THE EFFECT OF VERMICOMPOSTING ON FRUIT CONSUMPTION IN THE ELEMENTARY SCHOOL LUNCHROOM: A PILOT STUDY

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ABSTRACT

THESIS: The Effect of Vermicomposting on Fruit Consumption in the Elementary School Lunchroom: A Pilot Study

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Children are consuming "too many calories and not enough nutrients" (USDA, DHHS, 2010). The number of children considered overweight or obese in the United States has risen substantially, and children are not meeting many of the requirements for what is considered to be a healthy diet. Schools have the ability to play a unique role in a national effort to educate children on the importance of healthy food choice and steer children toward behavior change that encourages the consumption of healthier foods. This study measured the effect of an interactive vermicomposting model in the elementary school lunchroom as a visual cue and environmental stimulus to promote behavior change in children and encourage the increased consumption of whole fruit. Students were introduced to the concept of vermicomposting, and an interactive vermicomposting bin was placed in the cafeteria. For a portion of the study, worm stickers were also utilized as a visual cue. Students were given the opportunity to provide fruit remnants (i.e. cores, peels) to the worms as food. Compared to baseline, both the vermicomposting and the vermicomposting + stickers led to a significant increase in fruit consumption. However, the vermicomposting + stickers did not lead to a significant increase when compared to the vermicomposting alone.

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CHAPTER 1

INTRODUCTION

According to the Dietary Guidelines for Americans, children are consuming "too many calories and not enough nutrients" (USDA, DHHS, 2010). The number of children considered overweight or obese in the United States has risen substantially. Since the 1970s, the prevalence of obesity has more than tripled among children, rising from 5% in 1971–1974 (Ogden & Carroll, 2010) to 17% in 2011-2012 (Ogden, et al, 2014). Being overweight or obese during childhood is associated with an increased risk for heart disease, an increased risk of impaired glucose tolerance, insulin resistance and type 2 diabetes. It is also associated with a greater risk of social and psychological problems, such as discrimination and poor self-esteem, which can continue into adulthood.

While obesity in children continues to be a priority public health concern, it appears as if the rapid increase has slowed down. No significant change in the overall prevalence of childhood obesity was seen from 2003-2004 through 2011-2012 (Ogden, et al, 2014). One possible explanation for the current plateau of the childhood obesity rate can be explained by a decrease in energy intake reported by children and adolescents ages 2 to 19 years from 1999 -2000 to 2009-2010 (Ervin & Ogden, 2013). However, even with a decrease in overall calorie intake, many children's food consumption does not do not meet current dietary recommendations.

As eating habits that contribute to the prevention and promotion of chronic disease in adulthood are generally developed early in life and maintained with age; (Kelder, et al, 1994; Lake, et al, 2006; AND, 2014), the issue of poor nutrition should be addressed as early as possible. Efforts have been made at the national and local level to improve nutrition in today's youth in order to help establish healthy eating habits and reduce their risk of chronic disease in adulthood. As of the 2012-2013 school year, students participating in the National School Lunch Program are required to take either a serving of fruit or vegetable at every school meal. While this is a positive step, the major factor to consider in evaluating the effectiveness of these efforts lies in their ability to truly promote behavior change and improve the health of students participating in the program. On the local level, some school systems have the ability to purchase a variety of healthy foods through federal grant funding, such as the Fresh Fruit and Vegetable Program, (Bartlett, et al, 2013) which allows students in participating schools access to free fresh fruits and vegetables as a snack during the school day.

Schools have the ability to play a unique and important role in a national effort to educate children on the importance of healthy food choice and consumption, as no other institution has near as much continuous and intensive contact with children during their first two decades of life (Story, et al, 2006). Unlike health and nutrition education interventions which target individuals, school food and nutrition policies focus on changing the school environment in a way that will improve access to healthier food options and support healthy behaviors in the entire student population. By altering the school environment in a way that promotes positive, dietary behavior change, schools can leave a lasting impact on children by helping them to develop lifelong healthy eating habits.

In addition to altering the physical environment of the lunchroom, schools may also promote healthy eating through environmental stimulus by encouraging a sense of responsibility and a connection to the environment from which food is grown that motivates students towards the consumption of healthier foods. One method of encouraging this behavior change is through the use of composting, the process of converting organic food waste into a nutrient rich soil. A common method of composting known as vermicomposting, (Pagan & Steen, 2004) utilizes a special type of worm to process the food waste and can be performed in a contained environment conducive to the school setting. Vermicomposting in schools offers the opportunity for students to connect the food they eat to the environment from which it is grown. In addition, vermicomposting offers a fun incentive for students to increase their consumption of healthy fruits and vegetables, as remnants such as peels and cores are the main ingredients to the composting process.

Vermicomposting in schools as a means to promote positive behavior change in students and encourage better nutrition in students can lead to improved physical health. It may also provide for improved academic performance, as diets rich in fruits and vegetables have been associated with improved cognitive function in students (Story, et al, 2007; Datar, et al, 2004). Further benefits include a financial incentive to schools by significantly reducing the cost of waste disposal and the provision of an extra source of income for school activities if schools can sell the nutrient rich soil to local municipalities.

Problem

The increased prevalence of overweight and obesity, as well as poor dietary habits in children has resulted in an influx of research to examine the effectiveness of nutrition education to improve the health of America's children. As a result, recent decades have been marked by an

increased awareness concerning nutrition recommendations for fruit and vegetable consumption in the United States. In 2004, 40% of American adults were aware that fruit and vegetable intake should consist of at least 5 servings per day compared to only 8% who were aware in 1991 (NCI, 2004; Stables, et al, 2002). However, an increase in awareness does not always lead to behavior change as is the case with fruit and vegetable consumption in the United States. In a survey of American adults and adolescents, researchers found that fewer than 1 in 10 Americans met the MyPyramid fruit and vegetable recommendations (Kimmons, et al, 2009). This is a problematic discovery, considering the new MyPlate guidelines (which have replaced MyPyramid) and Dietary Guidelines for Americans now recommend that half of the American diet consist of fruits and vegetables. These recommendations were put into place in order to decrease the risk of chronic diseases, including comorbidities of obesity, such as heart disease and type 2 diabetes mellitus in Americans (USDA, DHHS, 2010).

Purpose

The purpose of this quasi-experimental quantitative study was to measure the effectiveness of an interactive vermicomposting model to operate as a visual cue and environmental stimulus to promote behavior change, measured by increased whole fruit consumption, in elementary school children.

Research Questions

1. Will an interactive vermicomposting model promote increased whole fruit consumption by elementary school children in the school lunchroom?
2. Will a visual cue in the form of a sticker placed on fruit in the lunch line increase the impact of a vermicomposting model on whole fruit consumption by elementary school children in the school lunchroom?

Hypotheses

1. The placement of an interactive vermicomposting model in an elementary school lunchroom will lead to an increase in whole fruit consumption by elementary school children in the school lunchroom.
2. The placement of a visual cue in the form of a sticker placed on the fruit in the lunch line will increase the impact of a vermicomposting model on whole fruit consumption by elementary school children in the school lunchroom.

Rationale:

This research study provides a fun, interactive environmental stimulus to promote behavior change in elementary school children in an effort to increase consumption of whole fruits in the school lunchroom. In utilizing the vermicomposting bin as a visual cue and environmental stimulus, students are encouraged to increase their consumption of wholesome foods that may be missing in their diet. In doing so, students may benefit from increased physical and mental health, as increased fruit consumption in childhood is associated with a decrease in chronic disease risk and an increase in cognitive function (USDA, DHHS, 2010; Florence, et al, 2008) Research shows that increased fruit and vegetable consumption can lead to better weight control and overall health in children (USDA, DHHS, 2010). In addition to improved student health, vermicomposting may also benefit schools by decreasing the amount of food waste in the cafeteria and providing an extra source of revenue for schools. By promoting positive benefits to both students and school systems, this study has the ability to open the door for more schools to implement similar measures, thus improving the health of school children nationwide.

Assumptions

The researcher made the following assumptions in the implementation of the study and in the interpretation of the data:

- The schools studied in this research were currently complying with all National School Lunch Program standards.
- The schools were monitoring and enforcing the mandate that each student must pick up one fruit or one vegetable with every meal.
- Students were not hiding fruit being served in the lunchroom in a place unable to be unaccounted for or unseen by researcher.

Definitions

- Environmental stimulus - an object or idea that serves to connect actions and thoughts to the environment in a positive way
- Consumed fruit – refers to fruit that has been $\geq$ 50 % consumed
- Unconsumed fruit- refers to fruit that has been < 50 % consumed
- Compost/Vermicompost– decayed organic material used as a plant fertilizer

Summary

Poor nutrition in children is a national problem that demands attention, as eating habits and health concerns generated in childhood tend to continue and increase into adulthood. Schools can play a unique and important role in a national effort to educate children on the importance of healthy food choices by providing an environment that fosters the increased consumption of fresh fruits and vegetables. This is especially important for children today, as these foods are

associated with a decrease in risk for certain chronic diseases associated with overweight and obesity.

In using the concept of vermicomposting as a means to promote fresh fruit consumption within the elementary school lunchroom, there is potential to not only improve the health of students, but also to promote a common sense of environmental responsibility among students. As students work together to "feed the worms," they are collectively striving to help the earth by reducing and recycling food waste, thus promoting the idea of sustainability. In doing so, they have the ability to motivate each other using positive peer pressure toward a common purpose, which has been shown to be a positive and influential catalyst for behavior change.

CHAPTER 2

REVIEW OF LITERATURE

The purpose of this quasi-experimental quantitative study was to measure the effectiveness of an interactive vermicomposting model to operate as a visual cue and environmental stimulus to promote behavior change, measured by increased whole fruit consumption, in elementary school children. This chapter will present an overview of the literature related to the risks of childhood overweight and obesity, the current trends of food consumption in children, and the ability of schools to promote dietary behavior change, along with an overview of vermicomposting as it fits into the school setting to promote behavior change.

Introduction

Research has shown that the traditional approach to nutrition education as a means to improve food intake will not succeed to improve the health and diet of most youth unless it is also accompanied by environmental supports to promote behavior change (Edquist, 2009). Recent decades have been marked by an expanded interest in nutrition education as a solution to the overall poor health status of Americans, specifically in children. A review of nutrition education research articles published in the *Journal of Nutrition Education and Behavior* indicated the number of articles indexed in Medline raised from 6,066 between 1986-1996, to 11,213 from 1997-2007, an increase of 85% between the two decades (Contento, 2008).

In order to promote significant behavior change, more time and energy should be invested to develop healthy eating habits and food choice at the elementary level. Healthy eating habits established during childhood and adolescence are generally carried through into adulthood (Lake, et al, 2006; AND, 2010). For this reason and more, the school lunchroom is a prime target for implementing strategies to improve nutrition in children. Changes to the National School Lunch Program have mandated that school lunchrooms provide more nutrient dense food choices to students in order to match the recommendations of the 2010 *Dietary Guidelines for Americans*. These guidelines include the recommendation to increase fruit and vegetable consumption, as well as increase certain nutrients in the diet such as dietary fiber and potassium, both found prevalently in whole fruit. (USDA, DHHS, 2010).

Within the new school lunchroom environment, innovative, behaviorally focused strategies can be used to improve healthful eating behaviors of children (IOM, 2007). In doing so, the lunchroom is transformed into a "learning laboratory" where students can practice nutrition-related skills (ADA, 2010) while experiencing the benefits of a healthier diet. Within this strategic environment, nutrition education can reach beyond the pages of a traditional textbook in its ability to produce behavior change and improve nutrition in children.

Risks Associated with Childhood Overweight and Obesity

In recent years, the number of children considered overweight or obese in the United States has risen substantially. Current estimates place nearly 32% of children ages 2-19 as overweight (at or above the 85th percentile of BMI for age) and 17% of the same age as obese (at or above the 95th percentile of BMI for age (Ogden, et al, 2014). Research has found that a child who has a BMI over the 85th percentile (overweight) at multiple occasions during childhood has a much greater likelihood of remaining overweight in the future (Nader, et al, 2006) and children

and adolescents who are obese are likely to remain obese as adults (Guo & Chumlea, 1999; Freedman, et al, 2005).

Health risks associated with obesity in children

Increased rates of childhood overweight and obesity have also led to an increased risk of chronic diseases during childhood. Diseases once considered very rare to find in children such as hypertension, type 2 diabetes mellitus, heart disease, and hyperlipidemia, are now being diagnosed early in childhood (USDA, DHHS, 2010). Further health complications associated with obesity in children include sleep apnea (Tauman & Gozal, 2011) and early puberty or menstruation (Kaplowitz, et al, 2001). Because of the health complications associated with obesity, it is projected that the current generation of children will have a shorter life-expectancy than the generation before them (Olshansky, et al, 2005).

In addition to the physical consequences, overweight and obese children are often subject to psychological consequences in the form of bullying, teasing, negative self-image, and a peer-association with negative characteristics such as sloppiness and laziness (Janssen, et al, 2004; Puhl & Latner, 2007; Libbey, et al, 2008; van Geel, et al, 2014). For this reason, some children resort to dieting as means to control weight, which can be a dangerous practice during preadolescence. Preadolescent dieting is considered to be a risk factor for future weight cycling and gain, and the development of eating disorders/disordered eating often begin during preadolescence as well (Eliassen & Wilson, 2007).

Obesity in children and academic performance

In addition to physical and psychosocial consequences related to overweight and obesity, some researchers have found worrisome associations between weight problems in children and poor academic development. One study found severely overweight children and adolescents to

be four times more likely to report impaired school functioning (Story, et al, 2006). Another study involving 11,192 kindergarteners found overweight children to have significantly lower math and reading test scores at the beginning of the year than did their healthy-weight peers (Datar, et al, 2004). While these studies provide valuable insights, caution should be given before blaming poor academic performance on overweight and obesity, as many underlying causes may contribute to poor performance, such as poor nutrition or absenteeism. With this in mind, overweight and obesity should be considered a marker for poor academic performance and not the cause itself (Story, et al, 2006). For example, one research study found that overweight and obese adolescents had 36 – 37% more sick days absent from school than their normal weight peers (Pan, et al, 2013), a finding that could help to explain poorer academic performance. Due to the prevailing physical, psychological, and academic consequences associated with obesity and overweight, the treatment and prevention of these conditions in childhood should be at the forefront of public health concern.

