Seeds of Knowledge: integration of A Garden-Based Science Curriculum at Dr. Pedro Albizu Campos High School, A Youth Connection Charter School

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ABSTRACT

SEEDS OF KNOWLEDGE: INTEGRATION OF A GARDEN-BASED SCIENCE CURRICULUM AT DR. PEDRO ALBIZU CAMPOS HIGH SCHOOL, A YOUTH CONNECTION CHARTER SCHOOL

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Northern Illinois University, 2021
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This engaged scholarship study includes three parts, a grant proposal to redesign the greenhouse at Dr. Pedro Albizu Campos High School into a learning garden and two mixed-method studies. The Costco Charitable Giving grant proposal to redesign the greenhouse is provided as a supplemental document to this dissertation. The two mixed-method studies were designed around a garden-based science curriculum. The first study investigated the effects of the curriculum on students’ attitudes toward science. The second investigated this same curriculum on students’ attitudes toward and consumption of fruits and vegetables.

Paper 1, prepared for Science and Education, utilized the validated Assessment of Attitudes in Science Constructs (AASC-4) survey to evaluate perceptions of the science teacher, self-efficacy for science, fear of failure in the course, value of science, enjoyment of science, motivation toward science, attitudes of friends and peers toward science, and attitudes of family (parents) toward science as pre- and post-tests. Both the gardening and the non-gardening groups completed the surveys and were compared to determine change in attitude toward science. Fifty-one total paired surveys were collected: 40 in the non-garden group and 11 in the gardening group. In addition, the gardening group completed a subjective gardening survey (n=17) and a few students were interviewed (n=3). There were no significant interactions between gardening
vs. non-gardening groups on any of the variables. However, profile plots for value, enjoyment, and motivation showed potential positive results. Subjective data and interviews confirmed this.

Paper 2, prepared for *Health, Education and Behavior*, utilized the Health Beliefs Survey (HBS) and the SPAN (School Physical Activity and Nutrition) Survey for nutrition behavior to evaluate students’ social support, self-regulation, self-efficacy, outcomes expectations, and consumption. Both tools were modified to focus specifically on fruit and vegetable consumption and were provided as both the pre- and post-tests. Forty-nine total paired surveys were collected: 39 in the non-garden group and 10 in the gardening group. Results from the gardening survey and interviews were also considered. The results showed no significant interactions \( p < .05 \) for any variable when comparing gardening to non-gardening groups; however, the group mean for self-efficacy significantly increased from pre-test to post-test. In addition, self-efficacy was a significant predictor of consuming fruits and vegetables. Subjective data and interviews substantiate the importance of self-efficacy for fruit and vegetable consumption.

This research shows promise that a garden-based science curriculum can provide the framework to improve attitudes toward science as well as increase self-efficacy toward consuming fruits and vegetables.

Supplemental File: Grant proposal. Costco Charitable Contribution.pdf
SEEDS OF KNOWLEDGE: INTEGRATION OF A GARDEN-BASED SCIENCE CURRICULUM AT DR. PEDRO ALBIZU CAMPOS HIGH SCHOOL, A YOUTH CONNECTION CHARTER SCHOOL

BY

NANCY PRANGE
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A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE DOCTOR OF PHILOSOPHY

DEPARTMENT OF LEADERSHIP, EDUCATIONAL PSYCHOLOGY AND FOUNDATIONS

Doctoral Director:
Laura Ruth Johnson
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CHAPTER 1

INTRODUCTION AND METHODS

Significance of the Problem

During the past three decades, the United States has witnessed a dramatic increase in the prevalence of overweight and obesity. In 1998, the National Institute of Health (NIH) found that 97 million U.S. adults (55% of the population) were considered obese or overweight (Abelson & Kennedy, 2004). The Surgeon General issued a “Call to Action” on the obesity problem, but it drew a lackluster response (Abelson & Kennedy, 2004) and it is now estimated that over two-thirds of the U.S. population is overweight (Moore et al., 2010). According to the Dietary Guidelines for Americans, physical inactivity, and diets high in fat and low in nutrient-dense foods such as fruits and vegetables, resulting in an energy imbalance, are the most important factors contributing to the increase of overweight and obesity in the United States (Michimi & Wimberly, 2010). While it is true that calories in versus calories expended is the proximal cause of obesity, risk factors for overeating and reasons for underexpenditure need to be considered. What the Guidelines miss is this consideration of the physical and social environments contributing to obesity (Lopez, 2007; Margellos-Anast et al., 2008).
It’s been said that your zip code is more important than your genetic code when it relates to obesity since obesity rates are not randomly distributed across the population (Drewnowski et al., 2007). One factor that may play a role in the risk of obesity is the built environment. *Built environment* refers to the human-made surroundings that provide the setting for human activity, including buildings, parks or green space, sidewalks, streets, and transportation, as well as infrastructure such as water supply and energy networks (Lopez, 2007). Consumption of fresh produce can be dependent on this built environment, reflecting resources that are readily available and those that are not. Evidence suggests that supermarkets are less likely to be found in low-income and non-White neighborhoods (Lopez, 2007). The term *food desert* has been used to describe an area with limited access to affordable, quality produce (Michimi & Wimberly, 2010). Many food desert neighborhoods also have a plethora of fast food and convenience stores. One study by Timmermans et al. (2018) found that, in general, the number of fast food chains was greater in lower income neighborhoods (28.6%) than in higher income neighborhoods (11.5%). Additionally, several studies found a relationship between neighborhood design as it relates to walkability and amount of physical activity and rates of obesity (Frank et al., 2004, Frank et al., 2006; Lopez, 2007).

