GROUP FEEDBACK IN THE CLASSROOM

PROMOTES HOME ENERGY CONSERVATION

By

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Abstract

Pro-environmental behavior is considered one of the most immediate and effective solutions humans possess to solve our current environmental crisis. Pro-environmental behavior that seeks to minimize the negative impact of ones actions on the environment has been identified as evidence of effective environmental education. However environmental curricula have been relatively unsuccessful in generating these behavioral outcomes. Abundant research in the field of environmental psychology characterize efficacy as a predictor of human action, however limited research exists connecting efficacy beliefs of adolescents and their environmental behaviors. Efficacy helps explain whether a group or individual believes in their capacity to accomplish a task. Using feedback as a means to reduce energy consumption is substantiated by numerous intervention studies finding significant reductions in energy use when applying a feedback treatment.

This research investigates how an energy education program targeting sixth to ninth graders can promote home energy conservation. In a quasi-experiment, using student data from an energy activity implemented in 27 middle school and 4 high school classrooms via a convenience sample, the relationship between efficacy and student home energy behaviors was measured after a group feedback intervention. Results from an ANCOVA test revealed that students who received feedback completed more energy-related behaviors than those who did not receive any feedback, $F(1, 403) = 5.4$, $p = .02$. Although feedback encouraged more action, student efficacy was unaffected by feedback. In addition, qualitative observations inside the classroom found that four emergent factors supported the feedback process, *Student Household Behaviors Expressed by Teacher, Teacher Influencing, We Language, and Teacher Inquiry.* This

study suggests that using group feedback in a classroom environment has important implications for interventions promoting adolescent pro-environmental behavior.

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Table of Contents

List of Tables and Figures

Introduction

Statement of Problem

Through energy consumption actions, U.S. households generate nearly 40 percent of national carbon emissions, greater than any other country except for China (Gardner & Stern, 2008). Since 1990, emissions related to electricity use have risen by 2.4% annually, and those related to gas use have increased by 0.9% each year (US Department of Energy, 2005). The proportion of energy used for air conditioning and for appliances and electronics has experienced a notable increase since 1993. Consumer electronics have become one of the fastest-growing segments of residential energy use (Ehrhardt-Martinez, 2011). With that said, every year new energy efficient policy programs are piloted and, with each manufacturing update, technology becomes increasingly efficient. However, without careful consideration of the human component the energy savings of these programs may not realize their full potential (Armel, 2012).

Electricity runs discreetly into U.S. homes, powering heaters, appliances, and electronics undetected and therefore invisible to inhabitants. Conservation practices are difficult to maintain because lack of feedback on consumer’s electricity usage blinds them to the energy they consume. The unseen consumption of resources also impedes the formation of social norms regarding the “right” amount of energy use. People are not only in the dark about their own energy usage, but they are unaware of the energy consumption of others. Having little awareness of appropriate levels of energy use, households cannot determine if they are using reasonable or excessive amounts of energy (Ehrhardt-Martinez, 2011). Ehrhardt-Martinez (2011) states differences in household energy consumption are not only factors of design and technology, but are related to socio-demographic differences (household size, member’s ages, income, ethnicity and race) as well as differences in values, beliefs, norms and habits.

Considering that non-physical factors influence energy use, behavior plays an important and often neglected role in technology adoption as behavioral considerations must be made on whether or not to adopt, *which* technologies to adopt and how they are used throughout their life-cycle. Research on energy efficient technology adoption has acknowledged the importance of behavioral considerations in adoption rates and identified various ways behavior and technology can be incorporated to encourage energy conservation (Midden, Kaiser, & McCalley, 2007; Ehrhardt-Martinez, 2011; Hertwich, 2005; Armel, 2012). Combining behavioral programs with effective energy-efficient technology has a potential to reduce total U.S. residential energy consumption by as much as 20% (Heck and Tai, 2013). Midden and Ham (2012) take technology's role in changing user behavior further with the idea of *persuasive technology,* which can be created to tailor information, monitor user consequences and provide group performance feedback. Research on the use of this type of technology has successfully revealed that persuasive technology employing social influence feedback leads to lower energy consumption (Midden & Ham, 2009).

Since a major goal of environmental education is to create new patterns of behavior in individuals, groups and society in relation to the environment (Tbilisi Declaration 1977), using an educational platform to encourage pro-environmental behaviors offers an applied setting that could help decrease national carbon emissions. Hungerford and Volk (1990) stress the importance of evaluating the success of environmental education in regards to resolving urgently important environmental issues. Although, the importance of promoting environmentally responsible behavior is widely agreed upon among environmental educators, environmental curricula have been relatively unsuccessful in generating desired behavioral outcomes. Childress and Wert, (1976); Hungerford, Peyton, and Wilke, (1980); Rubba and Wiesenmayer, (1985); and

Stapp, (1978) agree that the ultimate goal of environmental education is to instill behavior that has a positive environmental impact. Since the 1960s environmental education programming has mainly relied on the idea that a direct relationship exists among cognitive (knowledge), affective (attitudes), and connotative (behavioral) realms; consequently, incorporating awareness and knowledge of ecology and/or environmental issues in educational programming, assuming environmental desirable behaviors will follow (Culen, 1998). If this direct relationship were indeed accurate, environmental problems would likely be in decline (Schultz, 2002). People can do a lot to reduce their environmental impact, but the majority of them do not engage in as many pro-environmental behaviors as they could. An opportunity exists for environmental programs and practitioners to motivate these accessible, but unrealized, behaviors. Disinger (1982) suggests a solution for environmental improvement may be found in examining the link between educational interventions and responsible behavior change.

Importance of Study

An abundance of research on environmental education has emerged over the past two decades. However, few studies include empirical evidence on outcomes of environmental education (Leeming, Dwyer, Porter, & Cobern, 1993). For researchers who agree that the primary goal of environmental education is to encourage people to engage in pro-environmental behaviors, assessment of outcomes is critical to identify effective educational methods. A meta-analysis by Leeming et al., (1993), largely directed at school children includes a review of 34 environmental education studies published since 1974 that attempted to alter environmental knowledge, attitudes, or behaviors. Of the studies reviewed, most concentrated on the effects that environmental education had on changes in attitudes, knowledge or both. Leeming et al. note that, "this trend is most unfortunate because ultimately it is behavior change that is required to preserve environmental quality" (p.19).

Similarly, environmental education efforts outside of school environments have relied on provoking public attitudes that are supportive of a desired activity and increasing public knowledge about an issue (McKenzie-Mohr, 2013). Much research on knowledge and attitude-based interventions suggests that information/attitude-based education programs cannot consistently motivate pro-environmental behaviors (Nolan, Schultz, Cialdini, Goldstein & Griskevicius, 2008; Midden, Meter, Weenig & Zieverink, 1983; Jordan, Hungerford, & Tomera, 1986; Geller, Erickson & Buttram, 1983). In other words, the amount of information one has on an environmental issue does not predict their intention to act (Schultz, 2002). This is not to say that environmental knowledge has no bearing on behavior change, only that it may serve as one of the factors rather than an isolated strategy (Seyranian, Sinatra, & Polikoff, 2015). Further, educational efforts should consider that there are multiple forms of knowledge that may work together in promoting pro-environmental behavior. Frick, Kaiser, and Wilson (2004) found that action-related knowledge (i.e., how to carry out an environmental behavior) and effectiveness knowledge (i.e., environmental benefit associated with a behavior) directly affect behavioral intentions, while system knowledge (i.e., knowledge about environmental problems), the type most often used in environmental curriculum, only had a mediated influence on behavior.

Environmental education also challenges the longstanding belief that knowledge leads directly to pro-environmental behaviors and suggests a different strategy: to empower throughout the education process. Hungerford and Volk (1990) describe variables that contribute to pro-environmental behavior, citing that empowerment (i.e., gaining confidence in environmental action skills that help resolve environmental issues) is a critical step, often neglected in educational practice. Exploration into what is known about pro-environmental behaviors in the field of environmental psychology may provide direction for the development of this process.

Bandura (1997) identifies key ingredients to the empowerment process as providing people with a strong belief in their ability produce valued effects by their collective action and providing them with the means to do so. In other words, two people who possess an equal amount of knowledge can take varying amounts of action based on the strength of their perceived efficacy.

Research on the development of collective efficacy has shown that performance evaluation and collective (or group) feedback are important sources of information used to arrive at efficacy estimates (Bandura & Cervone, 1986; Cervone, Jiwani, & Wood, 1991). Intervention studies aimed at household energy conservation have found that comparative energy use feedback based on similar others, especially repeated feedback, is a successful strategy in reducing energy consumption (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Midden et al., 1983; Carrico & Riemer, 2011). Considerable research on self-efficacy characterizes its empowering effect on human action; however the increasing interdependence of human interaction can harness the use of *collective efficacy*, another type of efficacy, in group endeavors. Collective efficacy is the perceived belief of a group's capacity to accomplish a task, whereas self-efficacy concerns itself with perceptions of an individual's own capabilities (Bandura, 1997; Rees & Bamberg, 2014).

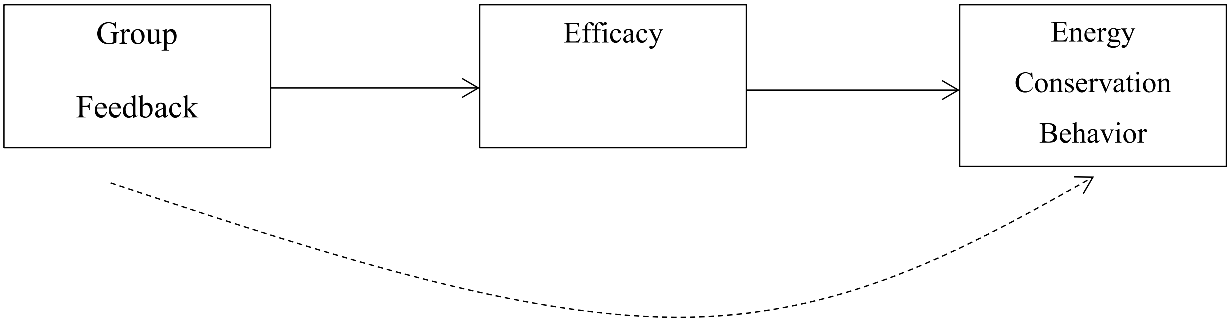
Considering the success of feedback as a strategy in reducing energy consumption and its possibility as a determinant of collective efficacy this study explores how environmental education programs can directly influence pro-environmental behavior by using group feedback. Feedback methods can vary and have been used to accomplish various goals (Fischer, 2008). For the purpose of this study, feedback will serve as both a method of *collective feedback* on group performance to induce efficacy estimates and *comparative feedback* to trigger group norms, social pressure and social identities. According to Cialdini and Trost (1998), influence on others is achieved by using at least one of three strategies: social norms, conformity, and compliance. Norms are shared beliefs about how we do or ought to act that are enforced by the threat of sanctions or the promise of rewards. If norms are activated they can motivate action and increase the likelihood of norm-consistent behaviors (Van Lange, Kruglanski, & Higgins, 2011). Norms can be activated by social comparisons, especially within like-groups (i.e., classrooms), by evaluating one's own behavior compared to others in a group. If the evaluation involves a skill, a need for continuous improvement is sought (Midden et al., 1983). By providing feedback on the extent to which fellow students perform energy related behaviors, a classroom descriptive norm is established and made salient. Classrooms are places where social norms are created and reinforced daily, making them excellent intervention sites.

