LED (light emitting diode) are set up. Students observe the light output using their eyes and heat output using a thermometer. Students then calculate the cost per bulb and bulb life, thus, estimating the cost per year of using each type of light bulb.	A lot of the energy of the incandescent light bulb is wasted as heat. Students are taught to use energy more efficiently by using different types of light bulbs.
	How Much is That, What does it cost	A board game that compares the amount of energy in wood, gasoline, refrigerators, and Big Macs needed to complete activities such as running, travelling, watching TV etc.	The rough comparisons help students to understand the amount of energy needed to do various activities and the sources of energy in our daily life.
	Where do your Energy Dollars Go	Each group is given \$2200 of play money. Students need to estimate how much money is spent annually in each household category such as electronics, lighting, electric appliances, water heating, heating, cooling and others.	By understanding the annual household energy costs for families, students are encouraged to think of ways to reduce some of the unnecessary uses of energy.

### Phase III: Family Energy Day on Campus

Sixty-five 4th graders visited the university for the day (34 in the morning and 31 in the afternoon morning. PSETs (20 in the morning, 21 in the afternoon) facilitated groups of 4-5 students, teachers, and chaperones as they rotated through the 8 stations, spending approximately 10 minutes at each. At the end of the event students were sent home with a goodie bag containing science items and activities they could try out at school and at home.

#### Research Questions

1. What benefits do PSETs perceive after participating in Family Energy Day, a service-learning project?
2. How do the self-reported energy saving habits of PSETs change as a result of the Family Energy Day experience?
3. How does elementary students' participation in the event impact their commitment energy saving habits?

#### Methods

##### *Participants*

**PSET Participants.** Two groups of PSETs in a science methods class participated in the Family Energy Day. The PSETs (40 females and 1 male; 10 seniors and 31 juniors) were enrolled in a Bachelor of Science degree program in education at a liberal arts university.

**Elementary School Student Participants.** Sixty-five students enrolled in fourth grade classrooms at a local elementary school attended the event with their teachers and parent chaperones.

##### *Data Collection*

**PSETs Perceptions of the Service-Learning Project.** After the completion of the Family Energy Day, PSETs were asked to write a reflection paper and to participate in a focus group discussion. Data on what PSETs learned through their participation in the service-learning project and how their daily energy saving habits changed were obtained by analyzing these data sources. Reflection is a major component of service-learning courses (Sherman & MacDonald, 2009), with open-ended questions allowing PSETs to more fully process and consider their experience, both personally and professionally.

**Elementary School Students' Commitment to Saving Energy.** To assess what elementary students had learned after participating in the Family Energy Day, an assessment worksheet was given to each student to be completed in school. The worksheet asked students what they had observed and what they had learned from each activity. At the end of the worksheet, students were asked if they were now committed to a variety of different energy saving practices. Four of the statements (Turn lights off when leaving a room; turn off electronics and appliances completely when not being used; tell my parents to use compact florescent light bulb (CFL) or light emitting diode (LED); and find drafts in my home and tell my parents to seal them) were directly linked to the activities in Family Energy Day and another four

(Bring a lunch in a reusable bag; help my parents hang clothes to dry; take 5-10 minute showers; recycle paper, glass, plastic, magazines and yard clippings) were not.

### *Data Analysis*

Phenomenological data analysis, as described by Moustakas (1994), was employed in this study. The two authors found significant statements that were shared by PSETs in their reflection papers and focus group discussions about their experiences participating in the service-learning project (horizontalization methodology). The two authors read through the reflection papers written by PSETs. A total of 473 codable phrases across 8 thematic areas were identified. Frequency counts were calculated for the number of phrases that fit into the themes for each category.