Current Trends of Food Consumption in Children

According to the Dietary Guidelines for Americans, children are well exceeding the guidelines set for solid fats and added sugars. On the contrary, children are not meeting the recommended intake for whole grains, fruits, vegetables (Guenther, et al, 2006). Consequently, children are not meeting guidelines for dietary fiber, calcium, potassium, and vitamin D. Two of these nutrients, dietary fiber and potassium are found prevalently in fruits and vegetables (USDA, DHHS, 2010).

As the newest food group symbol created by the United States Department of Agriculture, MyPlate has become a fairly common image representing how to build a healthy plate at mealtimes, and thus make healthier food choices. Compared to the previous MyPyramid

food guides, MyPlate places a higher significance on fruits and vegetables rather than grains. This change accurately reflects the 2010 *Dietary Guidelines for Americans,* and is based on a growing body of research that continues to support the positive effects of increasing fruit and vegetable intake in the diet (Dauchet, et al, 2009; WCRF, 2007; Blanchflower, et al, 2013; USDA, DHHS, 2010).

Physical effects of a diet high in whole fruits

Research continues to support the idea that eating a diet high in fruits and vegetables is associated with the decreased risk of certain chronic diseases, such as coronary heart disease and cardiovascular disease (Hung, et al, 2004; Bazzano, 2006; Dauchet, et al, 2009; AND, 2014). In addition, it can lead to a decreased risk of hypertension, diabetes and some cancers (Moore, et al, 2005; Kampman, 2007; Núñez-Córdoba, et al, 2008, AND 2014). When replacing high-fat foods, such as the usual school lunch side of French fries, increased fruits and vegetables can also aid in weight control and lead to a decreased risk of overweight and obesity in children (USDA, DHHS, 2010). .

The Dietary Guidelines for Americans recommend increasing whole fruit in all forms, including fresh, frozen, canned, and dried to aid in disease prevention. In some settings, such as within the school lunchroom, nutrient dense fresh fruits may provide positive health benefits at relatively low calorie levels compared to some canned fruits that are packaged in light to heavy syrup and may contribute to excess caloric intake. Whole fruits also contain nutrients not found in fruit juice such as fiber; and diets low in fiber are often a marker for increased risk of chronic disease (Freedman, et al, 2007). Furthermore, according to a report by the Economic Research Service of the United States Department of Agriculture, whole fruits, on average, are less expensive to purchase than their canned counterparts (Stewart, et al, 2011). In this case, a

healthier diet is not only good on the body, but it is also a smart economic choice for individuals, schools and households looking to save money.

Psychological effects of a healthier diet

While the physical effects of fruit and vegetable consumption have been extensively documented, other aspects of wellness may also be impacted by increased consumption. In a study examining psychological well-being, researchers found increased fruit and vegetable consumption to be connected with increased happiness and mental health, with optimal well-being peaking at approximately 7 servings per day (Blanchflower, et al, 2013). A healthy diet, classified by increased consumption of fruits and vegetables, has also been associated with improved achievement in children. In a study which was part of the larger Children's Lifestyle and School-performance Study (CLASS) of over 5000 fifth graders, students with an increased fruit and vegetable consumption were significantly less likely to fail a literary assessment than their produce-deficient peers (Florence, et al, 2008). In addition, a campaign to improve the nutrition in school lunches in the United Kingdom found improved academic performance and a 14% decrease in unauthorized absences compared to neighboring school systems (Belot & James, 2011).

Nutritional Impact of the School Setting

Schools can play a unique and important role in a national effort to educate children on the importance of healthy food choice and consumption, as no other institution has near as much continuous and intensive contact with children during their first two decades of life (Story, et al, 2006). Unlike health and nutrition education interventions which target specific individual behavior change, school food and nutrition policies focus on changing the school environment in

a way that will improve access to healthier food options and support healthy behaviors in the entire student population (Mâsse, et al, 2013).

Functions of the National School Lunch Program

The National School Lunch Program, recently updated by the Healthy, Hunger-Free Kids Act of 2010 (P.L. 111-296), is a federally assisted meal program offered in over 100,000 schools nationwide, which provides low-cost or free, nutritionally balanced lunches to American school children. In 2012, this program provided lunches to over 31 million children each school day for a total of over 224 billion meals since the initiation of the modern program (FNS, 2013). In 2010, the Healthy, Hunger-Free Kids Act upgraded the standard school lunch program to better meet the nutrition standards set forth by the 2010 *Dietary Guidelines for Americans,* which includes key recommendations to improve the health of all Americans (USDA, DHHS, 2010).

Within the school lunchroom, the addition of the Healthy, Hunger-Free Kids Act (P.L. 111-296) has translated into smaller portion sizes of most foods, limits on sodium and saturated fat, and an enhanced focus on whole grains, fruits, and vegetables. Specifically, students purchasing the standard lunch no longer have the option to select fruits and vegetables. They are required to take what is made available to them, a minimum of one serving of fruit or vegetable at every meal. One research study considered this removal of a choice as the likely reason for a 15.6% increase of student vegetable consumption. Interestingly, the study did not find any increase in fruit consumption among students since the implementation of the new standards (Cohen, et al, 2014). Results from this study and others suggest that simply increasing the availability and access to nutritious foods in schools may not be enough to improve childhood nutrition within the school setting. (Condon, et al, 2009). In removing students' choices and limiting the calorie intake per meal, some schools have seen a decrease in the number of students

choosing to buy the school lunch (Dinan, 2014), while other schools have been met with a refusal to eat the fruits and vegetables, resulting in an increase of food waste (Cohen, et al, 2014).

Developing a smarter school lunchroom

With the addition of the Healthy, Hunger-Free Kids Act, many federally funded school systems are now switching to the design of smarter lunchrooms to improve nutrition, rather than the further restriction of certain foods. In the smarter lunchroom setting, success may be measured not by the health benefits of the food offered in the school, but rather, the health benefits of the food actually consumed in the school (Just & Wansink, 2009). For example, in a research study designed to create smarter lunchrooms, simple changes such as improving the attractiveness and convenience of fruits and vegetables resulted in a significant increase in fruit and vegetable consumption. After observing students in the normal lunchroom setting, the researchers implemented multiple interventions such as relocating fresh fruit closer to the cash register, labeling vegetables with descriptive names, and serving salads in see-through containers. They also placed a "last chance for fruit" sign next to the fruit bowl, and regrouping some foods into a "healthy convenience line." After implementing all of the interventions in approximately three hours with a cost of less than fifty dollars, the researchers found an increase of 18% ($p = 0.04$) in actual fruit consumption by students (Hanks, et al, 2013).

Importance of early intervention

Research has shown that within the school environment, students can readily learn to accept new types of food and preparation methods (Matvienko, 2007; Roberts, et al, 2009). One factor in the school environment that has helped to solidify this impact is the United States Department of Agriculture's Fresh Fruit and Vegetable Program, a program that allows students

in participating schools access to free fresh fruits and vegetables as a snack during the school day (Bartlett, et al, 2013). A recent evaluation of this program found that participating students consumed more fruits and vegetables throughout the day than nonparticipants, without a significant change in energy intake (Bartlett, et al, 2013). Research continues to show that unique, hands on school interventions to improve nutrition can be effective in promoting increased fruit and vegetable consumption (Howerton, et al, 2007; IOM, 2007). In addition, these interventions tend to be more successful when targeted at elementary school students rather than older students (Bazzano, 2006).

An Environment to Support Behavior Change

In creating an environment to support behavior change, a combination of psychology and economics, known as behavioral economics, may provide key insights as to how student decisions can be influenced by biases in thought, memory, or perception. This idea of behavioral economics can be used as a practical way to encourage better choices in the school lunchroom without the need for additional nutrition education or the expense of introducing an entirely new menu (Just & Wansink, 2009). For example, researchers who examined the way people interpret healthy eating found that children tend to associate healthy eating with adults or as something that their parents wanted them to do. Children also connected healthy food with eating at home while unhealthy food was usually connected with eating away from home (Bisogni, et al, 2012). To overcome this bias in thought within the school environment, interventions should promote the guiding of choice in a way that is subtle enough that children are unaware of the mechanism (Just & Wansink, 2009). One simple method of "subtle guidance" is through the use of visual cues.

Function of visual cues

Although multiple senses can affect the type and amount of food intake, the first is usually the eyes (Wadhera & Capaldi-Phillips, 2014). Size, shape, color and even familiarity of foods can all impact the perceptions of those to whom it is available or offered. For some children, especially those whose parents do not frequently purchase fruit and vegetables, unfamiliarity with these offered items can occur and serve as a barrier to adequate consumption. Frequent visual exposure of new foods has been found to decrease neophobia and facilitate acceptance, resulting in increased consumption (Wadhera & Capaldi-Phillips, 2014). Changes in the National School Lunch Program have already resulted in an increase in the amount of fruit in the lunchroom, resulting in increased visual exposure. Through the use of certain visual cues, this exposure can be maximized to promote better intake by students.

One form of a visual cue is the strategic rearranging of food items in order to make the healthier food more visible. As a part of the "Smarter Lunch Movement," the Cornell Center for Behavioral Economics in Child Nutrition Program recommends movements such as displaying fruit in an attractive basket or container, placing fruit together for contrast of color, or making fruit available at least twice along the lunch line as simple, cost-free ways to increase fruit consumption (CCBECNP, 2014). In a 2012 study giving children the choice between choosing a cookie or an apple at lunchtime, children nearly doubled their choice of the apple after it was branded with a sticker of a well-known cartoon character. Interestingly, the same effect was not seen when researchers branded the cookie with the same sticker. (Wansink, et al, 2012).

Impact of Environmental Stimulus on Behavior Change

When considering behavior change in the school setting, one theory that has been already successfully implemented is the Social Cognitive Theory. This theory views human behavior in

terms of dynamic relationships and interactions among personal factors, environmental influences, and experiences (Bandura, 1986). In pairing the concept of Social Cognitive Theory with lunchroom choices, it seems that efforts toward promoting behavior change in children may be positively influenced by the association of that behavior with a strong sense of common purpose and responsibility. These associations with purpose and responsibility may be reflected in relationships with other students, as well as in the environment in which they live. By focusing on environmental stimuli that provide these associations, the school lunchroom may be able to promote behavior change in children in a way that is long-lasting and beneficial far beyond their school years.

Fostering a sense of purpose and responsibility

Environmental stimulus can be a strong motivator of behavior change, as research has found that feelings of joy that come from exhibiting "proenvironmental behavior" are more instrumental in motivation to recycle than feelings of worry (i.e. helplessness or inability to make a difference). Joy seems to function as a bridge between abstract environmental problems and behavior in everyday life" (p.791) (Ojala, 2008). In a separate study, researchers found that when people view a seemingly ordinary task in light of something more interesting and valued, such as a global idea or social construct, they tend to continue performing the task longer than those who do not share the same views (Werner & Makela, 1998). Specifically, the people who realized the purpose of recycling as it applied to the good of the environment or some other positive goal or outcome, were more likely to recycle long-term than those who lacked the same mentality. Although these principles have first been observed as motivators to recycling, it is possible that they may also transcend into other areas of behavior if those actions are being driven by a "greater good" mentality of responsibility to the environment.

Decreasing food waste in schools

When considering environmental stimulus to promote behavior change, the benefits of vermicomposting extend further than just connecting children to the earth from which their food is grown. Every school day, students in the United States throw away thousands of dollars in lunchroom food. One study found that an estimated $432,349 annually, or 26.1% of total food budget, of food was discarded as waste in Boston, Massachusetts middle schools. When translated to school lunches nationwide, roughly $1.25 billion of food was wasted that same year (Cohen, et al, 2013). Composting offers students the ability to utilize what would be plate waste in a way that is beneficial to the environment, thus connecting them to the earth from which their food is grown.

When considering the impact of food waste in schools, the most obvious theme is environmental, as high amounts of food waste are not conducive to sustainability goals and efforts. Another issue, however, is presented when the type of food waste is considered along with the overall amount. Recent changes to the National School Lunch Program, require students to take a minimum amount of food, specifically a serving of fruit and/or vegetable with every meal. Because of these new changes, standards of lunchroom nutrition have been calculated based on the assumption that students eat all of the food that is provided. For this reason, plate waste studies have become important when determining the true nutritional value of what students are receiving from school lunches.

Research has found that students are consuming approximately 60% of the calories they are served, far below the gold standard of 85% consumption usually used when estimating plate waste (Cohen, et al, 2013). Adding to the negative nutritional impact, research has also found that students are discarding approximately 60-75% of the vegetables and 40% of the fruit on

their trays (Cohen, et al, 2014). Considering the current state of childhood nutrition, this discarding of wholesome food is likely leading to an increase in unwholesome food consumption within and outside of the lunchroom. These trends, paired with the consequences associated with a poor diet are creating an environment of waste and nutritional deficiency.

Vermicomposting in Schools

In an effort to address the vast amount of plate waste and educate students on environmental principles, many schools, including primary, secondary, and post-secondary have begun to introduce the concept of composting within the lunchroom. Composting is a natural process that encourages the decomposition of organic wastes, such as produce and yard clippings to create a rich organic matter that can then be used as a fertilizer or soil enhancer. One common form of composting, known as vermicomposting, utilizes worms to aid in the decomposition of the organic matter. In using food wastes such as banana peels or apple cores to produce vermicompost, students have the ability to connect their food choices back to the environment. Currently, there is a gap in the research concerning the benefits of vermicomposting in schools as a means to increase the consumption of wholesome foods, but the benefits of garden-based nutrition education are widely reported (Blair, 2009; Parmer, et al, 2008). One common finding is that students who participated in this type of learning tended to have an increased consumption of healthier foods such as fruits and vegetables compared to students without this type of experience (McAleese, et al, 2007; Graham, et al, 2004).

Although composting is not a widely spread concept among school districts, likely due to the effort of upkeep, schools that have participated in even short-term initiatives seem to have had some level of success. One school district in Portland, Maine has found a significant reduction in the amount of trash going to the school dumpster since beginning an initiative to

curb the estimated 25%-40% of daily trash that was consisting of food waste (Portland, 2015). Similarly, after beginning a long-term compost project in 2009 as a part of the Cambridge Green School Initiative, the Cambridge Public School District in Massachusetts had kept over 34 tons of compostable material out of the trash in a three year time span (Cambridge, 2012).

Financial incentive to schools

Along with an increased emphasis on environmental responsibility and a decrease in food waste, composting and its associated behavior changes may also offer financial benefits to the schools involved. With the recent updates to the National School Lunch Program also arrived changes on how funds could be raised for the school and school programs. Candy bars, once sold as a fundraiser within many schools, are no longer allowed, as they present an unhealthy competition to school foods. This decrease in fundraising has left some schools unable to fund items such as team uniforms or equipment.