Research Question

How can energy education programs targeting sixth to eighth grade students encourage energy efficiency behaviors? More specifically, how does feedback on classmates' household energy habits influence engagement in future energy-related behaviors and is this relationship mediated by perceived collective efficacy? The aim of this study is to contribute to the understanding of how environmental education programs can directly influence pro-environmental behavior by (1) measuring the effect of collective feedback on amount of energy behaviors completed, (2) testing if the amount of energy behaviors completed can be explained by efficacy beliefs, (3) examining the feedback process and its contributions to behavior engagement (See Figure 1 for a conceptual framework diagram). The study hypothesizes that

Figure 1

Feedback mediated by efficacy to predict pro-environmental behavior



students exposed to feedback on their classmates' household energy behaviors will engage in a greater number of energy related behaviors and this relationship will be mediated by perceived efficacy.

Using student data from a K-12 Energy Education Program (KEEP) activity, the relationship between perceived collective efficacy and students' home energy behaviors were assessed. In addition, ethnographic observations of student reactions to feedback taken inside the classroom further examined group norms and determinants of pro-environmental behaviors. Ethnography studies the "shared understandings as well as the symbolic aspects of behavior that can uncover cultural or normative patterns" (O'Leary, 2010, p. 116). The observations attempted to build an understanding of the underlying elements that impact energy related behaviors in Wisconsin homes. The purpose of triangulating the broad student activity data and the detail of in-class observations was to help better understand the research problem.

Review of Prior Research

This chapter reviews literature in the field of psychology and environmental education to examine several feedback methods that encourage pro-environmental behavior and increase efficacy scores. The review will (1) examine feedback as a determinant of pro-environmental behavior in intervention studies, (2) explore efficacy as a determinant of pro-environmental behaviors, and (3) assess the effect of performance feedback on efficacy.

(1) Feedback as a Determinant of Pro-environmental Behavior in Intervention Studies

Environmental psychologists have identified a number of tools that can effectively promote pro-environmental behavior: incentives, commitments, social norms, prompts, cognitive dissonance and feedback. Numerous feedback intervention studies support that feedback is effective in reducing energy consumption (Abrahamse, Steg, Vlek, & Rothengatter, 2005; Fischer, 2008; Osbaldiston & Schott, 2012). The research that exists on feedback differentiates among a wide range of practices with various characteristics: timing of feedback (how close feedback is to the time of the behavior), content included in the feedback (normative or historical comparisons), and how feedback is presented (aggregated group-level versus personal consumption), among others.

Group-level or collective feedback has shown its potential success in reducing energy consumption. For example, a local news channel in a mid-sized U.S. city presented a graphical display of the city's gasoline use on the evening news. Results indicated that during the intervention fuel consumption decreased by 30 percent (Rothstein, 1980). In another study, participants who received feedback via email containing a graph summary of their building's energy use (i.e., group-level feedback), reduced energy consumption within their building by 7 percent more than participants in buildings who received no feedback (Carrico & Riemer, 2011).

Similarly, providing feedback with a focus on peer comparisons has accomplished a fair share of energy reduction. In a field experiment by Schultz, Nolan, Cialdini, Goldstein, and Griskevicius (2007), high energy consumers who received normative messages detailing average neighborhood energy use significantly decreased their energy consumption by 1.22kWh per day. Using normative comparisons has had such a measureable effect on energy-conserving behaviors that electric utilities are putting these methods into practice and seeing reductions in energy consumption rates ranging from 0.3 percent to 6.3 percent (Allcott, 2011; Ayres, Raseman, & Shih, 2012). Accordingly, "research has shown that individuals are especially susceptible to social normative information in ambiguous situations, but also in very familiar situations such as their home or campus residence hall" (Schultz, 1999, p. 3). In these studies feedback functions as a means to communicate normative information. Over the last 10 years the use of social norms as a behavior change strategy has seen success; however, it has been underutilized in solving environmental issues, especially in environmental education programs (Schultz et al., 2014).

Behavioral interventions can be targeted at either voluntary behavioral change by influencing individual perceptions, preferences and abilities, or at shifting the circumstance in which decisions are being made through financial rewards, laws or the supply of energy-efficient equipment. Although, circumstance incentives do help modify behavior, their effectiveness is limited to their presence. When an incentive is removed, the desirable behaviors are discontinued (Abrahamse et al.). The following review of intervention studies focuses on altering voluntary behavior and describes successful feedback approaches.

In an article by Abrahamse, Steg, Vleck, and Rothengatter (2005), 38 interventions were selected from peer-reviewed journals between 1977-2004 and were evaluated for their effectiveness in encouraging households to reduce energy consumption. During the selection process, two types of criteria were developed: 1) the study had to be designed so that effects could be measured, and 2) the participants in the study had to be households verses workplace studies due to the differential effect an intervention may have on a target group. The studies were classified according to the taxonomy for behavioral change interventions as proposed by Geller et al. (1990). This made a distinction between antecedent and consequence strategies. Antecedent strategies are identified as using commitment, goal setting, information, and modeling to encourage behaviors. Consequence strategies are based on the assumption that the presence of positive or negative consequences will influence behavior. The authors used feedback as a consequence strategy in their classifications.

Results from the study recognized that interventions to encourage environmental behavior in the household have had varying degrees of success. Antecedent strategies proved successful in changing behaviors related to energy use and are usually most successful when combined with more than one intervention (e.g., goal setting and feedback). Generally, information provided alone was ineffective; however, energy savings were achieved by providing tailored energy information via home energy audits. Consequence strategies, such as cost and consumption-related feedback, proved to be successful during the intervention. However, follow-up after intervention indicated that positive behaviors are not sustained once intervention is withdrawn. Feedback, especially repeated feedback, has established its success in reducing energy consumption. Interestingly, an exception in the meta-analysis by Brandon and Lewis (1999) found that energy consumption increased when feedback was given to already practicing low energy users. This finding is consistent with Schultz's et al., (2012) field experiment where households that were initially low in their base rates of energy consumption and received the same normative message as high energy users experienced increased levels of energy consumption. This makes the case that the wrong outreach to low energy users can backfire.

Abrahamse and colleagues (2005) concluded that factors of energy use and energy-related behavior have hardly been examined and call for a thorough monitoring of determinants of energy use and energy savings to help increase our understanding of the success or failure of intervention programs. The authors also concluded that more systematic research on the effectiveness of interventions under various circumstances would be advisable because when multiple interventions were used, the effects of each were not evident. Taken together, these recommendations can inform intervention research to explore its effects in different environments, decrease reliance on pure informational feedback and increase the frequency in which feedback is given.

Fischer (2008) reviews intervention studies over the last 20 years, which use feedback explicitly for various energy objectives, aiming to discover if feedback works at all and which types of feedback methods are most effective. The author reviews five meta-analytic studies and 21 original papers. The studies reviewed cover projects in the United States, Europe, and Japan. Most projects (17) have the goal of lowering overall energy consumption; however, it should be noted that some of the studies jointly focus on achieving alternate outcomes such as improving customer satisfaction and service, load shifting, raising consumer awareness, discovering customer preferences for feedback, and testing improved effects of feedback. The author theorizes that effective feedback will capture consumer attention, link specific actions to their effects, and activate various motives. Once feedback meets these conditions, different types of feedback can be assessed. The studies reviewed test various types of feedback which include the following characteristics: frequency, content, breakdown, presentation, inclusion of comparisons, and combination with additional information and other instruments.

A clear result of the review is that, in general, feedback leads to energy savings. The other results discovered require consideration of situational factors such as preconditions of feedback. In relation to frequency, immediate feedback can be very helpful while weekly to monthly feedback may be helpful, but is not adequate on its own since some studies that use weekly to monthly feedback reduced consumption while others had low success rates. In almost all the studies, the content of the feedback included a combination of consumption and cost information and did not attempt to analyze the effects of either. Two studies that use environmental information feedback are noted to have no difference in effects on energy savings, leading the author to suggest that information should be tailored to the motives and norms of the target group. Of the studies that used normative comparisons (12), none found an effect on energy consumption. The author reasons that while normative messages may be effective with high energy users, it reveals to low energy users that they have room to increase consumption (Fischer, 2008). Conceivably the majority of participants in this analysis were already low energy users, offering an explanation for the inferior effectiveness of the normative feedback strategies compared to other studies. Few studies considered the importance of presentation (i.e., graphic design or text construction) of the feedback and, therefore, left insufficient findings. One of the studies, that did consider presentation methods, suggested that the presentation be "simple, but not simplistic, that it should not involve additional paper, and that a combination of text, diagrams, and tables is more effective than single-format presentations" (Fischer, 2008, p. 99). The idea of considering presentation methods offers an interesting perspective to our study as feedback was projected in front of a classroom via comparison charts.

In a meta-analysis, Osbaldiston and Schott (2012) examined the various techniques that can be used to encourage pro-environmental behavior (e.g., providing information or instruction, creating incentives, making it easier or more convenient, providing feedback, etc.), providing practitioners with guidance on which techniques are most effective with which behaviors. The literature reviewed in their analysis included studies that were experimental in design, had outcome variables that were observable behaviors rather than self-reported or simulated, provided quantitative data for effect size computations, and were published after 1980. In regards to promoting home energy conservation they found that social modeling is an effective treatment for the behavior, and that goal setting and feedback treatments work well in combination with social modeling. An unintentional, but interesting discovery, was a pattern where behaviors that required more effort (e.g., home energy conservation, home energy-efficient equipment adoption) were best encouraged with high-engagement techniques (e.g., feedback, commitment, and goal setting) and low-engagement techniques (making it easy) were more effective for low-effort behaviors (e.g., public recycling). It should be noted that this study excluded environmental education interventions through the formal school system citing that the circumstances in these settings were too different than other research included. Although formal school settings are unlike general intervention settings, the information on feedback and its effects on home energy conservation can be applied to the current study as our setting and intervention begins in a classroom, but ends in homes as energy conservation behaviors. The results from Osbaldiston and Schott (2012) clearly identify that psychological interventions can promote pro-environmental behavior. These interventions can be incorporated into environmental education programs and curriculum to promote environmental sustainability.

The effectiveness of feedback for encouraging environmental behavior in a school setting is difficult to find; however, some studies have identified the important role it may play in motivating action. A qualitative study by Schelly et al. (2011) reported comparative feedback as a potential factor in motivating energy conservation within a high school intervention. Although the extent to which comparative feedback promoted conservation actions among students is not reported, students described being motivated by comparative messages that highlighted their efforts in relation to other schools in energy conservation. In an evaluation of 14 solid waste curricula conducted to discover which of the variables thought to promote environmentally responsible behavior were included in the activities, Boerschig and De Young (1993) identified the need to give students feedback on their current behaviors and engage them in actions that promote pro-environmental behavior.

(2) Efficacy as a Determinant of Pro-environmental Behavior

Social cognitive theory differentiates among different forms of human agency or a human's capacity to act: both independently and in groups (Bandura, 2000). Self-efficacy can be measured by the extent to which a person believes he or she is capable of engaging in an action. Bandura (2000) states that, "unless people believe they can produce desired effects and forestall undesired ones, they have little incentive to act" (p. 1). The idea of self-efficacy has been used to predict individual behavioral outcomes. Perceived self-efficacy is an important factor in human behavior as it can influence a person's negative and positive thoughts, endeavors, goals, as well as his or her commitment to them. Self-efficacy can also indicate level of perseverance in the face of obstacles and resilience in the face of adversity (Bandura, 2000).

Numerous studies have supported the influence of self-efficacy on human adaptation and change (Bandura, 2000). Most research on cognitive social theory has focused on self-efficacy.