### Results

#### **PSETs Perceptions of the Service-Learning Project**

Table 2 shows the percentage of responses endorsed by PSETs for each theme noted. The thematic category which PSETs noted most often was the impact that the experience had on their own energy use habits and ideas about sustainability (22.4% of all comments). The thematic category least mentioned was the role the experience had on the PSETs use of science process skills (2.5% of all comments). All PSETs did note at least once how the service-learning project had increased their knowledge of energy concepts (sources of energy, conservation of energy, energy transfer, difference between energy and power, and renewable and non-renewable energy). Some also found that by learning about energy and teaching it to elementary students, their misconceptions, such as the confusion between kinetic energy and potential energy, had been clarified. For example, PSETs had the misconception that electrical appliances did not draw any energy as long as they were not in use. They did not realize that energy (phantom energy) was still used by electrical appliances even in “sleep” mode.

Table 2. Themes in PSETs Reflections

Theme and Percentage of Responses	Description of Theme
Science Knowledge 11.4%	Specific information PSETs learned about science concepts related to energy and energy activities.
Science Process Skills 2.5%	Science process skills acquired, including how to ask questions, plan and carry out investigations, or communicate information.
Students 5.3%	Specific interactions with students and the real life learning process which occurred
Teachers/Parents 11.2%	Specific interactions with teachers or parents and the real-life learning process which occurred.
PSET as Teacher 15.6%	How Family Energy Day impacted PSETs as future teachers or might influence their teaching approach in the future.
PSET Energy Use Habits/Sustainability 22.4%	How the experience of learning and teaching energy affected PSETs own habits in using energy.
Relevancy of Activities 13.3%	The relevancy of the activity for elementary students in learning about sustainability.
Challenges 18.2%	Specific challenges encountered while working as an educator or communicating science knowledge in the field.

Overall, PSETs' reflections tended to focus on how the event had made them more aware of their own energy usage, their views on the relevancy of the activities to students and families, the challenges they experienced, and how the experience shaped their professional identity as teachers.

**PSET Energy Use Habits/Sustainability.** Most PSETs described how their energy saving habits had changed after learning about energy and doing the activities. They reported becoming more mindful about their habits in using energy. Some of their commitments included turning off lights and unplugging electrical appliances when not in use, being more aware of the power used by various electrical appliances and not using them for an unnecessary prolonged period of time, preventing drafts at home by sealing off crevices in windows or doors, and using energy saving light bulbs such as florescent or LED light bulbs instead of incandescent light bulbs.



An interesting comment of one PSET was *“My parents have told me countless times to turn things off when I leave the room but I never really understand why. When I was old enough to understand why, I did not understand the amount of money we could be saving by just turning off light, so I continued to not care. It was not until these activities that I understood why it is important to and how much money we could be saving!”*

*Relevancy of Activities.* The topic of energy is part of the NGSS at the fourth grade elementary level. It includes definitions of energy, conservation of energy and energy transfer, the relationship between energy and forces, energy in chemical processes and everyday life, natural resources, and engineering problems. PSETs were able to see the relevance of the activities which served as the basis of Family Energy Day and their alignment with these concepts and ideas. They could see how the activities allowed students to engage and explore the concepts of energy in a hands-on way. Feedback from elementary school teachers received during the event suggested that Family Energy Day activities also reinforced the energy concepts that they and their students had been learning in the classroom.

Comments from parents at the event also demonstrated the relevancy of the activities to the families and the community where the intervention took place. One PSET *noted “I found one parent in particular, when he began asking questions about energy expenditures the students followed his lead and began asking more in-depth questions. This leads me to think that the interaction between the parents, students and I at the station is what led to success.”* Another PSET wrote that many adults (parents or teachers) pulled her aside to ask questions about which light bulb they should be using at home and why. Thus, the activities not only interested the students, but the parents and teachers as they thought about how they could save energy in their workplace and home.

*Challenges.* All PSETs admitted the fast pace of the event made it challenging for them to do the activity and explain the concepts within 10 minutes. Another aspect which they found challenging was teaching a group of students with diverse learning abilities. A few PSETs admitted that they were not able to answer questions raised by students, teachers or parents that were related with the activity. Thus, they politely told the students, teachers, and parents that they didn't know the answer and had to look it up which is a valid and genuine response for PSETs.