Schools choosing to participate in composting initiatives have the ability to produce large quantities of worm castings, a nutrient-rich soil additive that can potentially be sold to local farmers or family gardens to make a profit. Additionally, composting saves schools money in waste disposal fees. After implementing a composting initiative in two schools during the 2000-2001 school year, one school district in California generated a gross savings of over $6,000 in disposal fees alone. After only three more school years, the program had been updated, expanded to all eight schools in the district and had become totally self-sustaining, leading to a continuation of profit and a reduction in energy spent toward upkeep of the compost (Graham, et al, 2004).

Summary

In recent decades, research concerning the effectiveness of nutrition education has seen a significant increase. It is not a coincidence that this trend has hit during a time when overweight and obesity rates have almost quadrupled, not only in adults but also in children. Latest estimates place nearly 32% of children ages 2-19 as overweight (at or above the 85th percentile of BMI for age) and 17% of the same age as obese (at or above the 95th percentile of BMI for age (Ogden, et al, 2014). At the same time, children's diets are not meeting the current dietary guidelines for good health and chronic disease risk reduction. While nutrition education and access to nutritious foods are important, they are not enough to attain the greater goal of positive behavior change that can lead to better nutrition and a reduction in the prevalence of overweight and obese American children.

Schools can play a unique and important role in a national effort against this trend as no other institution has near as much contact with students during the early stages of life. This contact time is especially important during the elementary years, as these years are ideal to encourage the development of healthy food behaviors in children. These years are also key for developing dietary habits and food preferences, which can become more difficult to change later in life. By creating an environment that utilizes visual cues and environmental stimulus to promote behavior change, schools can play a vital role in improving the diet of American children.

Using the idea of vermicomposting as an environmental stimulus to promote fruit consumption within the elementary school lunchroom can be a fun activity that not only serves as an instrument for behavior change, but also promotes a common sense of purpose among students. Numerous benefits such as improved physical health and mental and emotional well-

being for students, as well as a possible financial incentive for schools point to vermicomposting as a potential catalyst for change within elementary school lunchrooms.

CHAPTER 3

METHODOLOGY

The purpose of this quasi-experimental quantitative study was to measure the effectiveness of an interactive vermicomposting model to operate as a visual cue and environmental stimulus to promote behavior change, measured by increased whole fruit consumption, in elementary school children. This chapter describes the methods used in study design, data collection, and data analysis.

Institutional Review Board

Prior to initiating this study, permission was requested from Ball State University Institutional Review Board (Appendix A-1), and the study was approved on January 28, 2015, by expedited review. The primary investigator conducting this analysis completed the Collaborative Institutional Training Initiative (CITI) training (Appendix A-2) prior to beginning the study. All study assistants participating in this research also completed CITI certification (Appendices A-3-6) prior to beginning the study.

Consent

Both school principals and the Food Service Director who agreed to participate in the study were informed of all study procedures and of their rights as a participant. No identification of student identity was recorded. Based on the IRB approval of study requirements and risk, no

student or parental consent was necessary for the completion of this study. Students who did not wish to place their fruit in the collection bins were not required to do so.

Participants

The participants for this quasi-experimental quantitative study consisted of students receiving the National School Lunch Program meal in two K-5 elementary schools in an east-central Indiana school corporation. The schools were moderately comparable in size with 491 students enrolled at the control school and 560 students enrolled at the intervention school. They are also comparable by socioeconomic status of students, indicated by free and reduced lunch rates of 84% and 92%, respectively. Furthermore, schools were similar in racial diversity, with enrollment of non-white students at 31% and 25%, respectively.

Study Design

Prior to initiating research, the Food Service Director (FSD) of the school corporation was contacted by the Primary Investigator (PI) to gauge interest in the study. After receiving support from the FSD, the PI contacted the principals of both schools to gauge interest and garner permission. Both school principals provided letters of support for the research project (Appendices B-1-2). The PI met with the principals and the school lunchroom staff to discuss the study and its implications for the students and schools. It was agreed upon that the intervention would be performed in the spring of 2015 between two state-wide standardized testing time frames in order to avoid the schedule changes and lunchroom set up changes that were known to occur during testing timeframes.

The PI visited both schools during the fall of 2014 to view the layout of the lunchroom and determine the best locations for intervention materials and data collectors within the lunchroom. The FSD of the school system was contacted to confirm school lunch menus in order

to determine which days whole fruit was to be served in the lunchroom. The FSD provided lunch menus to the PI, and dates for data collection were set. Both schools followed the same menu rotation and served whole fruit on two non-consecutive days each week for the duration of the study.

Two weeks prior to the start of the study, the PI constructed a vermicomposting bin using 30 gallon plastic totes (Appendix C-1) and introduced two pounds of red wiggler worms into the system. The vermicomposting bin was constructed prior to the start of the study in order to ensure viability of the system during the intervention. A viewing window was built into the system to allow students to see inside the vermicomposting bin, and an illustrated worm was used to characterize the bin. The PI utilized a vermicomposting guide created for teachers by the California Integrated Waste Management Board (Pagan & Steen, 2004) to create and care for the vermicomposting bin throughout the study. At the start of the study, the vermicomposting bin was placed on top of a three foot rolling cart, where it remained throughout the duration of the study. On the cart was also a bottle labeled "worm water" and a pair of rubber gloves used when tending to the vermicomposting bin. On data collection days, the cart was wheeled into the lunchroom and positioned in a place that was easily visible by each grade of students as they entered and left the lunchroom. In addition to the movable vermicomposting bin, a large plastic tote with a "worm food" sign (Appendix C-2) was also positioned in the lunchroom so that it was easily visible to students throughout the data collection process. The same illustrated worm used on the vermicomposting bin was also added to the "worm food" tote.

Data collection occurred on nine days over the course of the five-week study period in the spring of 2015. On data collection days, data was collected by two researchers in each school. Researchers used visual observation to determine how much fruit was left uneaten on the

students' trays approximately 3-4 minutes prior to waste disposal. The elementary students (K-5) in both schools ate lunch with their respective grades at set, staggered times throughout the lunch period, allowing data to be grouped by grade level. Each grade level received 30 minutes to select food from the lunch line, sit down by class, and eat their meals. For example, kindergarten students would line up to get their lunch at 11:00 am and be dismissed to return to their classrooms at 11:30 am. Second grade students would line up to get their lunch at 11:20 am and be dismissed at 11:50 am. First grade students would line up at 11:40 am and be dismissed at 12:10 pm. This pattern was similar for each grade in both schools.

During the baseline data collection week (week 1), researchers at both schools with separate data collection sheets on clipboards walked down each aisle of the school lunchroom approximately 3-4 minutes prior to each grades' dismissal. Using visual observation and visual diagrams (Appendix D), researchers recorded fruit remnants on each student's tray. Fruit remnants were recorded as consumed ($\geq 50\%$) or not consumed ($< 50\%$).

During the intervention weeks (weeks 2-5), researchers at the control school continued the same data collection method. No changes were made at the control school. On the first day of the intervention at the intervention school, over a microphone with each grade level of students as they sat down with their lunch students were informed, at a basic level, about the meaning of vermicomposting (Appendix E-1). On the first day of the intervention and once per week throughout the study, the vermicomposting bin was rolled down each aisle of the lunchroom while students were eating their lunches. One researcher held the flap up that hung over the viewing window so that students could see the worms inside the bin.

On data collection days, researchers, using a microphone prior to dismissal for each grade, informed students that they were getting ready to collect the worm food. This allowed

students time to finish what they wanted of their fruit and prepare to place the fruit remnants in the collection bin. Researchers in the intervention school then walked down each aisle approximately 3-4 minutes prior to student dismissal and allowed students to place fruit remnants into a "worm food" collection bin (Appendix C-2). Visual observation and the same percent consumed criteria were used to determine student consumption. One researcher wheeled the collection bin with the "worm food" sign down each aisle between students while the other researcher recorded data on a data sheet using a clipboard. Students who were not coordinated enough to place their fruit in the bin (e.g. Kindergarteners) were asked by the lunchroom attendant to hold their fruit remnants up for the researcher to take and place in the bin. Students bringing their lunch from home were allowed to place their fruit into the tote, but their fruit consumption data were not used or analyzed with the data from students who received the National School Lunch Program meal.

During the final week of data collection, compostable worm stickers (Appendix F) featuring the same illustrated worm adhered to the bins were placed on the skins of the whole fruit prior to the beginning of the lunch period. These were utilized in the study to determine whether or not an extra visual cue would result in increased fruit consumption. All other data collection procedures remained the same.

Study Instruments

Researchers recorded the students' fruit consumption on a data sheet created for the purpose of this study (Appendix D). Fruit remnants were marked on the data sheet as consumed (≥50%) or not consumed (< 50 %). The consumption pattern data sheet was subdivided by grade level. To ensure consistency among data recorders, diagrams, which were placed behind the data

sheets, were used to provide a visual aid to measure fruit consumption. Research assistants were trained in the use of the study instruments prior to beginning the study.

Signs on the vermicomposting bin and collection totes were also used during this study. These signs featured an illustrated worm designed for the purpose of this study. The sign on the vermicomposting bin (Appendix C-1) functioned as a flap to cover a viewing window and was lifted when the vermicomposting bin was wheeled down each aisle for students to see. The signs on the "worm food" collection totes (Appendix C-2) featured the same illustrated worm along with images of orange peels, banana peels, and apple cores to serve as a visual cue for students.

Stickers featuring the same illustrated worm (Appendix F) were also used during the final week of the study. Stickers were placed on the skins of the fruit served to students prior to the beginning of the lunch period. The worm stickers were used as an extra visual cue to help students further connect the food on their trays with the vermicomposting idea. Stickers were chosen for this study because of the positive effects they had already been found to have on fruit appeal and increased fruit consumption among elementary students (Wansink, 2012).

Data Analysis

Data was collected by researchers at both schools, transferred into Microsoft Excel sheets, and then uploaded into SPSS v.22.0 for Windows for statistical analysis. A pairwise comparison t-test was used to determine changes in fruit consumption within and between the control, and intervention schools at each stage of the study. Tables of means were produced and mean fruit consumption differences by grade were analyzed using the Difference in Differences method. The DID statistical method, used commonly in economics, is beneficial when measuring the impact of an intervention on trends over time within a large entity, such as a state or school. This method was used to ensure that any variables that remained constant over time (but were

unobserved) that were correlated with the outcome would not bias the estimated effect of the intervention. It also allowed for the ability to control for potential confounders. (Abadie, 2005; Card & Krueger, 1994; Cates, et al, 2014). Statistical significance was set at $p \leq 0.05$.

Summary

This quasi-experimental quantitative study was designed to test an innovative method to improve whole fruit consumption among elementary school children. Using a vermicomposting bin as a visual cue allows students to connect their food choices and consumption habits to the environment from which their food is grown. This serves as a motivator to make better choices that can both positively affect their health and benefit the environment. Fruit consumption was measured before and after the implemented intervention using the methods described, and data were analyzed to evaluate differences between and within groups.

CHAPTER 4

RESULTS

The purpose of this quasi-experimental quantitative study was to measure the effectiveness of an interactive vermicomposting model to operate as a visual cue and environmental stimulus to promote behavior change, measured by increased whole fruit consumption, in elementary school children. This chapter will present an overview of the results of the research study by answering each of the research questions and presenting tables and graphs to support the findings.

Demographics

The participants for this quasi-experimental quantitative study consisted of students participating in the National School Lunch Program in two K-5 elementary schools. The schools were moderately comparable in size with student enrollment of 491 and 560, in the control and intervention schools, respectively. The schools were also similar in socioeconomic status, determined by free and reduced lunch rates of 84% and 92% respectively, and by racial diversity with enrollment of non-white students at 31% and 25%, respectively. No identifiable information concerning individual student identity was recorded.

Research Findings

After data was gathered, it was transferred into Microsoft Excel, and then uploaded into SPSS v.22.0 for Windows for statistical analysis. A pairwise comparison t-test was used to determine changes in mean fruit consumption within and between schools at different stages of the study. Tables of means were produced, and mean consumption differences by grade were analyzed using the Difference in Difference (DID) model.

Research questions:

1. Will an interactive vermicomposting model promote increased whole fruit consumption by elementary school children in the school lunch room?
2. Will a visual cue in the form of a sticker placed on the fruit in the lunch line increase the impact of a vermicomposting model on whole fruit consumption by elementary school children in the school lunch room?

Hypotheses

1. The placement of an interactive vermicomposting model in an elementary school lunch room will lead to an increase in whole fruit consumption by elementary school children in the school lunch room.
2. The placement of a visual cue in the form of a sticker placed on the fruit in the lunch line will increase the impact of a vermicomposting model on whole fruit consumption by elementary school children in the school lunch room.

Impacts on fruit consumption

Prior to running analysis on data, inter-rater reliability at baseline was calculated (Table 1) to account for possible impact of multiple observers. Inter-rater reliability for this study was found to be .99. Significance was set for this study at $p \leq .05$.

Table 1. Intra-class correlation coefficient to determine inter-rater reliability

		95% Confidence Interval		F Test with True Value 0			
	Intra-class Correlation[a]	Lower Bound	Upper Bound	Value	df1	df2	Sig
Single Measures	0.982[b]	0.959	0.992	109.178	23	23	0.000
Average Measures	0.991[c]	0.979	0.996	109.178	23	23	0.000

Two way mixed effects model where people effects are random and measures effects are fixed.
a. Estimator is the same, whether the interaction effect is present or not.
b. Type A intra-class correlation coefficients using an absolute agreement definition.
c. Estimate is computed assuming the interaction effect is absent, because it is not estimable otherwise.

Mean consumption data from each school was analyzed using pairwise comparison, and between school and within school differences were analyzed for each stage of the study. The first stage (baseline) was coded as stage 1. The second stage (vermicomposting bin only) was coded as stage 2. The third stage of the study (vermicomposting + stickers) was coded as stage 3. Mean fruit consumption per grade (Table 2) was determined by averaging the number of pieces of whole fruit that were consumed (≥ 50%) during lunch periods within each stage of the study. The average number of consumed pieces of fruit per day was then averaged across six grades. Within each stage of the study, the N was determined by averaging the number of students who received reimbursable meals in each school during each lunch period within that stage. The average number of students receiving meals per day was then averaged across six grades.