However, Bandura states, “the growing interdependence of human functioning is placing a premium on the exercise of collective agency through shared beliefs in the power to produce effects via collective action” (p. 1). Humans do not have the ability to perform every desired action alone. One must lean on others’ abilities, or in some cases, strategically come together to accomplish a task. The perceived belief of a group’s capacity to accomplish a task is referred to as collective efficacy. Collective efficacy may be rooted in self-efficacy, whereby one’s personal efficacy beliefs may impact their contributions to their group. Several researchers have found an individual's perception of collective efficacy may predict group level actions such as team performance in sports, academic and professional achievements and intention to participate in community collective action (Bandura, 1993; Hodges, & Carron, 1992; Little & Madigan, 1995; Lubell, 2002). Additionally, experimental settings have found efficacy to predict group effectiveness (Gibson, Randel, & Earley, 2000; Sosik, Avoli, & Kahai, 1997). Nonetheless, limited research exists connecting efficacy beliefs of adolescents and their pro-environmental behaviors. Much of the research focuses on factors that are seen as related to efficacy such as locus of control, self-concept, and self-esteem. One of the few studies in which students were used found that adolescents who demonstrated high environmental attitudes and greater amounts of self-efficacy will not always demonstrate more pro-environmental behaviors (Meinhold & Malkus, 2005). Despite this finding, the authors did find a strong correlation between adolescent environmental behaviors and self-efficacy.

Collective efficacy beliefs have been examined as a variable in predicting action intentions in a variety of contexts and are typically found within various possible determinants. In a study by Rees and Bamberg (2014), the determinants of intention to participate in collective climate action were assessed. The social identity model of collective action (SIMCA) was used, along with social norms and sense of community, to highlight the strength of social influence on intention to participate in climate action. Although, the SIMCA model developed by Van Zomeren, Postmes, Spears, and Bettache (2011) was used in the context of protest movements, suggesting that perceived discrimination provokes collective action when it increases collective efficacy and/or collective emotion, studies have indicated that the model can be applied to collective climate protection actions (Brugger, Kaiser, & Roczen, 2011).

Rees and Bamberg (2014) sampled 538 participants to complete a survey aiming to provide the first SIMCA correlational test. To obtain participants, an email was sent to all employees and students at the University of Applied Sciences in Beilefeld, Germany. Students were instructed to recruit at least four participants in their social networks as part of a course requirement. Under the assumptions of SIMCA, the authors hypothesized that perceived collective efficacy, negative group-based emotions, and social identification with one's neighborhood, directly and concurrently predict intention to participate in collective climate action. Sense of community and collective efficacy were measure using two Likert-type scales developed Long and Perkins (2003). Participants were then asked how frequently they perform 30 everyday environmental behaviors to assess their individual preference to behave in an environmentally-friendly way.

The results of the study supported the authors' prediction that social norms influence participation intentions. As predicted by SIMCA, collective efficacy beliefs ($\beta = .14$) and group-based emotions ($\beta = .20$) were significant predictors of participation intention and were successively predicted by social identity, which also maintained a direct correlation with participation intentions ($\beta = .14$). Perceived participation norms were the most powerful predictor of participation intentions ($\beta = .70$). However, this could be explained by the design of this construct having a more behavior-specific measure, whereas collective efficacy and group-based emotion were measured more generally. The authors suggest that further research should include perceived participation norms as a supplementary predictor of collective action, thus affirming collective actions as deeply rooted social indicators. Consistent with these findings, feedback on peer behavior could be used to shape perceptions of participation norms. If students perceive a high-level of energy-efficient behavior from their peers, it may serve as a motivator to act in a similar manner.

Collective efficacy has been found to provide a mediational role in predicting school academic achievements. Collective efficacy beliefs were studied in a project involving 79 elementary schools within the same school district (Goddard, 2001). The results suggest that student body characteristics (a factor that has long been argued to have a major influence in school achievements) have a relatively small effect on academic achievement compared to staff member's beliefs about their collective efficacy to motivate and educate their students. In other words, the stronger the staff's shared beliefs in their instructional abilities, the better their students performed academically (Bandura, 1993). From this study, we can conclude that the stronger the students' shared beliefs in their abilities to contribute to solving energy related issues, the stronger the motivation to perform behaviors that can mitigate those issues.

Social cognitive theory maintains that the motivation for change is not a problem of attitudes, but one in which factors such as efficacy beliefs, outcome expectations and perceived impediments must be addressed in order to motivate people to take action (Bandura, 1993). Research on determinants of pro-environmental behavior have reinforced efficacy beliefs as motivators for action (Homburg & Stolberg, 2006; Bonniface & Henley, 2008; Tabernero & Hernández, 2011). In the process of addressing these motivations, one must investigate their determinants. Research on performance feedback has suggested its significant role in efficacy beliefs.

(3) The Effect of Performance Feedback on Efficacy

Though the predictive validity of efficacy is well supported, there is limited research on the effect of performance feedback on perceived group efficacy. According to Bandura's Social Learning Theory, “timely and constructive performance feedback can serve as a means for increasing group members' collective confidence for attaining desired outcomes” (Jung & Sosik, 2003, p. 372). Tasa, Taggar, and Sijts (2007) studied the factors that contribute to the development of collective efficacy in teams. They studied 191 business college students who were enrolled in four sections of an upper level Human Resource Management course. They selected 50 teams of 3 or 4 individuals by randomly drawing names from major specific lists such as finance, marketing and engineering. In order to meet their objective of assessing the development of collective efficacy over time, the teams were monitored in the Human Resource Management Simulation over a 10-week period. Collective efficacy was assessed twice, at Weeks 2 and 7 of the simulation. Performance feedback was given within three days of team tasks and was primarily quantitative.

The study first concluded that individuals in successful groups (groups that fell within their prescribed project budget) are more likely to be motivated to engage in team work behaviors, because collective efficacy illuminates individual teamwork behavior. Second, feedback is most effective in contributing to a shared sense of collective efficacy when provided at a team level rather than at an individual level. Third, collective efficacy plays a role in motivating and demotivating individual team member behavior. Lastly, teamwork behaviors contribute to the collective development of perceptions of group capability (Tasa, Taggar, &

Seijts, 2007). These findings relate to a notion by Prussia and Kinicki (1996) that feedback offers information that cues group-level perceptions regarding performance capabilities. Results of Prussia and Kinicki's intervention which consisted of three levels (positive, negative and a no-feedback control group) indicated that feedback influenced collective efficacy in university students. Although Tasa, Taggar, and Seijts (2007) provide findings meant for understanding the development of collective efficacy in an organizational setting, implications can extend to K-12 institutions because collective efficacy can refer to teams, departments, organizations, classrooms and even nations (Gully, Incalcaterra, Joshi, & Beaubien, 2002).

Similarly, in a repeated measures study by Jung and Sosik (2003), the effect of performance feedback on university students' group efficacy and subsequent performance was examined. Participants were randomly assigned into three to four person groups, where they had to complete two group projects over the course of fifteen weeks. Results revealed that collective efficacy measured at Time 1 (before feedback) had a direct effect on performance and that performance feedback was significantly and positively related to collective efficacy measured at Time 2. In light of these findings, Jung and Sosik recommend providing true performance feedback in a constructive and positive way, so group members can use it as a learning experience. Additionally, the study found individual assessment methods of collective efficacy predict better future performance.

Limited research on the effect of feedback on reported efficacy exists. However, the available literature supports the positive effects of feedback on perceived efficacy. Supporting literature spans various environments, such as the ones previously discussed, and encompasses organizational studies that report strong relationships between performance feedback and ensuing levels of reported efficacy in work environments (Lawler & Porter, 1971; Shea &

Guzzo, 1987). While there was no research on the effect of feedback on perceived efficacy in adolescents as it related to environmental behavior, the psychological process of perceived efficacy in adolescents has identified that students provided with feedback experience stronger motivation and report stronger self-efficacy (Pajares & Urdan, 2005).

Summary

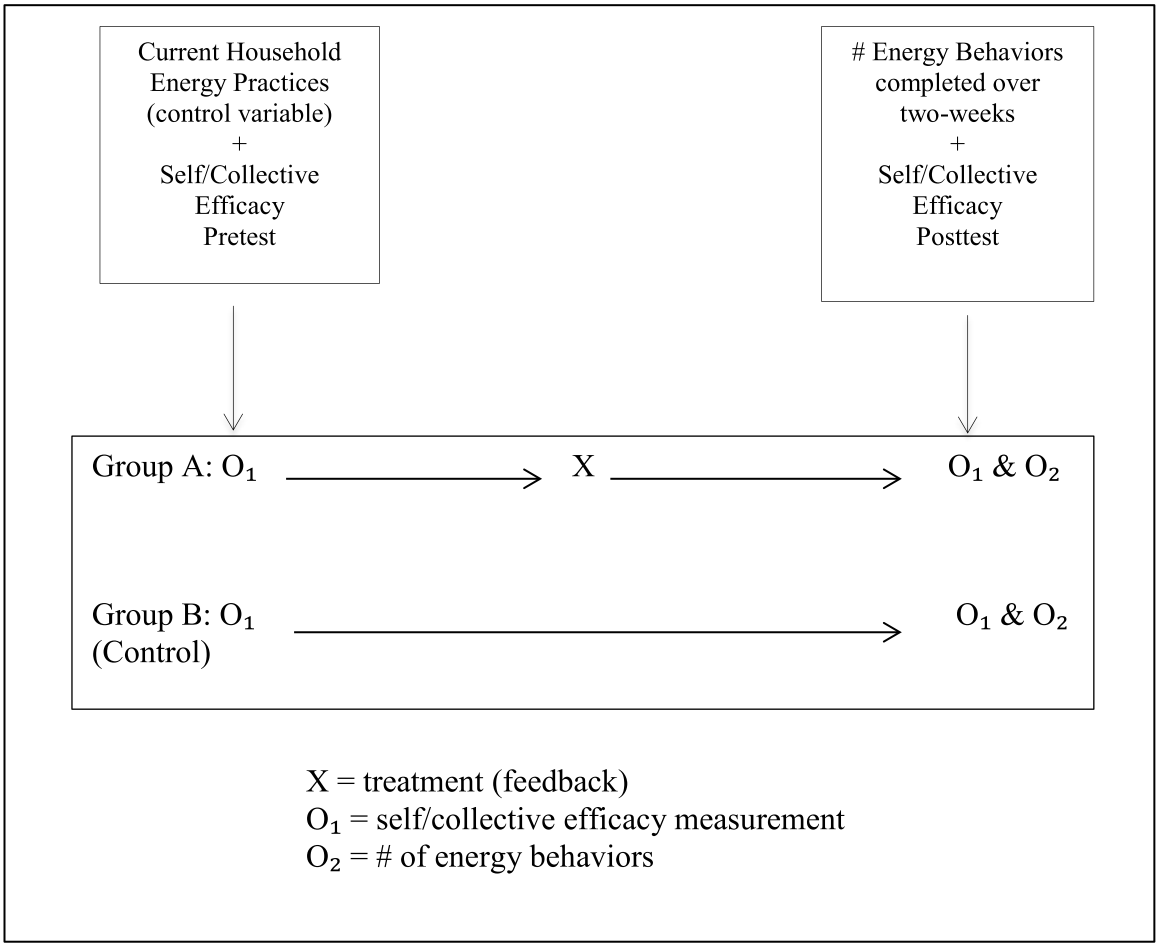
Many theories exist that discuss predictors of behavior change. Environmental education has operated mainly on knowledge-deficit models, which has resulted in the increase of awareness, but with little success in the motivation of pro-environmental behavior. If environmental education aims to create a citizenry who will act in pro-environmental ways, it is imperative that the field acknowledge effective behavioral theories. A review of the literature on efficacy advocates that high perceived collective efficacy positively influences team outcomes and shapes behavioral intentions. Additionally, research has identified performance feedback given at the group-level (i.e., collectively) as a factor contributing to the development of collective efficacy in groups. Behavioral intervention literature suggests that feedback is effective in reducing energy consumption and is usually most successful when combined with normative messaging for high energy users. From this review, it can be concluded that there is not the perfect feedback for everyone and feedback should be tailored to specific target groups, identities and motivations. Furthermore, if interventions aim to reduce negative environmental impacts by changing patterns of behavior, it is useful to understand what factors are contributing to these patterns. This study builds on feedback strategies and explores whether feedback given in a classroom about fellow classmates' home energy behaviors influences perceived efficacy and ultimately has an impact on reported energy behaviors following an environmental education intervention.