*PSETs as Teachers.* Several PSETs were excited to have the teaching opportunity and many stated that they had more confidence in teaching science after the event; that the event contributed positively to their professional identity as a teacher. One PSET described the change in her attitudes toward the learning about energy as follows:

*“When first hearing that we were going to be teaching students about the different kinds of energy, what energy is and how to save energy, I was a little hesitant and nervous. I have never been taught much about energy, nor have I had the self-motivation to research or learn about energy on my own. However, after the presentations in class and having our peers teach us about the materials, I learned a great deal about energy and was very confident teaching the materials when Family Energy Day arrived.”*

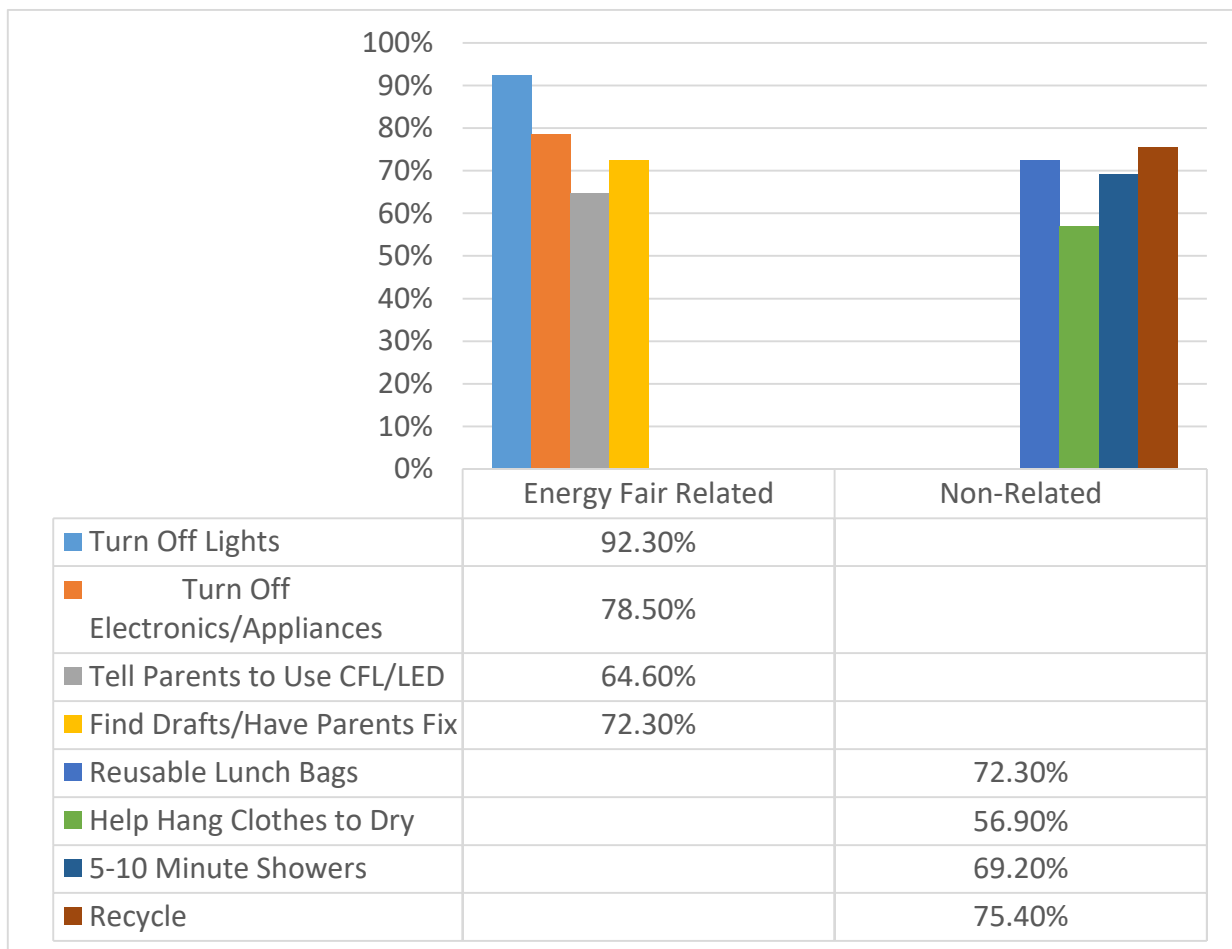
Through the authentic teaching experience, PSETs learned that in a real classroom setting, one has to think on one's feet. No matter how well one plans the lesson, one has to be flexible and make some adjustments. This is what one PSET wrote about her teaching experience of working with children of various levels of academic ability:

*"We never know how many students were going to be in our group at a time . . . the groups varied a great deal when it came to their background knowledge on our activity. Some students already had an understanding on why some light bulbs were better to use than others. Some students understood that in order to save energy, you did not want the light bulb to give off external heat; while other students thought the more heat the light bulb gave off the better because it would light the house up and keep it warm."*

#### Elementary Students' Commitment to Saving Energy and Sustainability Practices

A learning goal for students was to make them more conscious about energy – what it is and how it can be used efficiently. Figure 1 shows the frequency count of "My Commitment" section of the assessment completed by elementary students. Data show that students were more likely to commit to energy saving practices addressed during the Family Energy Day (76.9% on average) than those practices not directly addressed (68.5% on average). The practice which most students were aware of was turning lights off when leaving a room (92.3%). Habits that related to their family such as "tell my parents to use compact florescent light bulb (CFL) or light emitting diode (LED)", and "help my parents hang clothes to dry" were least frequently committed to, with 64.6% and 56.9% endorsing these items respectively.

Figure 1. Students' Commitment to Different Types of Energy Saving Habits (N=65)



## Discussion

High quality sustainability education efforts not only help students understand energy use, alternatives, and practices but consider their behavior, attitudes, and practices (Percy-Smith & Burns, 2013; Rachelson, 2014). While there are no easy or simple solution to the complex problems of energy sustainability (Compton & Thogerson, 2009; Sterling, 2001; Vazquez, 2013), this community-based service-learning project did provide many benefits to the PSETs and 4<sup>th</sup> graders. Benefits included gains in scientific knowledge about energy, an increased awareness of the relevance of the activities to energy education, and a commitment to some energy saving practices. For PSETs, the service-learning experience also helped develop and shape their professional identity as educators.

### *PSETs as Energy Consumers and Educators*

For PSETs, this community-based service-learning experience served as a major catalyst to consider their own energy habits and critically reflect on their own practices and lifestyle (Evans, 2012). Many of the PSETs themselves are from families with limited means (98% receive financial aid). Hence, the relevancy of the activities used to not only science education (such as the NGSS) and place-based

community concerns but to personal issues may have helped to facilitate this awareness (Sobel, 2013; Smith, 2007; Smith & Sobel, 2010).

While all PSETs reported gains in their knowledge about energy, far fewer saw the experience as one which assisted them in developing science process or inquiry skills. The context of the service-learning event may have limited gains in this area. Each Family Energy Day session was 100 minutes for each group of elementary students, with approximately 10 minutes for students to work on each station. With such a short time period to implement each activity it was challenging for PSETs to go in-depth in utilizing an inquiry-based approach to teaching science. At least one student did mention how they could change a direct instructional activity (Censible battery) into more an inquiry-based activity incorporating higher order thinking by adding more opportunities for analyzing, explaining, communicating, and recording information. However, more extended time working with students at the event or in an additional classroom experiences outside of the event may have assisted PSETs in developing these skills.