Table 2. Mean fruit consumption* per grade at study stages

School	Stage	N	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Control	1	63	18.54	1.54	15.11	21.97
	2	65	21.93	2.09	17.28	26.59
	3	65	16.13	1.82	12.07	20.18
Intervention	1	61	24.54	1.54	21.11	27.97
	2	62	36.57	2.09	31.91	41.22
	3	64	33.83	1.82	29.78	37.88

*Refers to fruit consumed ≥ 50%.

Differences in mean fruit consumption per grade (Table 3) were determined by running a pairwise comparison of the mean fruit consumption per grade within each stage of the study. For each comparison, the N was determined by averaging the number of students receiving reimbursable school meals between the two stages being compared.

Table 3. Mean differences in fruit consumption* per grade

School	Compared Stages		N	Mean Difference	Std. Error	Sig.	95% Confidence Interval for Difference	
							Lower Bound	Upper Bound
Control	1	2	64	3.39	2.02	0.124	-1.11	7.90
	1	3	64	-2.42	1.20	0.070	-5.07	0.24
	2	3	65	-5.81	1.33	0.001	-8.77	-2.88
Intervention	1	2	62	12.03	2.02	0.000	7.53	16.52
	1	3	63	9.29	1.20	0.000	6.64	11.94
	2	3	63	-2.73	1.33	0.067	-5.70	0.23

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker
*Refers to fruit consumed ≥ 50%.

Results of this study show that a significant increase of mean fruit consumption per grade (M 12.03, $p<0.001$, n=62) occurred in the intervention school between baseline and vermicomposting stages of the study. A significant increase in mean fruit consumption per grade (M 9.29, $p<0.001$, n=63) was also found in the intervention school between baseline and vermicomposting + stickers stages of the study. In contrast, a significant decrease in fruit consumption per grade was found in the control school (M-5.81, p=0.001, n=65) between the vermicomposting and vermicomposting + stickers stages of the study. A similar, though insignificant decrease in fruit consumption was found in the intervention school (-2.73, p=0.067, n=63) between the same stages. A graph representing the changes in the mean fruit consumption per grade at each stage of the study can be seen in Figure 1.

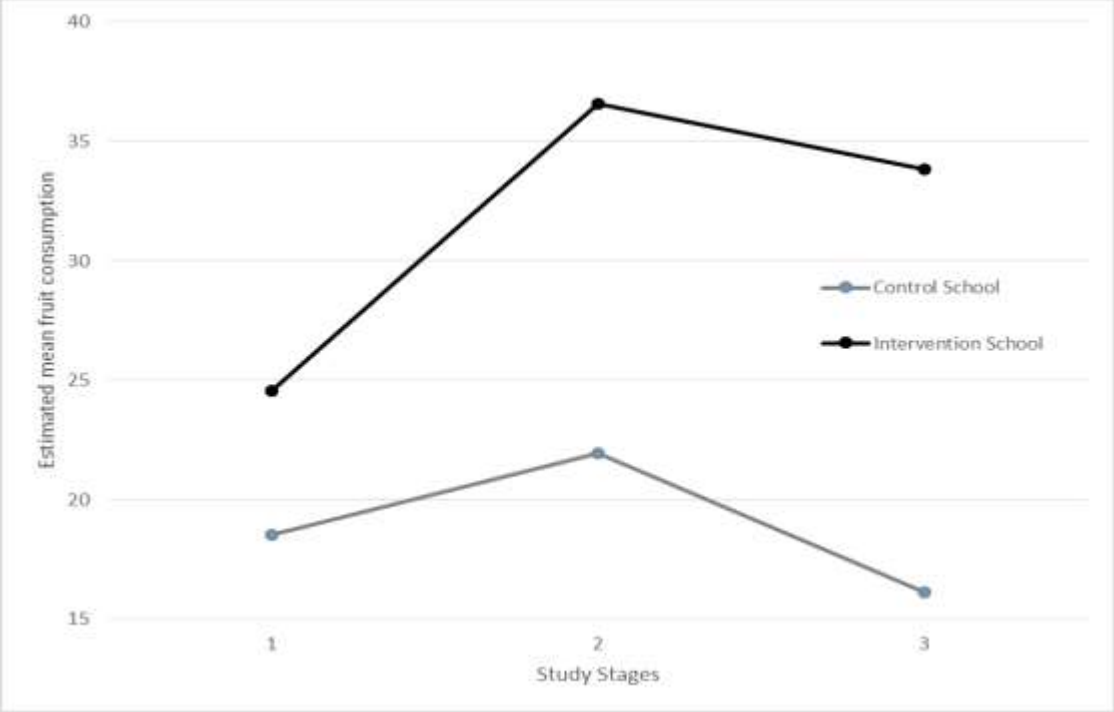

Figure 1. Mean fruit consumption (>50%) per grade during at each study stage

Within school and between school differences in fruit consumption were analyzed using pairwise comparison within the DID model (Table 4). In looking at pieces of fruit that were consumed (≥ 50%) in all grades combined within each school during the lunch period, a significant increase (M 72.15, p<0.001, n=378) was found in the intervention school between baseline and vermicomposting stages the study. A significant increase (M 55.75, p<0.001, n=378) in mean fruit consumption was also found in the intervention school between baseline and vermicomposting + stickers stages. Between the baseline and vermicomposting + stickers stages of the study, a significant decrease (M-34.85, p=0.001, n=384) in mean fruit consumption was found in the control school.

Table 4. Mean differences in fruit consumption* by school

	Stages			Differences		
School	1	2	3	Difference (2) - (1)	Difference (3) - (2)	Difference (3) - (1)
Control (n=384)	111.25	131.60	96.75	20.35	-34.85[a]	-14.50
Intervention (n=378)	147.25	219.40	203.00	72.15[b]	-16.40	55.75[b]
Difference	36.00	87.80	106.25	51.80	18.45	70.25

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker
*Refers to fruit consumed ≥ 50%.
[a]The mean difference is significant at < 0.005 level.
[b]The mean difference is significant at < 0.001 level.

Mean differences in consumption at the individual grade level can be found in Table 5. However, an insufficient amount of data prevented the use of ANOVA statistical analysis on differences in mean consumption at the individual grade level. In looking at grade level data within schools, students in every grade at the intervention school consumed ≥ 50% of more pieces of fruit during the vermicomposting stage of the study than during the baseline. An increase in mean fruit consumption between baseline and the vermicomposting + stickers stages was also seen in all grade levels at the intervention school. When compared to the changes that

occurred at the control school, students at every grade in the intervention school consumed more pieces of fruit per lunch period between the baseline and the vermicomposting stages of the study.

Table 5. Mean fruit consumption* by grade level

		Stages			Differences		
Grade	School	1	2	3	Difference (2) - (1)	Difference (3) - (1)	Difference (3) - (2)
	Control	16.50	20.50	15.75	4.00	-0.75	-4.75
K	Intervention	23.00	30.40	29.00	7.40	6.00	-1.40
Difference		6.50	9.90	13.25	3.40	6.75	3.35
	Control	19.75	19.50	15.75	-0.25	-4.00	-3.75
1	Intervention	27.75	45.60	42.00	17.85	14.25	-3.60
Difference		8.00	26.10	26.25	18.10	18.25	0.15
	Control	20.50	25.60	20.75	5.10	0.25	-4.85
2	Intervention	21.25	40.20	30.00	18.95	8.75	-10.20
Difference		0.75	14.60	9.25	13.85	8.50	-5.35
	Control	23.75	27.10	19.50	3.35	-4.25	-7.60
3	Intervention	25.25	31.40	32.00	6.15	6.75	0.60
Difference		1.50	4.30	12.50	2.80	11.00	8.20
	Control	10.00	19.80	10.25	9.80	0.25	-9.55
4	Intervention	26.25	40.40	38.00	14.15	11.75	-2.40
Difference		16.25	20.60	27.75	4.35	11.50	7.15
	Control	20.75	19.10	14.75	-1.65	-6.00	-4.35
5	Intervention	23.75	31.40	32.00	7.65	8.25	0.60
Difference		3.00	12.30	17.25	9.30	14.25	4.95

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker
*Refers to fruit consumed ≥ 50%.

Excluding the effect of bananas on results

In analyzing the data, it was discovered that during eight of the nine lunch periods of the study, students were served apples or oranges with the school lunch. On one day during the

vermicomposting stage of the study, students were served bananas. On this day, in both schools, students consumed more fruit than on any other day of the same stage. In the intervention school, 86.8% of the bananas served were ≥ 50% consumed. On other days during the vermicomposting stage, only 52.7 – 63.9% (mean=59.5%) of fruit was ≥ 50% consumed. Using the same pairwise comparisons, the data was reanalyzed to investigate if a banana bias influenced the results.

Again, mean fruit consumption per grade (Table 6) was determined by averaging the number of pieces of whole fruit that where consumed (≥ 50%) during lunch periods (with the exception of the day when bananas were served) within each stage of the study. The average number of consumed pieces of fruit per day was then averaged across six grades. Within each stage of the study, the N was determined by averaging the number of students who received reimbursable meals in each school during each lunch period within that stage (with the exception of the day when bananas were served). The average number of students receiving meals per day was then averaged across six grades.

Table 6. Mean fruit consumption* per grade with bananas excluded

					95% Confidence Interval	
School	Stage	N	Mean	Std. Error	Lower Bound	Upper Bound
Control	1	63	18.54	1.54	15.11	21.97
	2	64	19.49	1.97	15.11	23.88
	3	65	16.13	1.82	12.07	20.18
Intervention	1	61	24.54	1.54	21.11	27.70
	2	62	33.13	1.97	28.74	37.51
	3	64	33.83	1.82	29.78	37.88

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker
*Refers to fruit consumed ≥ 50%.

Differences in mean fruit consumption per grade (Table 7) were determined by running a pairwise comparison of the mean fruit consumption per study within each stage of the study. For

each comparison, the N was determined by averaging the number of students receiving reimbursable school meals between the two stages being compared.

Table 7. Mean differences in fruit consumption* per grade with bananas excluded

School	Stages Compared		N	Mean Difference	Std. Error	Sig.	95% Confidence Interval for Difference	
							Lower Bound	Upper Bound
Control	1	2	64	0.95	2.02	0.648	-3.55	5.45
	1	3	64	-2.42	1.20	0.070	-5.07	0.24
	2	3	65	-3.37	1.37	0.034	-6.43	-0.31
Intervention	1	2	62	8.58	2.02	0.002	4.08	13.08
	1	3	63	9.29	1.19	0.000	6.64	11.94
	2	3	63	0.71	1.37	0.617	-2.35	3.77

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker
*Refers to fruit consumed ≥ 50%.

Results of the study show that a significant increase in mean fruit consumption per grade (M 8.58, $p<0.005$, n=62) occurred in the intervention school between the baseline and the vermicomposting stages of the study. The significant increase in mean fruit consumption per grade (M 9.29, $p< 0.001$, n=63) previously found in the intervention school between the baseline and the vermicomposting + sticker stages remained the same. However, in excluding the bananas, a clearer trend can be seen. A significant, but lesser decrease (M-3.37, $p< 0.05$, n=65) is still seen in the control school between the vermicomposting and vermicomposting + sticker stages. In the intervention school, a slight increase in mean fruit consumption (M 0.71, p=0.617, n=63), though insignificant, is seen between the same stages. A graph representing the changes in mean fruit consumption per grade, with bananas excluded, at each stage of the study can be seen in Figure 2.

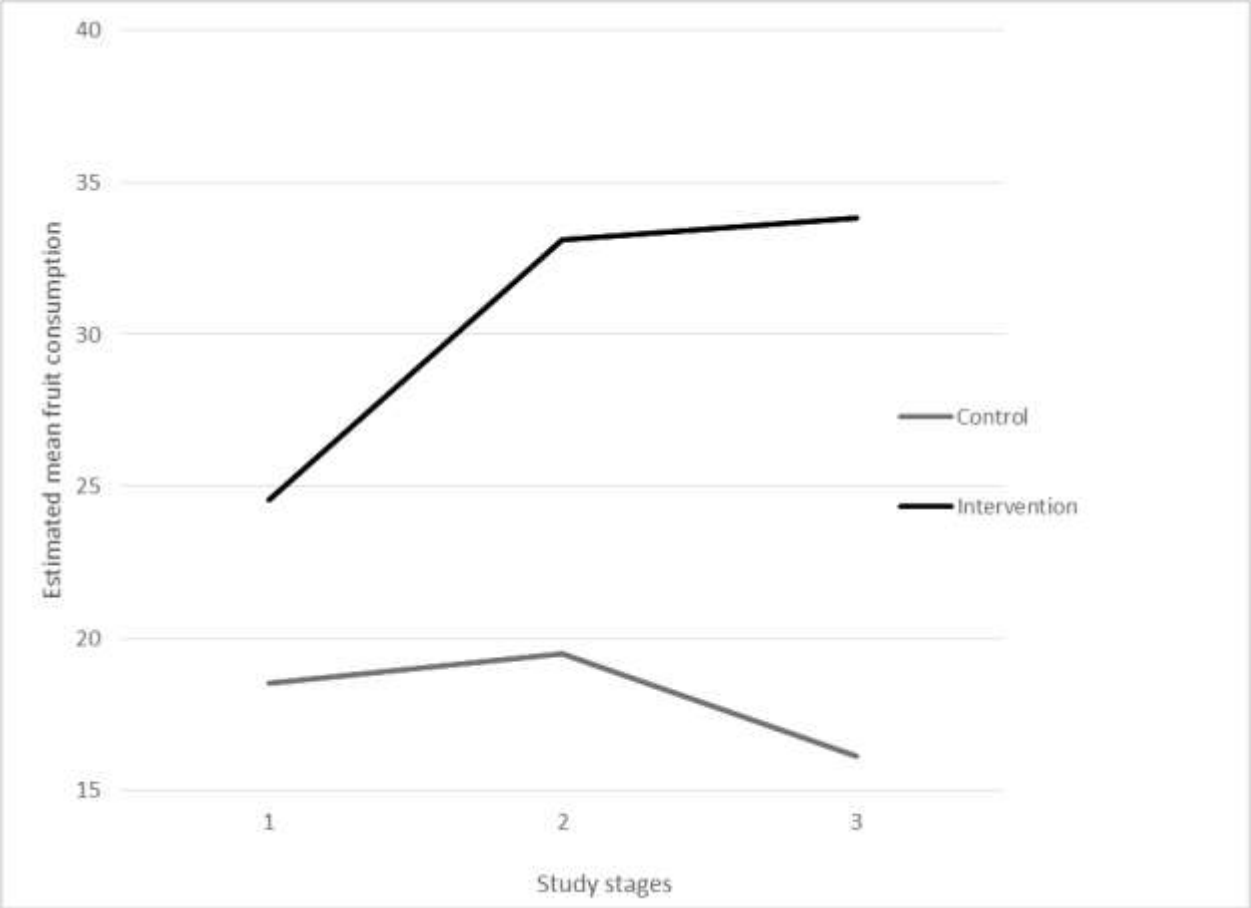

Figure 2. Mean fruit consumption (≥ 50%) per grade at each study stage with bananas excluded

Within school and between school differences in fruit consumption were again analyzed using pairwise comparison within the DID model (Table 8). After excluding bananas, in looking at pieces of fruit that were consumed (≥ 50%) in all grades combined within each school during the lunch period, a significant increase (M 51.50, $p<0.005$, n=378) was found in the intervention school between the baseline and vermicomposting stages of the study. A significant increase (M 55.75, $p<0.001$, n=378) in mean fruit consumption was also found in the intervention school between the baseline and the vermicomposting + stickers stages. Between the vermicomposting and vermicomposting + stickers stages of the study, a significant decrease (M-20.22, $p=0.034$, n=384) in mean fruit consumption was found in the control school.