Method

The aim of this study was to find out if providing feedback to students about their peers' household energy habits would influence engagement in their own energy-related behavior and to see if this relationship was mediated by perceived self and collective efficacy. This study follows a quasi-experimental, pretest-posttest research design. As depicted in Figure 2, Group A served as the Experimental Group and Group B as the Control Group. Both groups completed a pretest and posttest measure of self- and collective efficacy. Each group was asked to report on current household energy practices and track number of energy behaviors completed over a two-week period. Group A received a treatment in the form of feedback before the posttest measure of self and collective efficacy, and prior to tracking the number of energy behaviors completed over a two-week period. In social science research, a quasi-experiment is used when random assignment of participants (i.e., students) for a true experiment is not reasonable or when one is interested in how behaviors work in the real world. Although random assignment of students was not feasible, this study randomly assigned classrooms (e.g., naturally formed groups) to one of two groups, experimental or control.

Figure 2

Nonequivalent (Pretest and Posttest) Control Group Design



The study also includes an embedded mixed method approach where qualitative methods serve to examine the process of the intervention in an embedded design. “The Embedded Design is a mixed methods design in which one data set provides a supportive, secondary role in a study based primarily on the other data type” (Creswell & Clark, 2007, p.67). In this approach, the researcher collects quantitative data before and after an intervention while collecting qualitative data during the intervention (Creswell, 2009).

Participants and Procedure

Study participants were students in science classes from five public middle schools and one high school in the State of Wisconsin (n = 595). Specific school demographics and participation dates are in Appendix F. In December 2014, a query was sent via email to The Wisconsin K-12 Energy Education Program's (KEEP) database of over 1,500 members. Interested teachers were selected by convenience sampling in order coincide with their energy units. All teacher participants completed a consent form (Appendix A). Specifically to address extraneous variables that can confound the measure of behavioral outcomes (i.e., teacher effect, student past curriculum experiences and socio economic-status) teachers who taught more than one section were chosen to reduce the impact of differential influence that can occur with multi-group designs. Classes were randomly assigned to serve as the experimental group (presented with a treatment within the in-class portion of the activity) or control group. The teachers were blind to the study's hypotheses, however some were aware that there were differences between the type of instruction provided to students. First, the teacher conducted the in-class activity over one to two class periods. Second, after completing the in-class portion, the students each took a kit, consisting of one kilowatt meter, a hot water temperature card, a refrigerator and freezer temperature card, and a support booklet. Along with the kit, the students received a worksheet with the first measure of personal and collective efficacy, as well as questions asking them to report on their current household energy practices. They then had the weekend to use the kit to perform an energy audit of their homes and return the worksheet and kit to their teacher. Third, the experimental group was exposed to an aggregation of the home audit results in bar graph format to understand how the class performed overall (i.e., feedback). The control group did not receive the aggregated exposure and simply turned in their assignments. Fourth, both groups were assigned a home energy challenge log to track prescribed energy-related behaviors over a two week period. This log included the second measure of self- and collective efficacy. The log was assigned to the control group after they turned in their home energy kits and to the experimental group directly after the feedback.

Qualitative data was gathered in class observations on the day the teacher assigned students the home energy challenge log. For the experimental group, this was also when feedback was given. The researcher observed five classrooms in the control group and 10 classrooms in the experimental group. Qualitative data collection followed an ethnographic exploration approach in order to, "explore a way of life from the point of view of its participants" (O'Leary, 2010, p. 115). The type of information collected during the observations attempted to not only identify what is, but attempt to explore why it is. See Appendix B for the structured observation protocol which includes a setting description and area to record feedback reactions from students and teachers. Finally, data from the energy audit worksheet and two-week energy challenge log was collected and analyzed. Due to the nature of conducting the study in a classroom environment the quantitative instruments were designed within an activity that appropriately complements existing classroom and homework assignments.

Current Household Energy Practices

The study intends to measure whether students that have a high level of perceived efficacy participate in more energy related behaviors at the end of two weeks. Behaviors included in the measurement have been purposely selected from Gardner and Stern's (2008) shortlist of the most effective behaviors to resolve critical environmental issues. These behaviors center on the following energy themes: space heating, water heating, lighting, refrigeration/freezing, and appliance use/efficiency. Most behaviors included can be completed by non-home owners with the exception of installing energy efficient appliances such as heating and cooling systems, stoves, refrigerators, and washers and dryers. The scale includes only two measures of these efficiency behaviors since they require larger upfront costs, making students' ability to influence this behavior difficult within the time period of the study.

Following selection of the energy behaviors, a home energy audit activity (see Appendix C) was developed around the energy themes, whereby each section of the activity required students to measure, calculate or report on household energy consumption and behaviors. In each section, the students were asked to report on how often they engage in energy-related behaviors within the themes referred to above. Answers were scored on a five-point Likert-type scale (0 = "Never" to 4 = "Almost Always"). The measure consisted of 15 questions and had a reliability score of ($\alpha = .63$). The intent was to provide a measure of current household energy practices prior to receiving the treatment, ruling out previous behavior as a confounding variable.

Self-Efficacy and Collective Efficacy

Beliefs of self-efficacy are not isolated from social situations in which members must interact. While appraising their personal efficacies, they inescapably consider their group's abilities (Bandura, 1997). On this account, the home energy audit activity includes a measure of self and collective efficacy adapted from the Wisconsin High School Environmental Survey (WHSES), a published scale with high reliability and validity scores. This survey was developed to assess the general level of environmental literacy in the statewide population of K-12 students. The development of the literary assessments involved an extensive three year research process involving an advisory council made up of the Wisconsin Center for Environmental Education, elementary and secondary classroom teachers, school administrators, university professors, the

Department of Natural Resources, the Department of Public Instruction, the Wisconsin Association for Environmental Education, and the Wisconsin Education Association Council.

WHSES was pilot-tested twice to assess the validity of the measures and to inform the construction of the final instruments used in the assessment. The survey was designed to assess student perspectives in four areas: affective learning outcomes, perspectives on environmentally responsible behavior, environmentally responsible behaviors, and cognitive learning outcomes. The questions adapted for this study came from Section II of the WHSES, Perspectives on Environmentally Responsible Behavior and within Subscale A, Locus of Control (perception of efficacy; do students feel they, as individuals, can have an impact). The reliability of this subscale has shown acceptable reliability in previous work ($\alpha = 0.88$). Since this subscale only included questions measuring perceptions of individual capabilities, an adjustment to these questions was made to include perceptions of collective efficacy. Both self-efficacy and collective efficacy scales consisted of two questions and were administered in a pretest and posttest. Answers were scored on a four point scale (2 = "Strongly Agree" to -2 = "Strongly Disagree").The reliability scores for the pretest measures were self-efficacy ($\alpha = 0.69$) and collective efficacy ($\alpha = 0.58$). The reliability scores for the post-test measures were self-efficacy ($\alpha = 0.64$) and collective efficacy ($\alpha = 0.64$). The specific questions used in this study can be found in Appendix C as the first four questions on the home energy audit activity.

Feedback

Feedback has shown to be successful in reducing energy consumption through norm activation and in increasing group confidence, thus triggering perceived efficacy. In this study feedback was used to test its influence on student household energy-related behavior in a K-12 school setting by exposing one group of classes to an aggregation of their peers' current household energy practices.

The energy practices were displayed in the form of bar graphs generated from students' home energy audit activity data entered into an Excel worksheet by their teachers (see Appendix D for an example). The excel worksheet was created so that once data was entered, bar graphs would self-generate. The researcher of this study developed the worksheet as a means to provide feedback to classrooms. Graphs were only shared with classes in the experimental group, and were revealed to the entire class at the same time so that students were aware that everyone knew their class's accomplishments in regards to their current household energy practices. The graphs allow students to see a snapshot of their classmates' energy-related behaviors, thus focusing attention on the current class norm and inducing estimates on their group's ability to contribute to energy savings.

Two-week Energy Behaviors

To track the amount of home energy-related behaviors completed by students, a take-home energy challenge log was developed (Appendix E). Students tracked behaviors completed over two weeks by placing a tally mark in the row of the behavior on the day they completed it. Once the two weeks ended, students added all tally marks and final counts for behaviors were collected. The behaviors tracked on the two-week energy log were the same as the current household energy practices on which students were asked to report their frequency of execution.

Results

Quantitative Data Analysis

The primary purpose of this study was to examine whether perceived self-efficacy or collective efficacy mediate the effects of feedback on engagement in energy-related behaviors. To accomplish this, an ANOVA test on the covariates examining the difference in means between the control and experimental groups determined if there were significant differences in pre-intervention scores. ANOVAs of covariates were conducted using SPSS 21.0. The covariates included the pretest measures of self-efficacy and collective efficacy and the current household energy practices scale. Next, to test for differences between the control and experimental groups, as well as to account for confounding variables, ANCOVAs posttest measures of self-efficacy and collective efficacy, as well as total # of energy-related behaviors, were performed.

Preliminary Data Analysis

Data screening resulted in extraction of participants who had missing scores on both the pretest and posttest scales. This reduced the dataset by 3.3% (final n = 414). Missing data is a common issue in random assignment interventions in educational settings. Missing data can occur due to student absenteeism, refusal to answer a certain item on a questionnaire, inability to answer a particular question, inadvertently skipping a question, or provision of an unintelligible answer (Puma, Olsen, Bell, Price, 2009). With the new dataset, a principal components analysis was conducted on the current household practices scale to see how particular items contributed to each component. An examination of differences between groups found that there were significant differences by school and by teacher on number of completed behaviors. School was not a significant covariate and was omitted from the final model. Although teacher was a significant covariate, analysis was run with and without this difference and results were unaffected. Therefore, teacher differences were not included in the final model.

Current Household Energy Practices

The measure of current household energy practices was used to control for pre-existing differences in energy-related behaviors between the control and experimental group. Students were asked to report on the frequency in which they participate in various household energy practices. Answers were scored on a five-point Likert-type scale (0 = "Never" to 4 = "almost always"). The means for both groups indicated that most students answered in the "Never and Almost Never" categories. A one-way ANOVA test showed that there was not a significant difference in household energy practices at the $p < .05$ level between the control group and experimental group, F (1, 407) = 0.53, p = .13 (see Table 1).

Table 1

Current Household Behaviors for Control and Experimental Groups (N = 409)

	Current Household Behaviors	
Group	*M*	*SD*
Control	1.80	.49
Experimental	1.73	.47
F	2.3	
p	.12	

Note. M = Mean; *SD* = Standard Deviation; *F* = F ratio; *p* = Significance Value; *N* = Sample Size.