The event also helped to build the professional identity of the PSETs as teachers, as other such efforts have noted (Cone, 2009, 2012). By teaching science in an informal, science fair type setting using hand-on activities PSETs had the opportunity to build their confidence. Repeating the same activity multiple types allowed for lesson study, modification, and refinement, potentially building their feelings of personal self-efficacy. In discussing their interaction with students, many discussed the personal satisfaction they felt when elementary students learned ideas and concepts from their stations. As one PSET wrote, *"When students were asked what they have learned in the end, some elementary students were bringing up things they learned at my station, and that was really rewarding to me."*

As PSETs worked in teaching teams and planned the entire event, they also learned about the value of teamwork and collaboration, not only with one another, but with the local school, parents/caregivers, and community, important aspects of the service-learning experience (Cress, 2005; Eyler & Giles, 1999).

### *The Elementary School and Students*

To the elementary school and its students, Family Energy Day served as a cost-effective field trip and an opportunity for students to learn not only about energy and sustainability practices but the higher education institution, students, and faculty that reside in their own community. While it is difficult to ascertain how much energy knowledge students gained during the fast-paced event or what information was reinforced by teachers afterward, children did seem to comprehend the value of undertaking a commitment to many of the energy-saving practices addressed (turning off lights, appliances/electronics, fixing drafts).

However, students were less likely to endorse practices which required altering their parents' behavior (telling them which type of light bulb to buy or to hang clothes to dry). One hypothesis that could be drawn was that most students did not want to impede their parents when completing household chores or did not feel it appropriate to question/comment on their actions. It is important to consider that children are sometimes dependent on others to make energy saving changes within the family context. Given differences in power differentials within the family, they may feel less comfortable endorsing practices which would require them educate their parents. This is an important consideration in developing and implementing sustainability education efforts with children.

Energy concepts and energy saving habits are more likely to be reinforced when the various ecological systems which surround children, such as parents, teachers, and administrators are included (Bronfenbrenner, 1979). Efforts which empower students as direct agents of change within their schools, using a whole school approach (Evans, 2012; Percy-Smith & Burns, 2013; Sobel, 2013; Smith, 2007; Vazquez, 2013) to save energy rather than a one-time event may be valuable, thus allowing us to examine the transformative effects of learning about energy and sustainability on children's behavior at schools, at home, with their families, and in the future.

### Limitations and Future Work

A major limitation of this study is that the initial energy saving habits of the PSETs and elementary students were not directly and quantitatively assessed. Percy-Smith and Burns (2013) caution that while sustainability education efforts in schools have been developed with the best intentions, it is hard to know whether children are developing a tendency toward sustainable practices through these experiences. Integrating energy saving habits in one's life is a lifelong process that needs practice and continuous reinforcement.

While Family Energy Day introduced and reinforced to students the importance of sustainability, more intensive and continuous efforts are needed to build from the momentum of this one event. Among the efforts currently underway include using different modes of service-learning and comparing the effectiveness of the different models. Modes include doing only classroom visits to implement the lessons and using a combination of the classroom visits and the Family Energy Day event with a more extended visit to campus using a trip to the campus biomass plant and community reuse-it center.

Expanding the length and scope of the interchanges between PSETs and the school is also a goal as the project moves forward. Enriching lessons to include more STEM and interdisciplinary focus to address topic of sustainability more broadly and comprehensively would allow for more comprehensive use of the NGSS and open the door to more school-wide initiatives to link knowledge and practice.

It is also crucial to enrich the depth of the data collected for the project. Future efforts need to incorporate lesson observations to see how PSETs are applying their learning and teaching in the classroom. Further analysis of data collected from elementary students to assess their understanding of the science concept of energy is also planned.

### Conclusions

Sustainability practices and daily habits around energy consumption take time to change. Through their participation in Family Energy Day, PSETs and children were more likely to endorse the use of sustainability practices for which they have had direct, hands-on experiences which heighten their awareness and facilitate conceptual development.

Sustainability education is important to all of us because we need to learn how to manage and share the limited natural resources available in the world in which we live.

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