Table 8. Mean differences in fruit consumption* by school with bananas excluded

	Stages			Differences		
School	1	2	3	Difference (2) - (1)	Difference (3) - (2)	Difference (3) - (1)
Control (n=384)	111.25	116.97	96.75	5.72	-20.22[a]	-14.50
Intervention (n=378)	147.25	198.75	203.00	51.50[b]	4.25	55.75[c]
Difference	36.00	81.78	106.25	45.78	24.47	70.25

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker

*Refers to fruit consumed ≥ 50%.

a. The mean difference is significant at < 0.05 level.

b. The mean difference is significant at < 0.005 level.

c. The mean difference is significant at < 0.001 level.

Mean differences in consumption at the individual grade level with bananas excluded can be found in Table 9. However, an insufficient amount of data still prevented the use ANOVA statistical analysis on differences in mean consumption at the individual grade level. In looking at grade level data within schools, students in every grade at the intervention school still consumed ≥ 50% of more pieces of fruit during the vermicomposting stage of the study than during the baseline. An increase in mean fruit consumption between baseline and the vermicomposting + stickers stages was also seen in all grade levels at the intervention school. When compared to the changes that occurred at the control school, students at the intervention school consumed more pieces of fruit per lunch period between the baseline and the vermicomposting stages of the study.

Table 9. Mean fruit consumption* by grade level with bananas excluded

		Stages			Differences		
Grade	School	1	2	3	Difference (2) - (1)	Difference (3) - (1)	Difference (3) - (2)
	Control	16.50	18.33	15.75	1.83	-0.75	-2.58
K	Intervention	23.00	27.50	29.00	4.50	6.00	1.50
Difference		6.50	9.17	13.25	2.67	6.75	4.08
	Control	19.75	15.88	15.75	-3.87	-4.00	-0.13
1	Intervention	27.75	41.50	42.00	13.75	14.25	0.50
Difference		8.00	25.62	26.25	17.62	18.25	0.63
	Control	20.50	23.75	20.75	3.25	0.25	-3.00
2	Intervention	21.25	36.25	30.00	15.00	8.75	-6.25
Difference		0.75	12.50	9.25	11.75	8.50	-3.25
	Control	23.75	25.38	19.50	1.63	-4.25	-5.88
3	Intervention	25.25	29.50	32.00	4.25	6.75	2.50
Difference		1.50	4.12	12.50	2.62	11.00	8.38
	Control	10.00	18.50	10.25	8.50	0.25	-8.25
4	Intervention	26.25	35.00	38.00	8.75	11.75	3.00
Difference		16.25	16.50	27.75	0.25	11.50	11.25
	Control	20.75	15.13	14.75	-5.62	-6.00	-0.38
5	Intervention	23.75	29.00	32.00	5.25	8.25	3.00
Difference		3.00	13.87	17.25	10.87	14.25	3.38

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker
*Refers to fruit consumed ≥ 50%.

Impact on Amount of Fruit Picked Up By Students

In analyzing the data beyond the context of the original research questions, it was found that more students at the intervention school picked up fruit, regardless of consumption, during the vermicomposting and vermicomposting + stickers stages of the intervention than during the baseline. Amount of fruit picked up by the students was determined by combining all observations of mean fruit consumption, (< 50%) and (≥ 50%), at the intervention school (Table 10).

Table 10. Mean pieces of fruit picked up per grade

School	Stage	N	Mean	Std. Error	95% Confidence Interval	
					Lower Bound	Upper Bound
Control	1	63	39.67	1.087	37.24	42.09
	2	65	40.95	2.733	34.87	47.04
	3	65	41.83	3.769	33.44	50.23
Intervention	1	61	39.67	1.087	37.24	42.09
	2	62	56.17	2.733	50.08	62.26
	3	64	58.75	3.769	50.35	67.15

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker

Mean differences in fruit picked up per grade at each stage of the study were analyzed using pairwise comparison (Table 11). It was found that students at the intervention school picked up more total pieces of fruit (M 16.5, $p<0.001$, n=62) per grade during the vermicomposting stage than during baseline. Students at the intervention school also picked up more fruit (M 19.1, $p=0.001$, n=63) during the vermicomposting + sticker stage than during baseline.

Table 11. Mean difference in pieces of fruit picked up per grade

School	Stages Compared		N	Mean Difference	Std. Error	Sig.	95% Confidence Interval for Difference	
							Lower Bound	Upper Bound
Control	1	2	64	1.288	2.839	0.660	-5.038	7.613
	1	3	64	2.167	3.793	0.580	-6.284	10.618
	2	3	65	0.879	2.09	0.683	-3.779	5.537
Intervention	1	2	62	16.500[a]	2.839	0.000	10.175	22.825
	1	3	63	19.083[b]	3.793	0.001	10.632	27.534
	2	3	63	2.583	2.090	0.245	-2.074	7.241

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker

Between school differences in the mean amount of fruit picked up by students, regardless of consumption, were also analyzed using pairwise comparison at each stage of the study (Table 12). When compared to the control school, students at the intervention school picked up 91.27 more pieces of fruit (p=0.003) during the vermicomposting stage and 101.5 more pieces of fruit (p=0.01) during the vermicomposting + sticker stage.

Table 12. Mean differences in pieces of fruit picked up between schools

						95% Confidence Interval for Difference	
Stage	Schools		Mean Difference (I-C)	Std. Error	Sig	Lower Bound	Upper Bound
1	Control	Intervention	0.00	1.54	1.00	-3.43	3.43
2	Control	Intervention	91.27[a]	23.19	0.003	39.61	142.94
3	Control	Intervention	101.50[b]	31.98	0.010	30.25	172.75

Study Stages: 1) Baseline 2) Vermicomposting 3) Vermicomposting + Sticker

Summary

Results of this study show that a significant increase of mean fruit consumption per grade (M 12.03, p<0.001, n=62) occurred in the intervention school between baseline and vermicomposting stages of the study as well as between the baseline and vermicomposting + stickers stages of the study (M 9.29, p<0.001, n=63). In looking at pieces of fruit that were consumed (≥ 50%) in all grades combined, a significant increase (M 72.15, p<0.001, n=378) was found in the intervention school between baseline and the vermicomposting stages of the study as well as between baseline and the vermicomposting + sticker stages of the study (M 55.75, p<0.001, n=378). After excluding bananas, a slight increase in mean fruit consumption (M 0.71, p=0.617, n=63) per grade, though insignificant, was also seen between baseline and vermicomposting + sticker stages. In looking at all grades combined within each school, a

significant increase was found at the intervention school between baseline and vermicomposting stages (M 51.5, $p<0.005$, n=378) as well as between baseline and vermicomposting + sticker stages (M 55.75, $p<0.001$, n=378). When compared to baseline, it was also found that students at the intervention school picked up more total pieces of fruit per grade during the vermicomposting stage (M 16.5, $p<0.001$, n=62) as well as during the vermicomposting + sticker stage (M 19.1, $p=0.001$, n=63). When compared to the control school, students at the intervention school picked up 91.27 more pieces of fruit ($p=0.003$) during the vermicomposting stage and 101.5 more pieces of fruit ($p=0.01$) during the vermicomposting + sticker stage.

CHAPTER 5

DISCUSSION

The purpose of this quasi-experimental quantitative study was to measure the effectiveness of an interactive vermicomposting model to operate as a visual cue and environmental stimulus to promote behavior change, measured by increased whole fruit consumption, in elementary school children. This chapter will present a discussion of the results and the implications of the findings within the school lunch room environment. It will also compare and contrast the findings of this study with the studies that have been previously discussed in chapter two.

Summary of Findings

Results from this study found that the placement of an interactive vermicomposting model in a school lunch room did lead to a significant increase in whole fruit consumption (M 12.03, $p<0.001$, n=62) per grade by elementary school children. When comparing the vermicomposting stage to baseline at the school level, an increase of 72.15 pieces of consumed fruit ($p<0.001$, n=378) was seen, or approximately 0.19 pieces of fruit per student receiving the school lunch meal. This increase between baseline and the vermicomposting stage was seen across all grade levels. After excluding bananas, adding a visual cue in the form of a sticker placed on the fruit in the lunch line did lead to a slight, increase in whole fruit consumption per

grade (M 0.71, n=63) when compared to the effect of the vermicomposting model alone, however the increase was insignificant (p=0.617). Excluding bananas did lead to a lesser effect of the vermicomposting stage at both the grade level (M 8.58, p<0.005, n=62) and at the whole school level (M 51.5, p<0.005, n=378), or approximately 0.14 pieces of fruit per student, when compared to baseline. The difference between the vermicomposting + sticker stage both at the grade level (M 9.29, p< 0.001, n=63) and the school level (M 55.75, p<0.001, n=378), or approximately 0.15 pieces or fruit per student, when compared to baseline was unchanged.

In addition, further analysis of data found that students in the intervention school picked up more pieces of fruit during the vermicomposting (M 16.5, p<0.001, n=62) and vermicomposting + sticker (M 19.1, p=0.001, n=63) when compared to baseline. When compared to the control school, students at the intervention school picked up 91.27 more pieces of fruit (p=0.003) during the vermicomposting stage and 101.5 more pieces of fruit (p=0.01) during the vermicomposting + sticker stage. Regardless of whether or not students consumed the picked up fruit, this finding is encouraging, as it indicates that students may have been more open to the idea of fruit consumption. Over time, this greater acceptance of fruit may lead to greater consumption.

Utilizing Environmental Responsibility as a Catalyst for Behavior Change

Though the methods of this pilot study are unique, this study adds to the growing body of literature aimed at increasing children's consumption of wholesome foods, specifically fruits and vegetables. This study only focused on increasing fruit consumption; however, it has opened the door to a new frame of thinking about improving children's nutrition. Many studies have focused on improving nutrition through educational initiatives (Howertown, et al, 2007;

Matvienko, 2007), but nutrition knowledge may not be enough to support sustained behavior change.

This study utilized a broader concept than standard nutrition education in an attempt to illicit a behavior change in students in regards to the increased consumption of whole fruit. Students were introduced to composting with worms, a concept encouraging environmental responsibility. No school curriculum was utilized to teach students more about this concept, but students were introduced to the idea that the worms create a better environment for food to grow. They were also reminded every day of the study that they were receiving the opportunity to feed the worms. When first introduced to the vermicomposting bin, students were eager to take part in the initiative, and that feeling seemed to continue throughout the duration of the study. In fact, on the last day of the study, one student shared a piece of artwork with the PI that she had created featuring an illustrated worm and the message: "Feed the worms. Save the plants" (Appendix G). With research showing environmental stimulus to be a strong motivator of behavior change (McAlesse, et al, 2007; Ojala, 2008; Parmer, et al, 2008), studies such as this one indicate that children can be motivated to change food consumption habits regardless of prior knowledge of nutrition principles.

Garden education initiatives are research-supported to increase nutrition knowledge and student consumption of fresh fruits and vegetables (McAleese, et al, 2007; Parmer, et al, 2008; Blair, 2009). While some schools have the ability to implement a full range garden-to-table education curriculum, others are hindered by issues such as location, funding, and community support. Vermicomposting as a means to improve nutrition status may provide schools the opportunity to open the door to further garden education initiatives. The bin can serve as a visual

cue for behavior modification in the lunch room as well as a learning tool within the classroom and even provide the base components necessary to sustain a school garden.

Cost Effective Interventions to Increase Fruit Consumption

Using the concept of behavioral economics, one researcher in particular, Brain Wansink, has focused on modifying food consumption behaviors in uncommon ways to illicit a self-driven healthier diet in children. In a 2012 study in which children were given the choice between a cookie or an apple at lunchtime, children nearly doubled their choice of the apple after it was branded with a sticker of a well-known cartoon character (Wansink, et al, 2012). Interventions to improve nutrition, according to Wansink, should promote the guiding of choice in a way that is subtle enough that children are unaware of the mechanism (Just & Wansink, 2009). This study of vermicomposting in the school lunchroom utilized Wansink's behavioral modification methods by providing a visual cue in the form of a sticker to promote students' choice to eat more fruit. This study did not utilize stickers as the primary intervention component, but rather as a secondary stimulus.

The primary behavioral stimulus, feeding worms so they produce compost, provided a more sustainable and cost effective (after initial investment) way to improve student nutrition. The budget for this study included materials to build a vermicomposting bin from scratch as well as order the compostable stickers from a private company. For the purpose of this study, the cost of the compostable stickers was approximately four times the cost of the materials to create one vermicomposting bin, including the worms. With proper care and maintenance, a well-built vermicomposting bin can be sustained for years, indicating higher cost effectiveness than purchasing and using stickers as a means to increase fruit consumption.

Findings from this study found that the vermicomposting bin alone elicited a significant increase in fruit consumption at the intervention school when compared to baseline and to the control school. Adding stickers as a visual cue in conjunction with the vermicomposting bin resulted in a significant increase in fruit consumption per grade (M 9.29, $p< 0.001$, n=63) and at the school level (M 55.75, $p<0.001$, n=378), or approximately 0.15 pieces or fruit per student, when compared to baseline. This finding should be encouraging for public schools offering National School Lunch Program, as financial hardships and budget cuts are common in this setting. Based on the findings of this study, schools choosing to implement this intervention with or without the sticker component should be able to expect positive results in the form of increased fruit consumption.