Pretest Self-Efficacy and Collective Efficacy

Pretest measures of perceived self- and collective efficacy were used as baseline measures to examine whether efficacy scores changed after the feedback intervention, thus checking for a mediational effect. They were also used as covariates to control for pre-existing differences between the control and experimental group. A one-way ANOVA test showed that there was not a significant difference in perceived self-efficacy at the $p < .05$ level between the control group and experimental group, F (1, 412) = 0.61, p = .43. However, the test indicated a significant difference in perceived collective efficacy between the two groups $F(1, 410) = 4.70$, $p = .03$ (see Table 3). The means in Table 2 and Table 3 are student efficacy reports on a four point scale (2 = "Strongly Agree" to -2 = "Strongly Disagree"

Table 2

Pretest and Posttest Perceived Self-Efficacy for Control and Experimental Groups (n = 414)

	Self-Efficacy Pre-test		Self-Efficacy Post-test	
Group	*M*	*SD*	*M*	*SD*
Control	1.08	.66	1.10	.57
Experimental	1.03	.65	1.04	.63
F	.61		.70	
p	.44		.40	

Note. M = Mean; *SD* = Standard Deviation; *F* = F ratio; *p* = Significance Value; *n* = Sample Size.

Table 3

Pre and Post Perceived Collective Efficacy for Control and Experimental Groups (n = 414)

	Collective Efficacy Pre-test		Collective Efficacy Post-test	
Group	*M*	*SD*	*M*	*SD*
Control	1.43	.48	1.32	.48
Experimental	1.31	.60	1.24	.58
F	5.0		.224	
p	.031*		.636	

Note. M = Mean; *SD* = Standard Deviation; *F* = F ratio; *p* = Significance Value; *n* = Sample Size; * = Significant Result.

Posttest Self-Efficacy and Collective Efficacy

An ANCOVA test was used to determine whether perceived efficacy had mediational effects on the amount of energy-related behaviors students completed. The test revealed there was no significant effect on either self-efficacy, $F(1, 411) = 0.70$, $p = .40$ or collective efficacy, $F(1, 409) = 0.22$, $p = .64$ after controlling for the effect of each group's pre-test self and collective efficacy measures. This tells us that student-perceived efficacy was not impacted by whether a student received feedback on their peers' household energy practices or not made aware of them.

Two-week Energy Behaviors

To determine the effect of feedback on the completion of energy-related behaviors during the two-week challenge, an ANCOVA test was conducted. The test revealed that feedback had a significant effect on total # of energy-related behaviors completed, even after controlling for current household practices, F (1, 403) = 5.40, p = .02. Students who received group feedback on average completed 16.2 more behaviors than those who did not receive any group feedback. Since there was a significant difference in pre-test collective efficacy measures (i.e., the covariate) between the two groups, an additional ANCOVA was run to examine its influence on the completion of two-week energy behaviors. As shown in Table 4, significance of the effect of feedback on completed energy behaviors remained after controlling for pretest efficacy measures; in fact, it made this effect even stronger, F(1, 406) = 6.50, p = .01.

Table 4

Effects of Feedback on Completed Energy Behavior (n = 406)

Group	# of Behaviors Completed	
	M	*SD*
Control	104.3	57.9
Experimental	120.5	88.0
F	5.4	
p	.02*	

Note. *M* = Mean; *SD* = Standard Deviation; *F* = F ratio; *p* = Significance Value; *n* = Sample Size; * = Significant Result.

Qualitative Data Analysis

The primary purpose of collecting qualitative data was to examine the feedback process and its contributions to behavior engagement. Following the characteristics of ethnographic research, data from in-class observations was analyzed for themes. As presented in O'Leary, (2010) the following strategy was carried out: (1) organization of data by transcribing observations into NVivo, a platform specifically designed for analyzing unstructured data, (2) all data was read through to gain an overall sense of the information, (3) data was coded using NVivo and organized into categories, (4) a description and a small number of themes were generated, (5) descriptions and themes are represented in a qualitative narrative, (6) data analysis was interpreted to extract meaning from the research.

An emergent coding framework was developed from the transcripts of 15 classroom observations. The emergent coding framework developed three themes: Group Norm Formation during Feedback, Elements Impacting Household Energy Behaviors, and Promoting Classroom Dialogue. All themes were developed directly from 19 emergent coded data. Table 5 shows the development of all three themes, corresponding codes, definitions, and sample quotes.

Table 5

Emergent Code Framework

Code	Definition	Sample Quote
Theme 1: Group Norm Formation during Feedback		
Future Behavior Intent	Expressed intent in engaging in future energy behaviors	"When they burn out we can replace with LED's." - Student
Household Behaviors by Teachers	Teacher expressing student's household habits.	"A lot of you are turning those lights off always and often." - Teacher
Household Behaviors by Students	Student household habits expressed (verbally or by raising hands).	"Almost all our lights in our house are LED." –Student "Mine was at 150 and we turned it down to 128." - Student
Parent Sentiment	Parent opinion or attitude expressed by student.	"My dad thought it was a waste of time." - Student
Recognizing Similarities	Expressed household behaviors or habits that are similar to another student.	"I end up in shower for an hour." – Student Another student responds: "I am like her."
Student Influencing	Student comments that may influence other's behaviors.	"Or when you are washing dishes, fill up the sink once and use that water." - Student
Student Reactions	Student verbally expressed reaction to other's habits.	"55 degrees at night is insane." – Student "We don't have any LED light bulbs." - Student Another student gasps, "REALLY?"
Teacher Influencing	Teacher comments that may influence student behaviors.	"Most of you have your temps in that ideal setting. And if you didn't hopefully you made that recommendation." – Teacher

		"Here's your challenge. Set the timer for a shower and try to shorten your 30 minute shower to 15 minutes." - Teacher
Teacher Reactions	Teacher verbally expressed reaction to student habits.	"Those people are energy savers." - Teacher
We Language	Using language that describes group characteristics or refers to the class as a cohesive group.	"Raise your hand if you think we do a good job of being energy efficient users." - Teacher "I think we spend too much money on incandescent bulbs." - Student
Willingness to Change	Expressed will or ability to modify behaviors.	"See if you can cut down your shower time." - Teacher Student responds: "Uh-uh, I can't do it."
Theme 2: Elements Impacting Household Energy Behaviors		
Appliance/Electronic Individualities	Behaviors influenced by the characteristics of a particular appliance or electronic.	"I have 2 fridges and 2 freezers and one of the freezers locks so you can't open it right away." - Student
Efforts to Save Money	Behaviors influenced by avoiding monetary costs.	"I'm in the almost never [CATEGORY]. It would be really nice to be in almost always to save money." - Teacher
Energy Perceptions/Beliefs	An opinion about energy	"I think we spend too much money on incandescent bulbs." – Student "LED is expensive." - Teacher
Lifestyle Preferences	Behaviors influenced by a desired style of living.	"We don't turn our thermostat down when we leave the house because we have dogs." - Student
More than Just a Shower	Behaviors influenced by the expectation of receiving more than solely hygienic benefits from taking a shower.	"I just stand under the water and it relaxes me." - Student

		"I listen to music [in the shower] and I want to listen to more than one song." - Student
Parental Impositions	Behaviors influenced by parent rules.	"We keep it below 68 degrees – my dad's rule." - Student "I told my parents that the water heater was at 135 and they said, 'yeah we like our water that hot when we get out of the shower, so our skin is red.'" - Student
Promoting Classroom Dialogue		
Student Inquiry	Students ask questions.	"Don't LED's save you more over time?" - Student
Teacher Inquiry	Teacher asks questions to students.	"Share at your table what you are already doing to save energy at home." - Teacher "What could you do if you're not within that range?" - Teacher

Group Norm Formation

In small interactive groups, group norms tend to be inferred by what others say and do (Hogg & Reid, 2006). The amount of expressed behaviors, attitudes and language in classrooms which received feedback on peer household energy practices differed to the amount expressed in classrooms where peer behavior was not collectively revealed. Tables 6-8 illustrate the proportion of observations wherein each code occurred, along with frequencies of recorded codes for both control and experimental groups. Teachers in classrooms who provided feedback tended to express student behaviors more than teachers in classrooms who provided no feedback. Out of 10 classrooms in the feedback group nine (90%) had teachers verbally express *Student Household Behaviors* for a total of 27 behaviors expressed by a teacher; compared with only two out of the five (40%) non-feedback classrooms who had teachers express household behaviors of students, for a total of three behaviors discussed. The degree to which the teacher would use language to influence student behavior was much more apparent in classrooms with feedback. Out of the 10 classrooms in the feedback group, nine had teachers who used language that influenced behavior for a total of 32 references (see Table 5 for sample quotes of *Teacher Influencing* language), while only three of the five classrooms with no feedback had teachers who used influencing language for a total of five codes referenced. Additionally, *We Language* was more frequently used in classrooms with feedback, 7 out of 10 observations, compared with two out of five observations for classrooms with no feedback.

Another interesting finding was that although, the number of coding references (i.e., the number of times a code was observed in all the experimental or control classroom observations) on Table 6 shows 68 references for *Student Behaviors Expressed by Students* in the experimental group and 37 in the control group, statistically on average *Household Behaviors Expressed by*

Students were nearly the same in both groups (experimental 7.5% vs. control 7.4%). Although, we would expect classrooms with feedback to have a higher percentage of behaviors verbally expressed, teachers in the control group with inquiry based teaching styles can help explain the increase in student behavior discussion. For the purpose of this paper, inquiry based teaching is defined as a pedagogical approach where a teacher engages students through probing questions.

Elements Impacting Household Energy Behaviors

As discussed in the introduction, behavior considerations are often neglected when it comes to energy efficient technology adoption. In this study, numerous situations were revealed that would impact how energy was consumed in households. Classrooms in the feedback condition expressed more elements that impacted how they consumed energy than classrooms in the control condition. One of the main elements found in impacting household energy use was *Energy Perceptions/Beliefs*. Someone who might think LED light bulbs are expensive may not be inclined to purchase and replace them for their less efficient ones. Seventy-percent of the classrooms in the feedback condition vocalized their energy perceptions/beliefs while only 30% of classrooms in the control condition voiced theirs. *Parental Impositions* was another factor that seemed to contribute to how energy is consumed in the household. In general, classrooms with feedback shared more parental impositions (60%) versus classrooms without feedback (40%) helping to describe why certain household behaviors existed. For example, many times a student who would normally behave in an energy efficient way could not do so due to a parent "rule" that governed how low or high a thermostat could be set.

Promoting Classroom Dialogue

Since norms are developed by what others say or do, successful classroom feedback needs to promote discussion of normative behaviors in households. A teacher's use of probing questions can be effective at promoting student explaining (Hogan, Nastasi, & Pressley, 1999). In the current study, teacher inquiry was observed to be a factor of promoting student discussion. Teachers in classrooms under the feedback condition were on average more likely to ask 8.6 probing questions per observation than teachers in the non-feedback condition six questions per observation. Although, there were a fair amount of probing questions observed in the control group (30 questions over five observations) 25 of the questions were from 1 teacher. This teacher in particular focused on inquiry based teaching, leading most of the discussion with questions.