These multifactorial causes have led to widespread obesity within the United States; however, obesity has most seriously affected children as child obesity rates have grown dramatically from the 1980s to the early 2000s (Ogden et al., 2016). Since 2003-2004, rates have remained high and unchanged, creating a new generation of overweight and obese children and adolescents who may be at greater risk for health problems later in life (Schlosser, 2012). Studies show that obese children tend to miss more school, which may affect academic
performance. Additionally, it is well documented that poor nutrition behaviors are linked with poor academic performance (Ogden et al., 2016).

Neighborhood schools are part of a community’s built environment and it is believed that schools can play an important role in promoting health and preventing childhood obesity. In addition to providing two-thirds of meals and snacks during the school day, current health curriculum standards address nutrition knowledge. Unfortunately, this typically adds up to less than 5 hours per year of classroom nutrition instruction (Story et al., 2009). This is because, as Murimi et al. (2007) found, 65% of educators reported teaching nutrition as a stand-alone topic. However, integrating nutrition education into other subjects, such as science, can increase the time students are exposed to nutrition content while not taking time away from other academic studies (White House Task Force, 2010).

Food and nutrition concepts can be utilized to provide interactive learning and be a vehicle for teaching science content (Perez-Rodrigo & Aranceta, 2003). Food is encountered by children on a daily basis and can provide the scaffolding for deeper science understanding (Duffrin et al., 2010). By being engaged in the learning process, students can make connections between new information and their background knowledge and previous experiences with food (Karchmer-Klien & Layton, 2006). With this in mind, it is imperative that pedagogy provide real-life active learning to increase motivation, engagement, and self-efficacy for science and health (Williams et al., 2018). Garden-based learning combines food, health, and science and provides an opportunity for students to gain confidence in both science and health.

Garden-based learning, or learning gardens, can be a platform to educate students and develop scientific literacy through observation and experimentation, including classifying and
organizing, collecting and interpreting data, and graphing and controlling variables (Blair, 2009; Duffrin et al., 2010). It also gives educators an opportunity to provide students with a tangible context when teaching the importance of healthy food choices (Blair, 2009). Including gardens within the built environment of a school and community may help increase consumption of fresh produce (Lopez, 2007).

Social Cognitive Theory

Albert Bandura developed the social learning theory (SLT) in the 1960s. SLT developed into the social cognitive theory (SCT) in 1986 and proposes that learning occurs in a social context with a reciprocal interaction of the person, environment, and behavior (Bandura, 1991). The distinctive feature of SCT is the emphasis on social influence as well as external and internal social reinforcement. SCT considers the unique way in which individuals acquire and maintain behavior while also considering the social environment in which individuals perform the behavior (Bandura, 1991). The theory considers a person's past experiences, which factor into how a person will behave in the future. These past experiences can shape whether a person will engage in a specific behavior and the reasons why a person may engage in that behavior (Bandura, 1991, 2001).

The goal of SCT is to explain how people regulate their behavior through control and reinforcement and how that behavior can be maintained over time. In the list below, the first five constructs were developed as part of the SLT; the construct of self-efficacy was added when the theory evolved into SCT (Bandura, 2001, 2005).
1. Reciprocal Determinism - This is the central concept of SCT. This refers to the dynamic and reciprocal interaction of person (individual with a set of learned experiences), environment (external social context), and behavior (responses to stimuli to achieve goals).

2. Content - This refers to a person's actual ability to perform a behavior through essential knowledge and skills. To successfully perform a behavior, a person must know what to do and how to do it. People learn from the consequences of their behavior, which also affects the environment in which they live.

3. Outcomes Expectation - This refers to the anticipated consequences of a person's behavior. People anticipate the consequences of their actions before engaging in the behavior, and these anticipated consequences can influence successful completion of the behavior. Expectations derive largely from previous experience. While expectancies also derive from previous experience, expectancies focus on the value that is placed on the outcome and are subjective to the individual.

4. Social Support - This asserts that people can witness and observe a behavior conducted by others and then reproduce those actions. This is often exhibited through "modeling" of behaviors. If individuals see successful demonstration of a behavior, they can also complete the behavior successfully.

5. Self-Regulation - This refers to the internal or external responses to a person's behavior that affect the likelihood of continuing or discontinue the behavior. Reinforcements can be self-initiated or in the environment, and reinforcements can be positive or negative.
This is the construct of SCT that most closely ties to the reciprocal relationship between behavior and environment.