In addition to the cost effectiveness of this intervention, schools implementing a vermicomposting intervention can also expect to reduce the amount of food waste generated in the lunch room (Cambridge, 2012; Portland, 2015). One school system in California, after implementing a composting initiative in two schools, generated a gross savings of over $6000 in disposal fees for the year. Within three more schools years, the program had become totally self-sustaining, been updated and expanded into every school in the system (Graham, et al, 2004). Schools that wish to implement vermicomposting as a means to improve nutrient dense food consumption may benefit by saving money, but vermicomposting also offers the possibility of creating a new source of revenue for schools. Worm castings are a highly valued soil additive, allowing schools the opportunity to package and sell the product produced by their worms, or use in school-based gardening projects.

Practical Applications for the School Lunchroom

Findings from this study provide practical application for the school lunch room setting, with one of the most interesting findings dealing with student preference. Over the five weeks that this study took place, student fruit consumption was observed during nine lunch periods. Of those nine lunch periods, eight of them offered apples or oranges as the whole fruit choice with the National School Lunch Program meal. Average consumption of whole fruit in the intervention school (≥ 50%) on days when apples and oranges were served ranged from 52.7% – 63.9%. On the one day that bananas were served, 86.8% of bananas picked up in the intervention school were eaten. This indicates that student preference may play a large part in consumption of whole fruit in the school lunch room.

According to the Economic Research Service of the United States Department of Agriculture, bananas were the most commonly consumed fruit in the United States in 2010. Apples were the second most common fruit, followed by watermelon, grapes, strawberries, oranges, and peaches. Comparatively, the top three most commonly consumed fruits in the United States in 1970 were apples, bananas, and oranges, respectively (ERS, 2012). Changing the school lunch menu to reflect these changes in preferences may result in an increase in the consumption of wholesome foods during the school day. For schools that may not have the ability to purchase fruits that are most preferred by students, programs like the Fresh Fruit and Vegetable Program sponsored by the USDA allow the ability to offer new types of fruits and vegetables as snacks during the school day.

Another practical application for the school lunch room that can be made from these findings is that student behavior is impacted by visual cues in the lunchroom. The vermicomposting bin served as a visual cue each day of the study, and the stickers served as a

cue during the final stage of the study. Both resulted in an increase in fruit consumption in the intervention school lunch room. Other visual cues in the lunch room such as colorful posters displaying the benefits of fresh fruit consumption or showing a variety of new and unfamiliar foods that could be served within the school may also help to improve student nutrition. In addition, visual cues delineating garden-to-table ideals may also be utilized effectively within the lunchroom.

A vermicomposting bin in the lunch room can have a positive influence on increased fruit consumption, but it may also serve as a positive influence for increased consumption of other nutrient dense foods, as both fruits and vegetables can be utilized in the bin. However, a combination of approaches, specifically targeting student preference while implementing appropriate visual cues, may further serve as a powerful approach to supporting the increased consumption of other nutrient dense foods by students. For schools looking to support better nutrition for students, the placement of a vermicomposting bin within the lunch room can serve as an effective tool as well as a foundation for future endeavors. More research on the impact of the combination approach should be conducted in order to test this assumption.

Summary

This study found that using a vermicomposting bin as a means to promote fruit consumption within the elementary school lunch room can be fun activity with a powerful ability to elicit behavior change in regards to the increased consumption of whole fruit. Within the school lunch room setting, a vermicomposting bin can serve as both as a visual cue and an environmental stimulus, two concepts that have been shown to have a positive impact on behavior change. In addition, it serves as a cost effective, virtually self-sustaining educational tool for students, and it provides the possibility of added revenue for schools that may be in too

much of a financial hardship to seek out other means to improve nutrition. This study also provided practical application for the school lunch room concerning student fruit preference and the importance of visual cues in the lunch room to promote behavior change. Utilizing a combination of these strategies within the school lunch room may even lead to an increase in nutrient dense food consumption beyond what was considered in this study.

CHAPTER 6

CONCLUSIONS, LIMITATIONS AND RECOMMENDATIONS

The purpose of this quasi-experimental quantitative study was to measure the ability of an interactive vermicomposting model as a visual cue and environmental stimulus to promote behavior change in elementary school children in regards to the increased consumption of whole fruit. This chapter will present a brief summary of the results of this study and discuss the implications of its findings within the school lunch room environment. It will also present the limitations of this study and provide recommendations for future researchers wishing to expand the body of knowledge surrounding this topic.

Study Results

Results from this pilot study indicate that the introduction of an interactive vermicomposting model may be a beneficial, cost effective approach to increasing fruit consumption in the elementary school lunch room. During this study, the placement of an interactive vermicomposting model in a school lunch room to a significant increase in whole fruit consumption (M 12.03, $p<0.001$, $n=62$) per grade by elementary school children. Even after controlling for the effect of greater consumption due to banana preference, a significant increase in fruit consumption (M 8.58, $p<0.005$, $n=62$) was still seen at the grade level and at the whole school level (M 51.5, $p<0.005$, $n=378$), or approximately 0.14 pieces of fruit per student, when

compared to baseline. With the addition of a visual aid in the form of a sticker placed on the fruit, an even further increase in fruit consumption (M 9.29, $p< 0.001$, n=63) at the grade level and at the school level (M 55.75, $p<0.001$, n=378), or approximately 0.15 pieces or fruit per student, when compared to baseline. The increase was not significant (M 0.71, p=0.617, n=63) when compared to the effect of the vermicomposting model alone. Another finding of this study was that students in the intervention school picked up more pieces of fruit (M 16.5, $p<0.001$, n=62) per grade during the vermicomposting stage when compared to baseline. With the addition of a visual aid in the form of a sticker placed on the fruit, an even further increase (M 19.1, p=0.001, n=63) in pieces of fruit picked up per grade by students was seen when compared to baseline. When compared to the control school, students at the intervention school picked up 91.27 more pieces of fruit (p=0.003) during the vermicomposting stage and 101.5 more pieces of fruit (p=0.01) during the vermicomposting + sticker stage.

Implications on the Health of Students

This study found that vermicomposting in the school lunch room has the potential to significantly increase fruit consumption in children. Currently, many school children are not meeting the recommended intake for fruits and vegetables. Consequently, they are also not meeting the guidelines for dietary fiber and potassium, two nutrients found prevalently in these food groups. Research supports the idea that eating a diet high in fruits and vegetables is associated with the decreased risk of certain chronic diseases, such as coronary heart disease and cardiovascular disease (Hung, et al, 2004 Bazzano, 2006; Dauchet, et al, 2009; AND, 2014), as well as hypertension, type 2 diabetes mellitus, and some cancers (Moore, et al, 2005; Kampman, 2007; Nuñez-Córdoba, et al, 2008).

Research also shows that nutrient dense foods, such as whole fruit, provide positive health benefits at relatively low calorie levels compared to some canned fruits that are packaged in light to heavy syrup and may contribute to excess caloric intake (USDA, DHHS, 2010).When replacing high-fat foods, increased fruit and vegetable intake can also lead to better weight control and a decreased risk of overweight and obesity in children (USDA, DHHS, 2010). Physical and psychological consequences related to overweight and obesity are extensive, including impaired academic performance (Story, et al, 2006; Datar, et al, 2004) and increased absenteeism (Pan, et al, 2013). Overweight and obese children are often subject to bullying, teasing, and negative self-image (Janssen, et al, 2004; van Geel, et al, 2014). The findings from this study should encourage schools to adopt a vermicomposting bin as a cost-effective and sustainable means to increase fruit consumption, a measure that may help to play a role in decreasing obesity and its complications in American school children.

Implications on Sustainability within the School Setting

For many schools, implications of this study within the lunch room may extend far beyond the walls of the cafeteria. This study placed a focus on instilling a sense of environmental responsibility within students, which would then result in an increase of fruit consumption. However, for the purpose of this study, students only heard about the positive environmental effects of a vermicomposting bin from the researchers within the cafeteria setting. Future studies may see an even greater impact on fruit consumption if an increased emphasis is placed on teaching students the environmental concepts surrounding the vermicomposting bin prior to its placement in the cafeteria. Not only would students benefit from the increased fruit consumption, they would also be learning important concepts of stewardship and sustainability that may be overlooked in the current school curriculum.

Vermicomposting is just one piece of a vast garden-based curriculum that has already proved effective in supporting life-long healthy eating habits in children (Graham, et al, 2004). Utilizing the principles of this study as a stepping stone, schools may find success in the development or enhancement of a school garden. They may also be able to implement immersive learning opportunities in which students can become more familiar with the origin of their food by visiting food farms and industries. By seeing the impact their actions in the lunch room have on the environment, students have the opportunity to gain a better understanding of sustainability principles, both now and in the future.

Schools can also benefit from this sustainability mind-frame. With immense pressure from the government to provide lunches that meet the new lunch program standards, schools today may be faced with more financial burdens than in the past. Sustainability efforts, such as those associated with vermicomposting, have the potential to save schools money by reducing the amount of plate waste, thus reducing the cost of waste disposal. In addition, schools have the opportunity to make money from vermicomposting, as worm casting are a highly valued soil additive, beneficial to farmers and gardeners on all scales. To add to the intrinsic benefits of a more sustainable school system, schools practicing sustainability efforts such as these are eligible for large amounts of funding in the form of grants to continue and improve their efforts.

Though this study was only performed during a five week period, findings indicate that garden education initiatives, specifically vermicomposting, have the ability to lead to an increase in fresh fruit consumption in children. Based on these findings, schools may be able to save money by implementing policies at a local level to purchase more fresh fruit in bulk rather than purchasing canned or packaged fruit (Stewart, et al, 2011). Policy changes at the local level may lead to stronger partnerships between schools and local farmers in an effort to further

sustainability efforts. Local policy changes then have the ability to influence policy at the state level, leading to improvements in sustainability efforts at a much larger scale.

Limitations and Recommendations

This pilot study provides valuable insight into the potential effects of vermicomposting on fruit consumption in the elementary school lunch room, but there are some limitations to be considered. All research assistants who took part in this study were nutrition students at the graduate or undergraduate level. With this in mind, nutrition students are likely to be eager to see positive impact of nutrition interventions, and it is possible that bias could have led to a more inclusive or optimistic idea of how much fruit was consumed by students during the intervention. In addition, the PI of this study also participated in data collection, so unintentional bias could have occurred. Another limitation of this study was that data were collected using observation and on-site data sheets within a narrow time window. Future studies of this nature may wish to consider taking pictures of the plate waste or weighing the fruit to possibly get a more accurate measure of fruit consumption by students. Additionally, this study utilized five different researchers to observe fruit consumption within the schools. While researchers were given visual guidelines to follow and attempted to be as consistent throughout the study, it is possible that differing perceptions could have had an impact on the data collection.

Another limitation of this study was the short time frame of five weeks for data collection. Due to the harsh weather and frequent school delays and cancellations that tend to occur in the area of the schools during the winter, this study was performed in the spring. It also took place between two windows of standardized testing at the school. During these testing windows, schedules are frequently changed to accommodate the tests, and students do not eat lunch at consistent times, thus making it very difficult to perform a study of this nature. Working

in the school system can be difficult. Schedules may change without notices, and research studies are not a priority for even the most accommodating faculty and staff. For this reason, communication with the school leadership should begin long before the implementation of the study.

A recommendation for future researchers who wish to implement a similar study would be to work with the principal or school administration well before the start date to set up a longer window for data collection. Allowing for more observation days will allow for a better look at the impact of the intervention and help to minimize the effect of unforeseen circumstances. This study, for example, was originally planned to allow for ten days of observation, two days per week of the study. However, on one day during the vermicomposting stage of the study, the food delivery truck did not arrive on time to deliver the fresh fruit. Fresh fruit was on the menu, but students were served canned fruit, and researchers were unable to collect data. Another recommendation for future researchers is to plan a follow up to see if any changes in fruit consumption patterns are still in effect beyond the time frame of the initial intervention. Seasonal changes in preference may result in implicit changes in fruit consumption that could not be seen during the five weeks of this study. This study did not plan for a follow up, thus the future impact of the vermicomposting model is unknown. Further research should be performed to determine the longevity of its effect on student fruit consumption.

Further recommendations to future researchers would include having a researcher count the amount of fruit that is present before and after students have gone through the lunch line to determine a true value of how much fruit is picked up by students. This may provide a more accurate count rather than relying on the researchers' observations of student trays. A final recommendation for future researchers would be to implement a study design that distinguishes

between completely unconsumed fruit and partially consumed fruit. Researchers for this study only reported whether fruit was "consumed" (≥ 50%) or "not consumed (< 50%). Stronger results would likely have been seen if the categories were to have been changed to "consumed" (≥ 50%), "partially consumed" (1% - 49%) and "not consumed (0% or no bites taken). Throughout the course of the five week study, multiple students commented that they had taken a couple of bites "for the worms" when they normally would not have taken any at all. However, based on pre-determined data collection methods, the fruit from these students was still marked as "not consumed" category.

Summary

In summary, the results from this pilot study show that a vermicomposting bin in the elementary school lunch room can be successful as a visual cue and environmental stimulus to promote behavior change in regards to the increased consumption of whole fruit. This study serves to open the door to a vast array of garden-focused, interactive education initiatives that have been proven to support life-long healthy eating habits in children. In addition, school systems may also benefit from implementing policies to support vermicomposting and other sustainability measures within the school setting. Further research should be conducted in the area of vermicomposting and other garden-based initiatives as means to support good health in school children and promote sustainability of school systems.

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APPENDIX A

INSTITUTIONAL REVIEW BOARD DOCUMENTS

A-1 LETTER FROM BALL STATE IRB

A-2 CITI CERTIFICATES OF COMPLETION

Appendix A-1- Letter from Ball State IRB

Office of Research Integrity
Institutional Review Board (IRB)
2000 University Avenue
Muncie, IN 47306-0155
Phone: 765-285-5070

DATE:	January 28, 2015
TO:	Kayla Stanton, B.S.
FROM:	Ball State University IRB
RE:	IRB protocol # 658262-1
TITLE:	The Effect of Vermicomposting on Fruit Consumption in the Elementary School Lunch Room
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
DECISION DATE:	January 28, 2015
EXPIRATION DATE:	January 27, 2017
REVIEW TYPE:	**Expedited:** This protocol had been determined by the board to meet the definition of minimal risk.

The Institutional Review Board has approved your New Project for the above protocol, effective January 28, 2015 through January 27, 2017. All research under this protocol must be conducted in accordance with the approved submission and in accordance with the principles of the Belmont Report.