Table 6

Theme 1 Coding Totals for Control and Experimental Groups

	Control Group		Experimental Group	
Codes	**Number of Classroom Observations Code Occurred (out of 5)**	**Total Number of Coding References**	**Number of Classroom Observations Code Occurred (out of 10)**	**Total Number of Coding References**
Theme 1: Group Norm Formation				
Future Behavior Intent	1	1	4	5
Student Household Behaviors Expressed by Teachers	2	3	9	27
Student Household Behaviors Expressed by Students	5	37	9	68
Parent Sentiment	1	4	3	6
Recognizing Similarities	0	0	4	6
Student Influencing	1	1	3	4
Student Reactions	2	2	4	4
Teacher Influencing	3	5	9	32
Teacher Reactions	1	1	5	6
We Language	1	1	7	17
Willingness to Change	2	3	2	5
Total Coding References/Treatment		58		125

Table 7

Theme 2 Coding Totals for Control and Experimental Groups

	Control Group		Experimental Group	
Codes	**Number of Classroom Observations Code Occurred (out of 5)**	**Total Number of Coding References**	**Number of Classroom Observations Code Occurred (out of 10)**	**Total Number of Coding References**
Theme 2: Elements Impacting Household Energy Behaviors				
Appliance/Electronic Individualities	0	0	1	5
Efforts to Save Money	0	0	3	3
Energy Perceptions/Beliefs	3	3	7	13
Lifestyle Preferences	1	2	3	3
More than Just a Shower	0	0	2	4
Parental Impositions	2	3	6	13
Total Coding References/Treatment		8		30

Table 8

Theme 3 Coding Totals for Control and Experimental Groups

	Control Group		Experimental Group	
Codes	**Number of Classroom Observations Code Occurred (out of 5)**	**Total Number of Coding References**	**Number of Classroom Observations Code Occurred (out of 10)**	**Total Number of Coding References**
Theme 3: Promoting Classroom Dialogue				
Student Inquiry	0	0	5	10
Teacher Inquiry	5	30	5	43
Total Coding References/Treatment		30		22

Note. 25 of the 30 coding references in the control group are from one teacher.

Discussion

The purpose of this study was to examine how energy education programs targeting sixth to ninth grade students can encourage energy efficiency behaviors. Results for this study as it relates to its objectives, along with implications for existing research, recommendations for future research and limitations are discussed in this chapter.

The results of this study support the hypothesis that collective and comparative feedback given in a classroom can increase household energy-related behaviors. The significant effect that more behaviors were completed in the experimental group suggests that collective feedback contributes to pro-environmental behavior. The fact that significant increases in energy-related behavior were maintained and became even stronger when controlling for pre-existing group differences (e.g., current household energy practices and perceived collective efficacy) signifies that there is a meaningful relationship between feedback and behavior. Students who received feedback may have been more inclined to follow their peer's behavior patterns when participating in the two-week challenge. Additionally, learning the behavior of their peers might have provided information about alternative energy efficient behaviors and the benefits of engaging in them. The results suggest that the use of feedback in education can play a significant role in motivating energy-related behavior.

However, the source of the main effect remains unclear as the results of this study did not support perceived efficacy's capacity to mediate completed energy-related behaviors. The null effects obtained for both self- and collective efficacy make it difficult to gage the extent to which they explain behavior engagement. While this connection is weak, the study's measures had low reliability, suggesting a need for more research to examine the value of considering student efficacy beliefs in pro-environmental behavior.

Qualitative results from this study help to explain emergent factors during the feedback process that contribute to its significant effect on behavior engagement. An important aspect of comparative feedback is norm activation (Hogg & Reid, 2006). Norm activation can occur when behavior comparisons are made within a group. Comparisons are made once someone says or does something to allow for self-contemplation.

In this study, four emergent factors arose during the feedback process with greater frequency than when no feedback was given, *Student Household Behaviors Expressed by Teacher, Teacher Influencing, We Language, and Teacher Inquiry.* While it may seem logical that during feedback teachers would speak more, it is important to consider what it is they are saying. When student household behaviors were expressed by a teacher it provided a platform for comparisons to be made by students, thus activating energy-related group norms. The more norms are discussed, the more salient they can become. Teachers who engaged in feedback about peer behavior were more likely to use language that refers to the class as a cohesive group (*We Language)*. Using pronouns like "we," "our," and "us," may help build a sense of being on the same team and increase classroom confidence in being able to face problems together, explaining the increase in participation in energy-related behaviors that are seen as a solution to environmental problems. Additionally, teachers who provided feedback had a tendency to encourage or challenge students (*Teacher Influencing*) to participate in energy efficient behavior. For example, suggesting that their students take shorter showers or talk with their parents about purchasing energy efficient appliances. Teachers can be seen as figures of authority or as mentors whom students take advice from. When a teacher makes recommendations, students may hold them in high regard and attempt to comply or proudly accept the challenge. Finally, this study found that *Teacher Inquiry* demonstrated the importance of probing questions for student engagement. Its use during the feedback process afforded students the opportunity to express their thoughts, attitudes, behaviors and beliefs creating an additional chance for norm activation to occur.

Although, the quantitative data did not provide clear results of the effect efficacy had on pro-environmental behavior, the feedback process may shed some light on factors that may contribute to increasing perceived efficacy in students. When energy efficient behaviors were expressed during the feedback it is possible that they served as cues to students that their peers are quite capable of being energy efficient. As suggested by Prussia and Kinicki (1996) feedback offers information that cues group-level perceptions regarding performance capabilities. Additionally, *We Language* used during the feedback may have contributed to a shared sense of teamwork that research has suggested helps to increase collective efficacy (Tasa, Taggar, & Seijts, 2007).

Implications of Results for Existing Research

Implications for Group Feedback in Environmental Education

Environmentally responsible behavior has been identified as evidence of effective environmental education (Gotch & Hall, 2004; Ramsey & Hungerford, 1989). The field of environmental education has examined various pedagogical approaches that can impact students' pro-environmental behaviors such as outdoor experiences, action-oriented activities, direct experiences, and issue-based learning (Duerden & Witt, 2010; Carrier, 2009; Zelezny, 1999; Blatt, 2013). Variables that contribute to responsible environmental behaviors have also been identified. Hungerford & Volk (1990) identify some of these variables: attitudes, locos of control, personal responsibility, action skills, knowledge of issues and action skills, personality factors, intention to act, and situational factors.

There is however, a propensity within environmental education to focus solely on increasing environmental knowledge and attitudes, often neglecting behavioral outcomes (Hungerford & Volk, 1990; Leeming et al., 1993; Culen & Volk, 2000). Of the environmental education studies that do measure behavioral outcomes very few have considered the effect of classroom interventions on pro-environmental behavior in the home (Legault & Pelletier, 2000; Ramsey, Hungerford & Tomera, 1981; Ramsey & Hungerford, 1989). If environmental education has identified responsible environmental behavior as a sign of its effectiveness and has identified pedagogical approaches and variables that encourage this behavior then why is it missing in practice? The results of this study substantiate the effectiveness of using group feedback in school environments as a means to encourage pro-environmental behavior in the home.

Similarly, numerous environmental psychology studies on the ability of feedback to reduce energy consumption operate on theoretical assumptions of predictors of pro-environmental action (e.g., knowledge, attitudes, social norms, perceived efficacy and social identity). Although they serve as useful guides for encouraging pro-environmental behavior most involve adult samples, leaving a wide portion of the future generation unstudied until they become adults. A major contribution of this study was to investigate the use of feedback, an effective method found by psychological intervention studies to encourage adult pro-environmental behavior, in environmental education programs aimed at youth. Its findings were consistent with extensive reviews of behavior intervention studies suggesting that pro-environmental behavior can be motivated by providing feedback (Abrahamse et al., 2005;

Fischer, 2008; Osbaldiston & Schott, 2012). The use of comparative feedback has been shown to activate social norms prompting behavior to adhere to the group standard (Schultz, 1999). Using this type of feedback within classrooms, which provide naturally salient groups, can impact which behaviors become normative.

This study affirms that using group feedback in a classroom environment can achieve the ultimate goal of environmental education: to encourage environmentally responsible behavior. In a world that cannot afford to continue at its current level of energy consumption, environmental education needs to adopt effective more effective methods of behavior change and integrate them into curriculum and practice.

Implications for Self and Collective Efficacy in Pro-environmental Behavior

Environmental psychology has recently questioned if fostering individual behavior change is a sufficient strategy to achieve the strength of change we need to solve today's environmental problems (Rees & Bamberg, 2014). Research on efficacy has not only demonstrated the ability to encourage individual pro-environmental behavior, but suggested its commanding effect on collective action. Similarly, because efficacy serves a critical role in reaching challenging goals, environmental education researchers propose its powerful impact on solving environmental issues (Chawla & Cushing, 2007). They have also noted that environmental education is inclined to promote individual actions at the expense of preparing students for public action and overlook the necessity of developing collective efficacy in students to encourage the undertaking of critical environmental problems. Given efficacy's significant role in taking action for the environment there should be a superior collection of reliable scales that can be distinguished from other similar constructs such as self-esteem, locus of control, and outcome expectancies. Locus of control is not concerned with perceived capability like are efficacy estimates, but with whether outcomes are determined by one's own actions or by external forces (Bandura, 2006). Hence, a student can have a high locus of control and believe that energy savings is a result of their reduction in electricity, however may not believe that they have the capability to perform these actions that reduce electricity.

Although, the results of this study could not support research in this field, there is great opportunity to create appropriate and standard measures to use with adolescents. Nearly all studies measuring efficacy in relation to pro-environmental behavior included varying instruments adapted from constructs like the ones mentioned above. Moreover, there are few studies that measure student efficacy as it relates to pro-environmental behavior, making it difficult to find efficacy scales that are appropriate for research with adolescents (Meinhold & Malkus, 2005).

Limitations

The present research has two limitations that should be addressed. The first limitation involves the measurements of self and collective efficacy. There were two questions in each measurement that were scored on a four point scale (2 = "Strongly agree," 1 = "Agree," -1 = "Disagree," -2 = "Strongly disagree"). One set prompted students to think of themselves and their class specifically, "I believe I can contribute to the solution of energy issues by my actions," and "I believe that my class can contribute to the solution of energy issues by our combined actions." The other set prompted a more situational response, "A student, working on his or her own, can contribute to the solution of energy issues," and "A class, working together, can contribute to the solution of energy issues." It is plausible that the situational items were unable to capture a student's actual perceived efficacy and responses were made based on situational perceptions. Additionally, it could be the way the scales were designed that produced a limited amount of variability. It is possible that the limited range of selections provided for narrower variability in responses, thus not allowing students to provide an accurate or more exact report of their perceived efficacy. Without a more precise representation of perceived efficacy it is difficult to describe its role in this study.

The second limitation involves the generalizability of the results. Although, similar results can be expected with other sixth to ninth grade classrooms, its effectiveness with younger or older students is unknown. Students at different developmental ages can have varying degrees of motivation for achievement and ability beliefs. Given that studies have found that younger children have more positive achievement-related beliefs than do older children, it is conceivable that high school students may not be as motivated to complete the assignment (Wigfield & Eccles, 2000). The generalizability of this study could also be affected by the use of convenience sampling the participants if selection bias were to occur. It is possible that the teachers who volunteered to participate had stronger environmental beliefs than those who did not volunteer to participate; potentially encouraging their students more than a typical teacher would and swaying the results of the study toward more pro-environmental behavior.