Appendix A-2 – CITI Certificates of Completion

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI)

SOCIAL & BEHAVIORAL RESEARCH - BASIC/REFRESHER CURRICULUM COMPLETION REPORT

Printed on 09/17/2013

LEARNER	Kayla Stanton (ID: 2774019)
DEPARTMENT	Dietetics
EMAIL	kmpickersgil@bsu.edu
INSTITUTION	Ball State University
EXPIRATION DATE	09/16/2016

SOCIAL & BEHAVIORAL RESEARCH - BASIC/REFRESHER : Choose this group to satisfy CITI training requirements for investigators and staff involved primarily in Social/Behavioral Research with human subjects.

COURSE/STAGE:	Basic Course/1
PASSED ON:	09/17/2013
REFERENCE ID:	7694254

REQUIRED MODULES	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction	08/26/13	3/3 (100%)
Students in Research	04/27/12	8/10 (80%)
History and Ethical Principles - SBE	08/29/13	5/5 (100%)
Defining Research with Human Subjects - SBE	08/29/13	5/5 (100%)
The Regulations - SBE	09/10/13	5/5 (100%)
Assessing Risk - SBE	09/10/13	5/5 (100%)
Informed Consent - SBE	09/10/13	5/5 (100%)
Privacy and Confidentiality - SBE	09/10/13	5/5 (100%)
Research with Prisoners - SBE	09/10/13	4/4 (100%)
Research with Children - SBE	09/10/13	4/4 (100%)
Research in Public Elementary and Secondary Schools - SBE	09/10/13	4/4 (100%)
International Research - SBE	09/17/13	3/3 (100%)
Internet Research - SBE	09/17/13	5/5 (100%)
Research and HIPAA Privacy Protections	09/17/13	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees	09/17/13	4/4 (100%)
Conflicts of Interest in Research Involving Human Subjects	09/17/13	5/5 (100%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research	09/17/13	3/3 (100%)
Ball State University	03/26/12	No Quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI Program participating institution or be a paid independent Learner. Falsified information and unauthorized use of the CITI Progam course site is unethical, and may be considered research misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Program Course Coordinator

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI)

SOCIAL & BEHAVIORAL RESEARCH - BASIC/REFRESHER CURRICULUM COMPLETION REPORT

Printed on 08/18/2014

LEARNER	[redacted] D: 4274063)
DEPARTMENT	[redacted] er Sciences
EMAIL	[redacted]
INSTITUTION	Ball State University
EXPIRATION DATE	08/15/2017

SOCIAL & BEHAVIORAL RESEARCH - BASIC/REFRESHER : Choose this group to satisfy CITI training requirements for investigators and staff involved primarily in Social/Behavioral Research with human subjects.

COURSE/STAGE:	Basic Course/1
PASSED ON:	08/16/2014
REFERENCE ID:	13615498

REQUIRED MODULES	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction	07/31/14	3/3 (100%)
Students in Research	07/31/14	10/10 (100%)
History and Ethical Principles - SBE	08/03/14	5/5 (100%)
Defining Research with Human Subjects - SBE	08/03/14	5/5 (100%)
The Regulations - SBE	08/03/14	5/5 (100%)
Assessing Risk - SBE	08/03/14	5/5 (100%)
Informed Consent - SBE	08/03/14	5/5 (100%)
Privacy and Confidentiality - SBE	08/08/14	5/5 (100%)
Research with Prisoners - SBE	08/08/14	4/4 (100%)
Research with Children - SBE	08/08/14	4/4 (100%)
Research in Public Elementary and Secondary Schools - SBE	08/08/14	4/4 (100%)
International Research - SBE	08/08/14	3/3 (100%)
Internet Research - SBE	08/16/14	5/5 (100%)
Research and HIPAA Privacy Protections	08/16/14	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees	08/16/14	4/4 (100%)
Conflicts of Interest in Research Involving Human Subjects	08/16/14	5/5 (100%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research	08/16/14	3/3 (100%)
Ball State University	08/16/14	No Quiz

For this Completion Report to be valid, the learner listed above must be affiliated with a CITI Program participating institution or be a paid independent Learner. Falsified information and unauthorized use of the CITI Program course site is unethical, and may be considered research misconduct by your institution.

Paul Braunschweiger Ph.D.
Professor, University of Miami
Director Office of Research Education
CITI Program Course Coordinator

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** [redacted] (ID: 4740997)
- **Email:** [redacted]du
- **Institution Affiliation:** Ball State University (ID: 1568)
- **Institution Unit:** FCFS

- **Curriculum Group:** Social & Behavioral Research - Basic/Refresher
- **Course Learner Group:** Same as Curriculum Group
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for investigators and staff involved primarily in Social/Behavioral Research with human subjects.

- **Report ID:** 15559684
- **Completion Date:** 03/16/2015
- **Expiration Date:** 03/15/2018
- **Minimum Passing:** 80
- **Reported Score*:** 97

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction	03/16/15	3/3 (100%)
Students in Research	03/16/15	9/10 (90%)
History and Ethical Principles - SBE	03/16/15	5/5 (100%)
Defining Research with Human Subjects - SBE	03/16/15	5/5 (100%)
The Federal Regulations - SBE	03/16/15	5/5 (100%)
Assessing Risk - SBE	03/16/15	5/5 (100%)
Informed Consent - SBE	03/16/15	5/5 (100%)
Privacy and Confidentiality - SBE	03/16/15	5/5 (100%)
Research with Prisoners - SBE	03/16/15	5/5 (100%)
Research with Children - SBE	03/16/15	4/5 (80%)
Research in Public Elementary and Secondary Schools - SBE	03/16/15	5/5 (100%)
International Research - SBE	03/16/15	5/5 (100%)
Internet-Based Research - SBE	03/16/15	5/5 (100%)
Research and HIPAA Privacy Protections	03/16/15	5/5 (100%)
Vulnerable Subjects - Research Involving Workers/Employees	03/16/15	4/4 (100%)
Conflicts of Interest in Research Involving Human Subjects	03/16/15	4/5 (80%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research	03/16/15	5/5 (100%)
Ball State University	03/16/15	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

CITI Program
Email: citisupport@miami.edu
Phone: 305-243-7970
Web: https://www.citiprogram.org

COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** [redacted] (ID: 4740719)
- **Email:**
- **Institution Affiliation:** Ball State University (ID: 1568)
- **Institution Unit:** Dietetics

- **Curriculum Group:** Social & Behavioral Research - Basic/Refresher
- **Course Learner Group:** Same as Curriculum Group
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for investigators and staff involved primarily in Social/Behavioral Research with human subjects.

- **Report ID:** 15556624
- **Completion Date:** 03/16/2015
- **Expiration Date:** 03/15/2018
- **Minimum Passing:** 80
- **Reported Score*:** 84

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction	03/15/15	3/3 (100%)
Students in Research	03/16/15	9/10 (90%)
History and Ethical Principles - SBE	03/16/15	5/5 (100%)
Defining Research with Human Subjects - SBE	03/16/15	4/5 (80%)
The Federal Regulations - SBE	03/16/15	5/5 (100%)
Assessing Risk - SBE	03/16/15	5/5 (100%)
Informed Consent - SBE	03/16/15	5/5 (100%)
Privacy and Confidentiality - SBE	03/16/15	5/5 (100%)
Research with Prisoners - SBE	03/16/15	3/5 (60%)
Research with Children - SBE	03/16/15	3/5 (60%)
Research in Public Elementary and Secondary Schools - SBE	03/16/15	5/5 (100%)
International Research - SBE	03/16/15	2/5 (40%)
Internet-Based Research - SBE	03/16/15	4/5 (80%)
Research and HIPAA Privacy Protections	03/16/15	3/5 (60%)
Vulnerable Subjects - Research Involving Workers/Employees	03/16/15	4/4 (100%)
Conflicts of Interest in Research Involving Human Subjects	03/16/15	4/5 (80%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research	03/16/15	4/5 (80%)
Ball State University	03/16/15	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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COLLABORATIVE INSTITUTIONAL TRAINING INITIATIVE (CITI PROGRAM)

COURSEWORK REQUIREMENTS REPORT*

* NOTE: Scores on this Requirements Report reflect quiz completions at the time all requirements for the course were met. See list below for details. See separate Transcript Report for more recent quiz scores, including those on optional (supplemental) course elements.

- **Name:** [redacted] (ID: 4324932)
- **Email:** [redacted]edu
- **Institution Affiliation:** Ball State University (ID: 1568)
- **Institution Unit:** Family and Consumer Sciences

- **Curriculum Group:** Social & Behavioral Research - Basic/Refresher
- **Course Learner Group:** Same as Curriculum Group
- **Stage:** Stage 1 - Basic Course
- **Description:** Choose this group to satisfy CITI training requirements for investigators and staff involved primarily in Social/Behavioral Research with human subjects.

- **Report ID:** 13629244
- **Completion Date:** 09/11/2014
- **Expiration Date:** 09/10/2017
- **Minimum Passing:** 80
- **Reported Score*:** 84

REQUIRED AND ELECTIVE MODULES ONLY	DATE COMPLETED	SCORE
Belmont Report and CITI Course Introduction (ID:1127)	08/26/14	3/3 (100%)
Students in Research (ID:1321)	08/26/14	8/10 (80%)
History and Ethical Principles - SBE (ID:490)	08/26/14	4/5 (80%)
Defining Research with Human Subjects - SBE (ID:491)	08/29/14	5/5 (100%)
The Federal Regulations - SBE (ID:502)	08/29/14	4/5 (80%)
Assessing Risk - SBE (ID:503)	08/29/14	4/5 (80%)
Informed Consent - SBE (ID:504)	09/04/14	5/5 (100%)
Privacy and Confidentiality - SBE (ID:505)	09/04/14	4/5 (80%)
Research with Prisoners - SBE (ID:506)	09/04/14	4/4 (100%)
Research with Children - SBE (ID:507)	09/05/14	2/4 (50%)
Research in Public Elementary and Secondary Schools - SBE (ID:508)	09/09/14	4/4 (100%)
International Research - SBE (ID:509)	09/09/14	3/3 (100%)
Internet-Based Research - SBE (ID:510)	09/09/14	4/5 (80%)
Research and HIPAA Privacy Protections (ID:14)	09/11/14	4/5 (80%)
Vulnerable Subjects - Research Involving Workers/Employees (ID:483)	09/11/14	4/4 (100%)
Conflicts of Interest in Research Involving Human Subjects (ID:488)	09/11/14	3/5 (60%)
Unanticipated Problems and Reporting Requirements in Social and Behavioral Research (ID:14928)	09/11/14	2/3 (67%)
Ball State University (ID:13475)	09/11/14	No Quiz

For this Report to be valid, the learner identified above must have had a valid affiliation with the CITI Program subscribing institution identified above or have been a paid Independent Learner.

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APPENDIX B

LETTERS OF SUPPORT

B-1 CONTROL SCHOOL LETTER OF SUPPORT

B-2 INTERVENTION SCHOOL LETTER OF SUPPORT

Appendix B-1 – Control School Letter of Support

[redacted]

September 30, 2014

To whom it may concern:

I am writing to express my support for a project that I believe will open the doors to a new perspective of well-being for children within the [redacted]. This research project, conducted by Kayla Stanton, B.S., aims to improve nutritious food consumption in elementary school children through the promotion of vermicomposting as a way to improve the world around them and directly influence the food they eat, thus indirectly promoting the consumption of fresh, whole fruit.

First through fifth grade students will be introduced to the concept of composting by learning its purpose in the farm-to-table ideal. They will then be given the opportunity to feed the cores/peels of consumed fresh, whole fruit to vermicomposting bin with the use of an illustrated worm as a guide through the process.

Not only is this project a fun opportunity for students, it also promotes a sense of citizenship by focusing the attention on taking care of the earth. As the majority of nutrition education tends to focus on learning lists of good food versus bad food, this novel approach to improving the health of children is something to be embraced.

I am excited at the potential for my school's involvement as the control school for this project, and I ask that you help to support it as we venture with Ball State students and faculty to open this new door to improving the health and well-being of the children in the [redacted]

Thank you for your consideration of our request.

Sincerely,

[redacted]

Dea Young
Principal

[redacted]

Appendix B-2 - Intervention School Letter of Support

[redacted]

[redacted]

July 25, 2014

To whom it may concern:

I am writing to express my support for a project that I believe will open the doors to a new perspective of well-being for at-risk children within the [redacted] This project aims to improve nutritious food consumption in elementary schoolchildren through the promotion of vermicomposting as a way to improve the world around them and directly influence the food they eat, thus indirectly promoting the consumption of fresh, whole fruit.

First through fifth grade students will be introduced to the concept of composting by learning its purpose in the farm-to-table ideal. They will then be given the opportunity to feed the cores/peels of consumed fresh, whole fruit to a Lucite vermicomposting bin with the use of an illustrated worm as a guide through the process.

Not only is this project a fun opportunity for students, it also promotes a sense of citizenship by focusing the attention on taking care of the earth. In addition, by using the compost in a near-by garden already visited by classrooms in the school, this project will give students the ability to take pride and ownership in building the local community, while reaping the health benefits of a more nutritious diet. As the majority of nutrition education tends to focus on learning lists of good food versus bad food, this novel approach to improving the health of children is something to be embraced.

I and a number of faculty are excited at the potential for my school's involvement with this project, and I ask that you help to support it as we venture with Ball State students and faculty to open this new door to improving the health and well-being of the children in the [redacted]

Thank you for the consideration of our request.

Sincerely,

[redacted]

Kara Miller
Principal

[redacted]

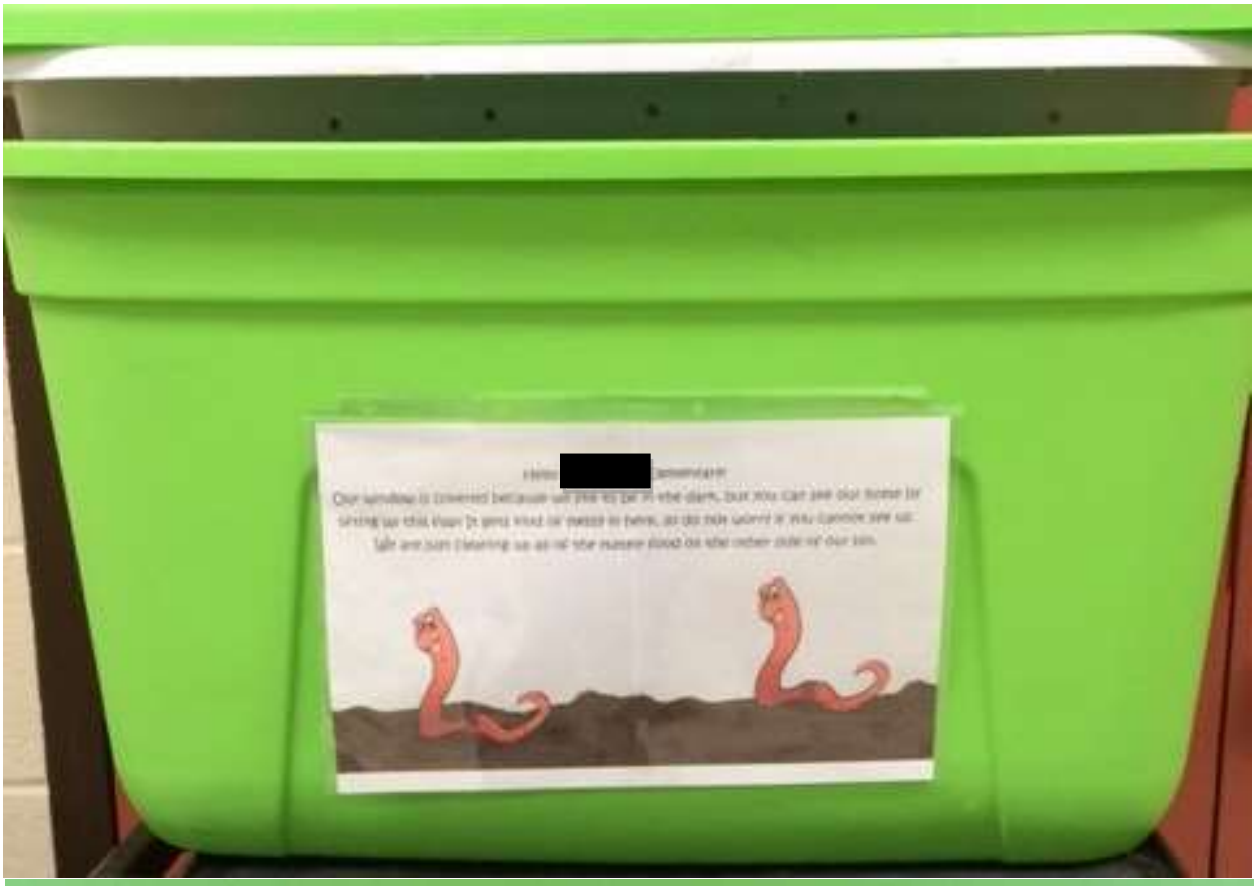
APPENDIX C

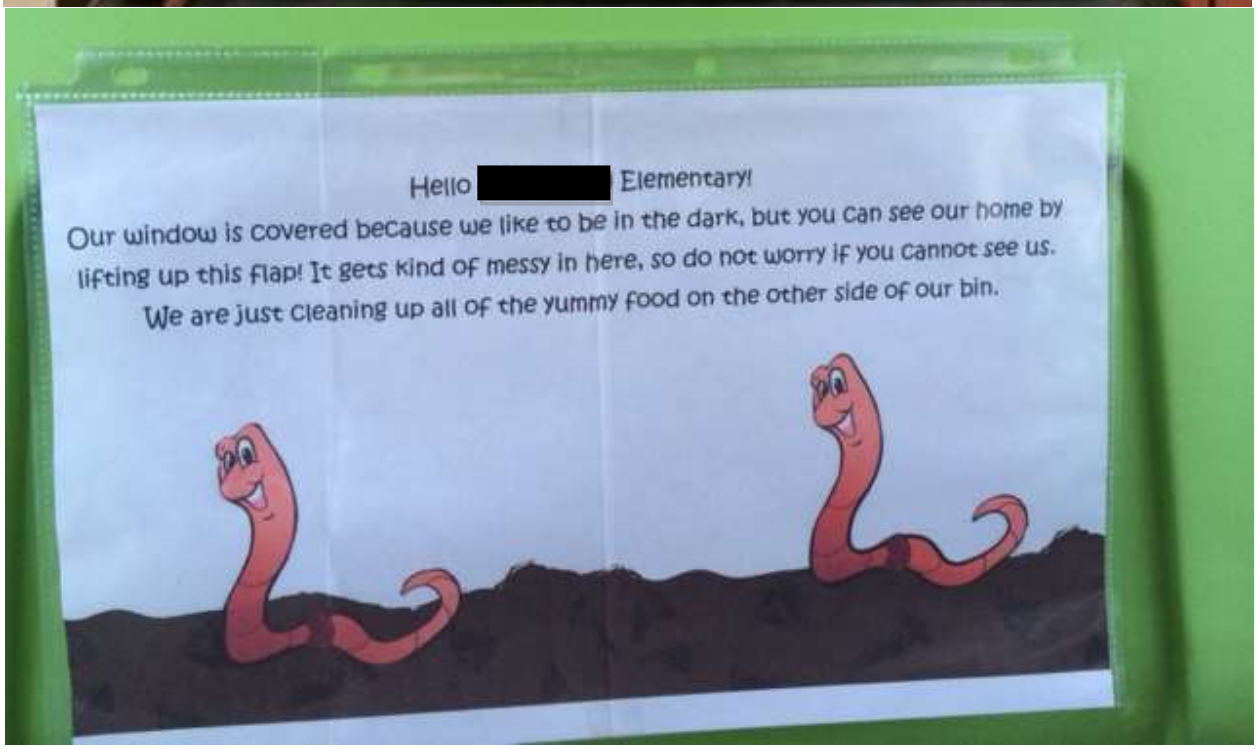
VERMICOMPOSTING MATERIALS

C-1 VERMICOMPOSTING BIN AND SIGN

C-2 “WORM FOOD” COLLECTION BIN AND SIGN

Appendix C-1 – Vermicomposting Bin and Sign





Appendix C-2 – “Worm Food” Collection Bin and Sign

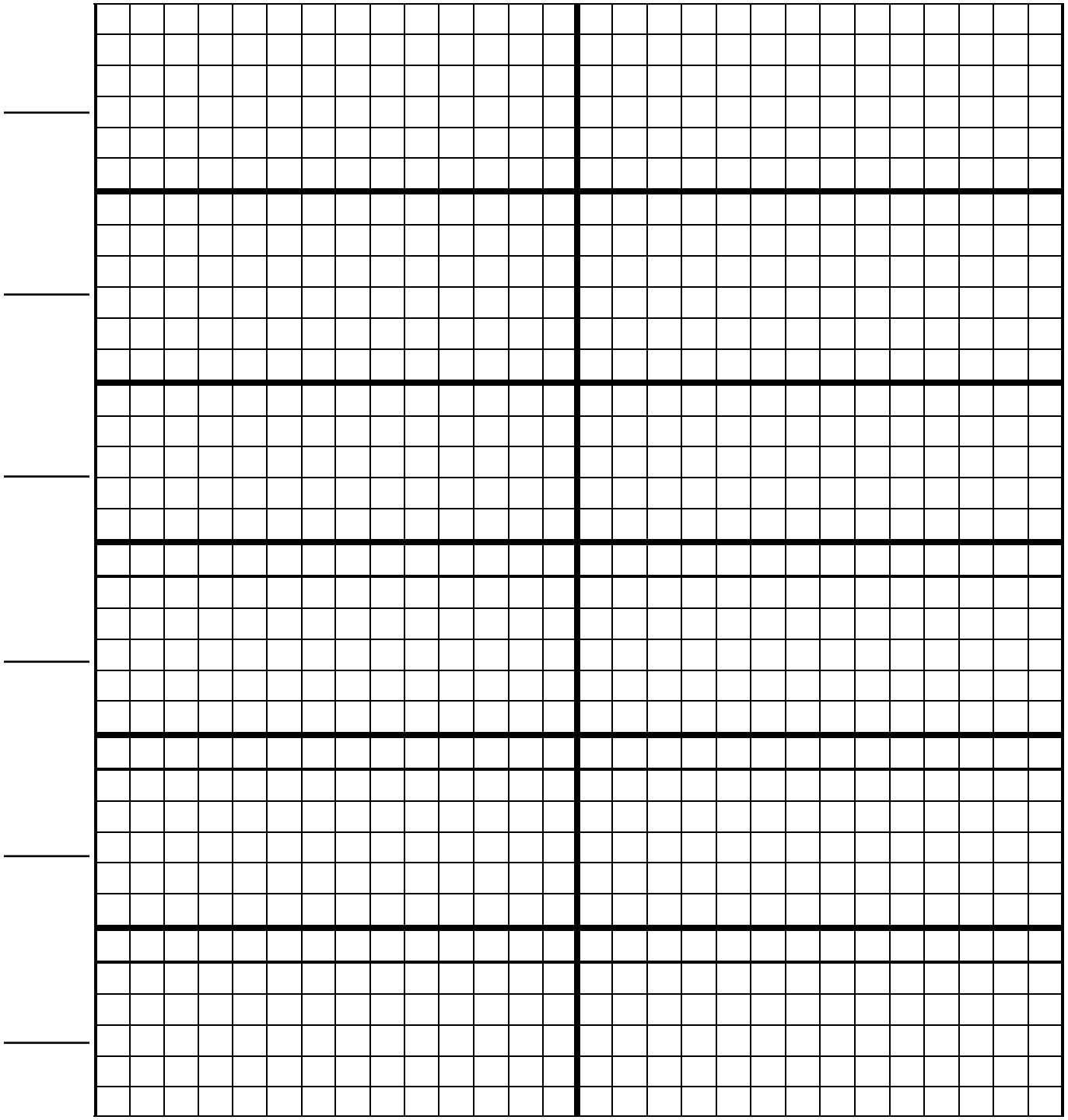
APPENDIX D

FRUIT CONSUMPTION DATA COLLECTION SHEET AND DIAGRAMS

Appendix D – Fruit Consumption Data Collection Sheet and Diagrams

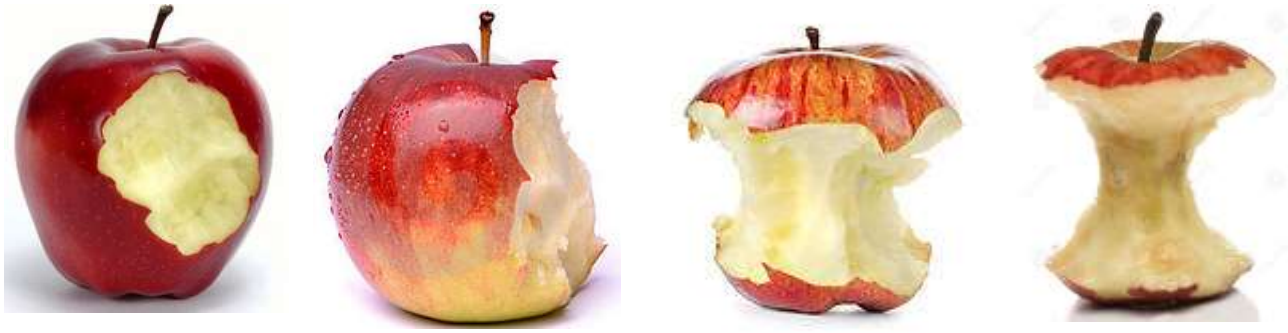
Day _____Fruit Served_____ Assistant name _____ Int. or Cont

Non-Consumed (< 50%) Fully Consumed (≥ 50%)

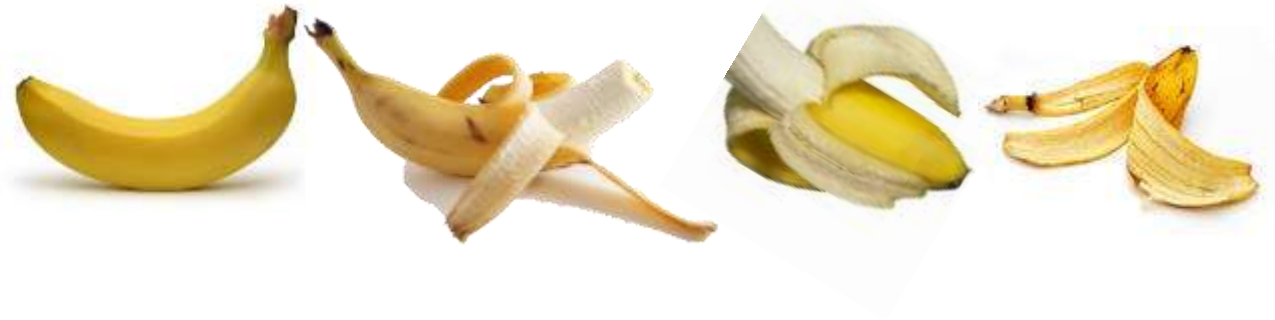


Place "x" for fruit of the day or other appropriate letter in the appropriate box that corresponds with the fruit that was disposed by the student eating fruit other than school lunch.

< 50 / ≥ 50%



< 50 / ≥ 50%



< 50 / ≥ 50%

APPENDIX E

SCRIPTED MESSAGES TO STUDENTS

Appendix E-1 Description of Vermicomposting in Lunchroom

Good morning! I want to tell you about something new that we are going to start doing at lunch time for the next few weeks. We are going to feed worms! Vermicomposting is a big word that means using special worms to turn food waste into nutrient-rich soil. Worms eat food waste and produce compost, a substance that helps plants in the garden grow better. Worm poop is the best compost, because it is full of beneficial nutrients. The fancy name for worm poop is "worm castings." When worm castings are put in the garden and mixed with the soil, plants grow bigger and stronger than they would normally grow.

Worms like to eat food, but they do not like to eat the same things that you do. You like to eat the apple, but worms like to eat the core. You like to eat the oranges and bananas, and worms like to eat the peel that you usually throw away. We are going to have some worms living in our cafeteria for the next few weeks. We need your help to feed the worms in order to get some worm castings. For the next few weeks, you will be able to put "worm food" that you don't eat into a special bin so that it can be fed to the worms. Worms can eat a lot of things, but we are going to be feeding them what is left-over from our fruit. There will be a window in their home, so you can see and say hi to the worms when you are in the lunchroom, but do not try to open or move the box. It could hurt the worms. Thank you!

Appendix E-2 – Verbal Warning Prior to “Worm Food” Collection

Good morning/afternoon [Insert grade level here (i.e. Fifth graders)]! It is almost time for us to come around and collect your worm food! If you have not finished eating yet, go ahead and finish what you want of your fruit, and we will feed the rest to the worms!

APPENDIX F

WORM STICKERS ON FRUIT

Appendix F – Worm Stickers on Fruit

APPENDIX G

STUDENT ARTWORK

Appendix G– Student Artwork