Future Research

Feedback in Environmental Education

The results of the present study highlight the impacts that group feedback in a classroom can have on pro-environmental behaviors in the home. Future research on the use of feedback in environmental education could benefit by testing the effectiveness of various feedback strategies. As discussed in this paper, feedback should be tailored for specific situations, motivations, and identities. Classroom intervention studies should examine the effectiveness of real-time feedback and the impact of the frequency with which the feedback is given to students. Additionally, studies can test the type of information communicated within the feedback. In this study, previous peer energy-related behaviors were shared. Perhaps sharing information on the amount of energy used or the class' effectiveness in achieving a target goal would encourage further participation. Research on outcome expectancy theory suggests that providing feedback to suggest that the group's behavior is influencing an outcome that group members desire may motivate individuals to do more to achieve that outcome (Carrico & Riemer, 2011; Truelove & Parks, 2012). Studies may also consider testing various presentation methods. Research on feedback suggests that it should be given about a specific behavior and present information in a simple fashion. However, comparing means of presenting this information (i.e., text, diagrams, tables, by the teacher, on a screen in front of the class, on individual student computers, etc.) would identify best practices for delivering feedback.

Future research on feedback in environmental education should also examine the feedback process and its effect on activating social norms. This study found that teachers in the feedback group asked more probing questions than those in the non-feedback group. Exploring if certain teaching styles during the feedback process effectively activate social norms could provide guidance to practitioners. Knowing the most effective practice to impart feedback provides teachers with a comprehensive and robust tool to foster pro-environmental behavior, thus contributing to the central goal of environmental education.

Self-Efficacy and Collective Efficacy in Environmental Education

Future research for efficacy in environmental education should address limitations of existing constructs. Studies should focus on creating valid and reliable measures that are appropriate for use with adolescents and are distinguishable from other similar constructs. Collective efficacy constructs are even more limited in these areas and warrant much attention.

Especially, since collective efforts make the greatest impact on environmental conservation. Additionally, researchers should concern themselves with the development of perceived efficacy during the feedback process. Chawla and Cushing (2007) discuss conditions that foster the development of efficacy in youth and adolescents: mastery experiences, discussion and conflict resolution, opportunities to taste success, etc. These conditions should be considered when providing feedback in an attempt to foster pro-environmental behavior through efficacy.

Conclusion

Pro-environmental behavior is considered one of the most immediate and impactful solutions humans possess to solve our current environmental crisis. By adopting methods that are effective at influencing this behavior, environmental education programs can profoundly contribute to the solution of resolving many of today’s pressing environmental issues. The present research on group feedback is a snapshot of how environmental education programs can work toward these solutions. Future research has an opportunity to continue exploring these methods in classrooms, contributing to a reduction in energy consumption at home.

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Appendix A

Informed Consent to Participate in Human Subject Research

Jenny Christopher, Graduate Assistant for K-12 Energy Education Program (KEEP) and student at the University of Wisconsin-Stevens Point is conducting a study on how energy education programs targeting sixth - eighth graders can encourage energy efficient behaviors. I would appreciate your participation in this study, as it will assist us in making recommendations for improving environmental education programing that encourage pro-environmental behavior outcomes.

As part of this study, you will be asked to conduct a prescribed energy activity in your classroom, assign a take-home energy activity to your students, compile and share the take-home activity results with your students, and have your students participate in a two-week home energy challenge. In addition, I would like to observe your classroom during the day you share the results of the take-home energy activity with your students. To do this, I will be present in your classroom to take notes on this day.

I do not anticipate the study will present any medical or social risk to you other than the inconvenience of the extra time required for you to prepare for the lesson and compile the student data.

Subjects who participate in this activity will:

- Understand and operate professional technological tools used to investigate energy consumption to collect real data about school and home energy use
- Analyze how the school and home use energy efficiently or inefficiently
- Recognize energy conservation opportunities in the classroom and at home
- Understand the effects of behavior change toward energy and cost savings
- Propose possible solutions to energy-related issues in the classroom
- Take action to save energy in the classroom and at home

The information I gather through observation will be recorded in anonymous form. Prior to returning student activity sheets, student identification must be removed. I will not release information on you or your classroom to anyone else in a way that could identify you or your students.

If you want to withdraw from the study at any time you may do so without penalty. The information on your classroom up to that point would be destroyed.

Once the study is completed, we would be glad to give you the results. In the meantime, if you have any questions, please ask us or contact:

Dr. John Doe
Department of Sociology
University of Wisconsin-Stevens Point
Stevens Point, WI 54481 (715) 346-xxxx

If you have any complaints about your treatment as participant in this study, please call or write:

Dr. Jason Davis, Chair
Institutional Review Board for the Protection of Human Subjects
Academic Affairs Office
University of Wisconsin-Stevens Point
Stevens Point, WI 54481
(715) 346-4598

Although Dr. Davis will ask your name, all complaints are kept in confidence.

I have received a complete explanation of the study and agree to participate.

Name____

Date ____________________

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This research project has been approved by the UWSP Institutional Review Board for the Protection of Human Subjects.

Appendix B

Classroom Feedback Observation Form

Setting: The cooperating teachers' classroom.
Participants: The cooperating teachers and students
Observer Role: Overt, non-participant
Observation Protocol: The observer (Jenny Christopher) will arrive five minutes prior to the start of class. She will ask the teacher on where to sit and if she or he has any questions. The observer will not interact with students, but may walk around to listen to student discussions. Each observation will last approximately 50 minutes.

Observer:____ Date:____________

School Information:

School Name:					
Location:					
District:					
Grade levels: (Circle all that apply)	5th	6th	7th	8th	
Amount of students enrolled:					

Class Information:

Teacher Name:					
Section (if teacher has more than one class participating record the section):					
Other adults in the room (circle all that apply): **How many of each:**	**Teacher Aid**	**Parent**	**Volunteer**	**Other:**	
Control/Experimental Group:	**Control**	**Experimental**			
Subject (circle one):	**Science**	**Math**	**FCS**	**Tech Ed**	**Other:**
Grade level (circle one):	**6th**	**7th**	**8th**		
# of students in class:	**Boys _______**	**Girls _________**	**Total___________**		
Class length:	**_________ minutes**				

Teaching time allocation:

Start time:	
End time:	
Total time:	

Tally of disruptions: **Record length of time for each disruption**	
Announcements:	**Students leave classroom:**
Late students:	**Fire drills:**
Other:	

Focused Description: Describe student and teacher mood and record setting. **Next to descriptions write a (T) for a teacher action/comment and a (S) for a student action/comment**	**Observer inferences**

Teacher Implementation:

Indicate if the graphs below were shared by circling yes or no.

Feedback Graphs Shared Indicate if "we" or "us" language is used. Note any observations relating to norms such as teasing for not following norms.				
Lighting (3)	**Circle one**	**Circle the type of feedback given:**		
Types of light bulbs used in the home	**YES** **NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Replacing light bulbs	**YES** **NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Turning off lights	**YES** **NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				

Refrigerator/freezer (2)	**Circle one**	**Circle the type of feedback given:**		
Refrigerator Temps	**YES NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Freezer Temps	**YES NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Hot Water (4)	**Circle one**	**Circle the type of feedback given:**		
Hot water temps	**YES NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				

~5min showers	**YES NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Cold water to wash clothes	**YES NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Turn off water for dishes	**YES NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Kilowatt Meter (4)	**Circle one**	**Circle the type of feedback given:**		
Cost of appliances	**YES**	**Positive**	**Neutral**	**Negative**

	NO			
Document Comments from teacher (T) and students (S)				
Turning off appliances	**YES** **NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Replace appliances with efficient models	**YES** **NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				
Using power strips	**YES** **NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				

Thermostat (4)	Circle one	Circle the type of feedback given:		
Thermostat temps	YES NO	Positive	Neutral	Negative
Document Comments from teacher (T) and students (S)				
Opening curtains	YES NO	Positive	Neutral	Negative
Document Comments from teacher (T) and students (S)				
Turning down thermostat/bed	YES NO	Positive	Neutral	Negative
Document Comments from teacher (T) and students (S)				

Turning down thermostat/not home	**YES** **NO**	**Positive**	**Neutral**	**Negative**
Document Comments from teacher (T) and students (S)				

Reflective Comments:

Note two examples of how students <u>motivated</u> each other to participate in energy efficient behaviors:

Note two examples of discussions on <u>willingness</u> to perform energy efficient behaviors

Note two examples of discussion on capacity/ability to perform energy efficient behaviors

Note two examples of discussions on effectiveness of performing energy efficient behaviors

Appendix C

Home Energy Worksheet

HOME ENERGY INVESTIGATIONS

NAME:

DATE:

CLASS:

Instructions: Use the materials in the Home Energy bag to complete the questions below. Consult with an adult before making any adjustments or unplugging appliances.

1. A student, working on his or her <u>own</u>, can contribute to the solution of energy issues. (Circle one)

strongly agree   agree   disagree   strongly disagree

2. I believe that <u>I</u> can contribute to the solution of energy issues by <u>my</u> actions. (Circle one)

strongly agree   agree   disagree   strongly disagree

3. A class, working <u>together</u> can contribute to the solution of energy issues. (Circle one)

strongly agree   agree   disagree   strongly disagree

4. I believe that <u>my class</u> can contribute to the solution of energy issues by <u>our</u> combined actions. (Circle one)

strongly agree   agree   disagree   strongly disagree

Home Lighting Activity

By replacing a home's five most frequently used bulbs with energy efficient models, Americans would save close to $8 billion annually in energy costs and prevent the greenhouse gases equivalent to the emissions of nearly 10 million vehicles.

1. Write down the number of the various types of lighting you find in <u>three</u> of your most used rooms.

Bulbs in your Home	Incandescent Light bulbs	Compact Fluorescent Light (CFL) bulbs	Light-Emitting Diodes (LED)	Other
Tally bulbs in all rooms				
Totals	a	b	c	d

2. Calculate your energy costs if you were to replace all incandescent light bulbs with CFL bulbs then LED bulbs.

Bulb Costs	Number of bulbs	x	Watts Average wattage	x	Hours on per day (same # for all	x	1 year	÷	Convert to KWh	x	kWh rate (WI Average) $0.13	=	Cost per Year

					boxes)								
# from box a		x	60 (Incandescent)	x		x	365	÷	1000	x	$0.13	=	
# from box a		x	14 (CFL)	x		x	365	÷	1000	x	$0.13	=	
# from box a		x	12 (LED)	x		x	365	÷	1000	x	$0.13	=	

2. Using the costs from the table on the first page calculate your energy savings of using energy efficient bulbs.

Savings = cost of incandescent bulbs – cost of CFL bulbs **Savings** = cost of incandescent bulbs – cost of LED bulbs

MY CFL ENERGY SAVINGS $_______________ MY LED ENERGY SAVINGS $_______________

a. My household replaces incandescent bulbs to more efficient bulbs. (Circle one)

almost always often sometimes almost never never

b. I turn off lights when they are not being used in order to conserve electricity. (Circle one)

almost always often sometimes almost never never

Refrigerator & Freezer Temperature Activity

1. Using the directions on the Refrigerator & Freezer Thermometer card, measure the temperatures of each. Record your findings below.

Refrigerator: ___________ degrees F Freezer: ____________ degrees F

a. The ideal temperature for your refrigerator is between 36°F-38°F. If your refrigerator was not between the ideal range did you adjust it? (Circle one)

Yes No Temperature was between the range

b. The ideal temperature for your freezer is between 0°F-5°F. If your freezer was not between the ideal range did you adjust it? (Circle one)

Yes No Temperature was between the range

Hot Water Temperature Activity

For every 10 degrees you turn down your hot water heater, you'll save 3% to 5% on your bill. Set too high, or at 140ºF, your water heater can waste anywhere from $36 to $61 annually in standby heat losses and more than $400 in demand losses.

1. Using the directions on the Hot Water Gauge card, measure the temperature of your home's hot water. Record findings below.

Temperature: ___________ degrees F **Color: _______________**

a. The recommended temperature for your hot water is between 120°-130°. If your hot water was not between the recommended range did you adjust your hot water heater? (Circle one)

Yes No Temperature was between the range Hot water heater not accessible

2. The following actions reduce the amount of hot water you use. How often do you?

a. Take (~5min.) showers (circle one)

almost always often sometimes almost never never

b. Use cold water to wash your clothes (circle one)

almost always often sometimes almost never never

c. Turn the water off when washing dishes by hand (circle one)

almost always often sometimes almost never never

Kill-A-Watt Meter Activity

Calculate the cost of operating two appliances for one year. Follow the instructions for using the Kill-A-Watt meter to find the wattage for each appliance and to see a list of appliance ideas.

Appliance	Watts	x	Hours per day (estimate in quarter-hour increments)	x	Days per year	÷	Convert to KWh	x	kWh rate (WI Average 0.13)	=	Cost per year
Example: Iron	200	x	.25	x	210	÷	1000	x	$0.13	=	$1.36
		x		x		÷	1000	x	$0.13	=	
		x		x		÷	1000	x	$0.13	=	

1. I turn off appliances when they are not needed in order to conserve electricity. (Circle one)

almost always often sometimes almost never never

2. My household replaces appliances with more energy efficient models such as ENERGY STAR®. (Circle one)

almost always often sometimes almost never never

Phantom Loads Activity

Phantom loads are caused by appliances and electronic devices that draw power while they are switched off or when they are in standby mode. Using a power strip to turn off electronics and appliances when they aren't in use ensures that they are truly off and not using extra electricity.

1. Locate the sources of phantom loads listed below within your home. Check off any not in use that you were able to unplug.

- ☐ Battery and Phone Chargers
- ☐ Videogame Consoles
- ☐ Laptops and Computers
- ☐ Digital Displays
- ☐ Digital Clocks
- ☐ LED Status Lights

a. I use a power strip to turn off electronics and appliances when they are not in use. (Circle one)

almost always   often   sometimes   almost never   never

Thermostat Activity

Recommended Thermostat Settings	Winter	Summer
When you're home:	68°	78°
When you're not at home:	55°	85°
When you're sleeping:	55°	78°

1. Locate your thermostat and record the setting. **Temperature: ___________ degrees F**

a. What type of thermostat do you use at home? (Circle all that apply)

Programmable   Digital   Manual   None

b. If your thermostat was not at the ideal setting did you adjust it? (Circle one)

Yes   No   Thermostat set to ideal temperature   Thermostat not accessible

2. In winter months, I open my curtains during the day to naturally heat my home.

almost always   often   sometimes   almost never   never

3. In the winter months, I turn my thermostat down when I go to bed.

almost always   often   sometimes   almost never   never

4. In the winter months, I turn my thermostat down when I'm not at home.

almost always   often   sometimes   almost never   never

Home Energy Conclusions

You have just conducted a simple energy audit of your home, which helps you better understand where your home may be losing energy and money. A professional Energy Auditor uses similar methods to conduct energy assessments and creates a report with recommendations for the household to save energy and money. Thinking as the professional Energy Auditor, complete the following statements about your household using complete sentences:

1. Describe two ways your household and its residents are currently exhibiting energy efficient behaviors and practices

1) ____

____

2) ____

2. Recommend two ways your household's residents could change their daily behaviors to help have the biggest increase in energy savings.

1) ____

____

2) ____

____

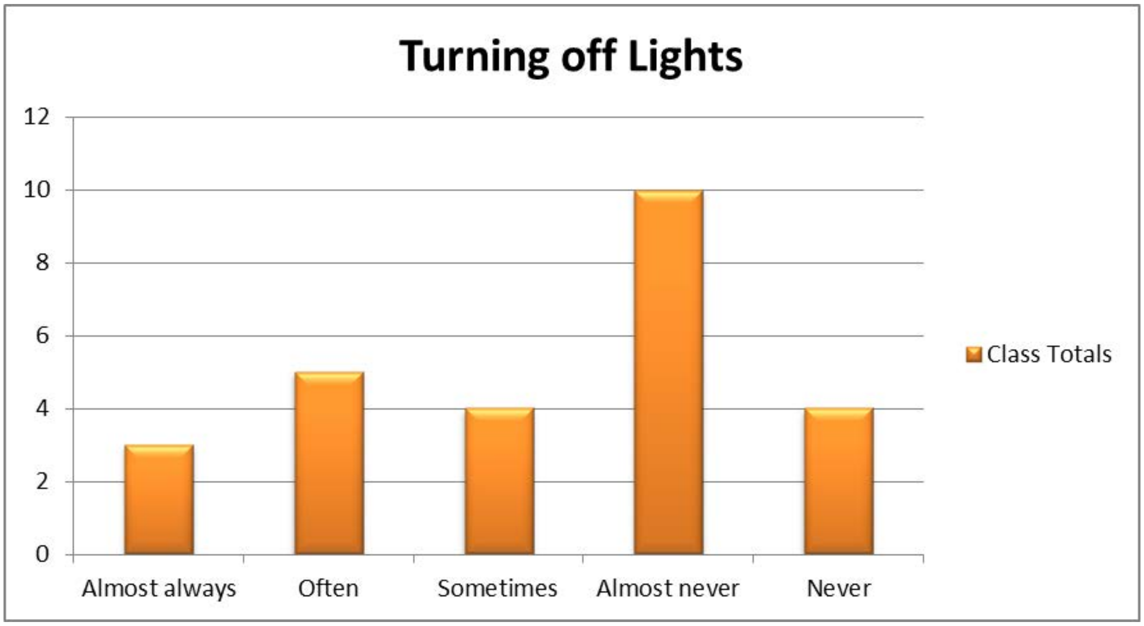
3. Recommend one way your household's systems could be changed to have the biggest impact on energy efficiency. Consider recommendations for appliances, lighting, water heaters, and heating and cooling systems.

1) ____

____

Appendix D

Feedback Graph Example



Appendix E

Two-Week Energy Behavior Log

Home Energy Challenge

Name: **Due Date:**

Directions: Record your energy related activities for the next two weeks by marking each activity performed with a tally mark. You may complete more than one activity per day. At the end of the two weeks add up your total points and return to class.

I believe that I can contribute to the solution of energy issues by my actions. (Circle one)

strongly agree | agree | disagree | strongly disagree

I believe that my class can contribute to the solution of energy issues by our combined actions. (Circle one)

strongly agree | agree | disagree | strongly disagree

A student, working on his or her own, can contribute to the solution of energy issues. (Circle one)

strongly agree | agree | disagree | strongly disagree

A class, working together can contribute to the solution of energy issues. (Circle one)

strongly agree | agree | disagree | strongly disagree

Daily Activities	Day 1	Day 2	Day 3	Day 4	Day 5	Day 6	Day 7	Day 8	Day 9	Day 10	Day 11	Day 12	Day 13	Day 14	Activity Totals
Lights Off in unoccupied room															
Shower < 5 min.															
Water Off when washing dishes															
Turned Off Appliance															
Used a power strip to turn off appliances															
Opened Curtains to heat house															
Turned thermostat to ____°F before bed															
Turned thermostat to ____°F before leaving home															
Used Cold Water to wash clothes															
Installed an efficient light bulb															
Appliance replaced with energy efficient model															

School to Home | Home Audit Investigations
KEEP Student Worksheet

My Energy Point Total:

Appendix F

Participation Dates and School Demographics

Spring 2015 School	Teacher	Grade	Group	# of students	Participating Dates
Waupaca Middle School	12	6th	Experimental	26	Week of March 2 & 9, 2015
Waupaca Middle School	12	6th	Experimental	28	Week of March 2 & 9, 2015
Pittsville Elementary	1	8th	Control	17	Week of April 13, 2015
Oregon Middle School	2	8th	Control	25	Week of April 27 & May 4, 2015
Oregon Middle School	2	8th	Experimental	16	Week of April 27 & May 4, 2015
Fall 2015 School	**Teacher**	**Grade**	**Group**	**# of students**	**Participating**
Waunakee Intermediate	8	6th	Control	25	Week of October 7, 2015
Waunakee Intermediate	8	6th	Control	25	Week of October 7, 2015
Waunakee Intermediate	4	6th	Control	25	Week of October 7, 2015
Waunakee Intermediate	4	6th	Control	25	Week of October 7, 2015
Waunakee Intermediate	7	6th	Control	25	Week of October 14, 2015
Waunakee Intermediate	7	6th	Control	25	Week of October 14, 2015
Waunakee Intermediate	6	6th	Control	25	Week of October 14, 2015
Waunakee Intermediate	6	6th	Control	25	Week of October 14, 2015
Waunakee Intermediate	5	6th	Experimental	25	Week of October 21, 2015
Waunakee Intermediate	5	6th	Experimental	25	Week of October 21, 2015
Waunakee Intermediate	5	6th	Experimental	25	Week of October 21, 2015
Waunakee Intermediate	3	6th	Experimental	25	Week of October 21, 2015
Waunakee Intermediate	3	6th	Experimental	25	Week of October 21, 2015

Horace Mann Middle School	10	7th	Control	25	Week of October 12, 2015
Horace Mann Middle School	10	7th	Control	25	Week of October 12, 2015
Horace Mann Middle School	10	7th	Control	25	Week of October 12, 2015
Horace Mann Middle School	10	7th	Control	25	Week of October 12, 2015
Horace Mann Middle School	10	7th	Control	25	Week of October 12, 2015
Horace Mann Middle School	10	7th	Control	25	Week of October 12, 2015
Horace Mann Middle School	9	7th	Experimental	25	Week of October 19, 2015
Horace Mann Middle School	9	7th	Experimental	25	Week of October 19, 2015
Horace Mann Middle School	9	7th	Experimental	21	Week of October 19, 2015
Northland Pines High School	11	9th	Experimental	25	Week of January 4, 2016
Northland Pines High School	11	9th	Experimental	25	Week of January 4, 2016
Northland Pines High School	11	9th	Experimental	25	Week of January 4, 2016
Northland Pines High School	11	9th	Experimental	30	Week of January 4, 2016

2014-15 School Year				
School	**School Student Population**	**Econ Disadv.**	**Non-White Students**	**Proficient or Advanced in WSAS Science test**
Waupaca	621	38.30%	9.10%	84.70%
Pittsville	576	35.20%	2.30%	92.90%
Oregon	1092	35.20%	9.80%	89%
Waunakee	617	10.70%	8.80%	94.70%
Horace Mann	763	47.20%	28.20%	84.70%
Northland Pines	422	36.70%	5.90%	91%
Percent of students in each demographic category				

Appendix G

Definitions

Curtailment Behavior: entails turning off lights, equipment or appliances when not in use, taking shorter showers, keeping room temperatures low, doing full loads of laundry at low temperatures.

Efficiency Behavior: can entail investing in energy-saving devices, equipment or appliances (a new heating system, meters, thermostats, etc.), or the weatherization of a home.

Pro-environmental behavior: Behavior that consciously seeks to minimize the negative impact of one’s actions on the natural world.

Tbilisi Declaration- October 14–26, 1977 - The Tbilisi Declaration "noted the unanimous accord in the important role of environmental education in the preservation and improvement of the world's environment, as well as in the sound and balanced development of the world's communities." The Tbilisi Declaration updated and clarified The Stockholm Declaration and The Belgrade Charter by including new goals, objectives, characteristics, and guiding principles for environmental education.