6. **Self-efficacy** - This refers to the level of a person's confidence in his or her ability to successfully perform a behavior. Self-efficacy is influenced by a person's specific capabilities and other individual factors as well as by environmental factors (barriers and facilitators). This theory suggests that self-efficacy beliefs work in conjunction with planned goals, outcome expectations and perceived environmental barriers to influence behaviors (Bandura, 1998). This theory is often used in health promotion and other action-oriented learning. Instead of teachers conveying facts to students, students can create knowledge for themselves through investigation and using real skills and tools to solve problems (Karchmer-Klein & Layton, 2006).

**Engaged Scholarship**

Informing both theory and practice is a challenge for researchers in profession-related disciplines like education. Academics must undertake research relevant to practice and disseminate it so that it has an impact, and practitioners must be aware of relevant research to use in their practice (Shawcross & Ridgman, 2019). Engaged scholarship is an approach designed to bridge the theory-practice divide. It is defined as a participative form of research for obtaining different perspectives of key stakeholders in studying real-world problems (Van de Ven & Johnson, 2006) and is based in positivism, relativism, pragmatism, and realism (Shawcross & Ridgman, 2019).
Engaged scholarship is an umbrella term for several types of related models such as participatory action research (PAR), service learning, community-based action research (CBAR) and collaborative and reciprocal ethnography, to name a few (Johnson, 2017). All these models engage diverse partners who have a shared authority and are committed to improving the lives of (often marginalized) communities through transformative research (Johnson, 2017). This work demands that researchers view communities through an asset perspective to recognize their strengths and the body of knowledge they possess instead of focusing on what they lack (Johnson, 2017). The products of this research are “not limited to research reports and articles, but they might also include curricula, public service announcements, action plans, advocacy efforts, and/or media campaigns” (Johnson, 2017, p. 6).

At the heart of engaged scholarship is praxis, practical knowledge leading to action (Johnson, 2017). This concept is central to several theories and concepts that provide the foundation for engaged scholarship. The *funds of knowledge* concept emphasizes the idea that families and communities are a wealth of knowledge and resources and utilizes the asset perspective of communities (Gonzalez et al., 2005; Johnson, 2017). Critical consciousness is grounded in the theory and pedagogy of Paulo Freire (1970) and includes critical reflection, motivation, and action (Diemer et al., 2016). Freire believed that as marginalized people develop an understanding of their social conditions, they become less constrained and, “in turn, developed the agency and capacity to change these conditions” (Diemer et al., 2016, p. 216).

Situated learning, developed by Lave and Wenger (1991), is a process that occurs through participation in communities of practice (CoP; Johnson, 2017; O’Brien & Battista, 2019). This theory characterizes learning as embedded in everyday activity and is fundamentally social
These concepts and theories can help guide engaged scholarship by allowing the community to play a significant role in research.

Engaged scholarship has been described as a promising research framework that leads to more effective, culturally appropriate, and sustainable community-based programs (Collins et al., 2018; Shawcross & Ridgman, 2019; Van de Ven & Johnson, 2006; Wallerstein & Duran, 2010). This collaborative design involves researchers and community members equally and recognizes the unique strengths that each brings (Collins et al., 2018; Mathiassen, 2017). The emphasis is on a bottom-up approach that takes into consideration community priorities, perspectives, and social norms (Cornwall & Jewkes, 1995; Wallerstein & Duran, 2006). This format allows the community to have a genuine voice in research allowing for practical approaches to be developed and implemented within the community that may increase the likelihood of an intervention’s success (Wallerstein & Duran, 2010). Engaged scholarship is not a specific methodology; instead, the difference lies in the location of power within the research process (Cornwall & Jewkes, 1995). This shift in power allows for bidirectional learning, shared resources, collective decision making, and outcomes that are beneficial to the community (Wallerstein & Duran, 2010).

According to Van de Ven and Johnson (2006), engaged scholarship’s strengths include an improved chance that research will be used in practice, advances both theory and practice, facilitates an understanding of real-world problems, and can be applied to interdisciplinary research. Challenges include maintaining community-researcher relationships, losing of researcher control, and requiring flexibility on both sides. The strengths outweigh the challenges to create knowledge for action (Cronwall & Jewkes, 1995). Engaged scholarship promotes
research being done with participants instead of on participants — enabling the development of solutions to real-world problems (Mathiassen, 2017).

This research through the Engaged Scholarship Initiative is a collaboration with Dr. Pedro Albizu Campos High School (PACHS) to develop a high-quality program that meets the needs of the teachers and students. The collaboration included both science teachers, the principal, and students to fully understand the needs within the school and how best to design the learning garden to meet those requests. It was imperative to understand the perspective of these key stakeholders to fully participate in engaged scholarship.

Community Partners

As early as the 1950s, Puerto Ricans settled in the neighborhoods of Chicago, many migrating directly from Puerto Rico. In the late 1960s, the city government and business leaders developed the “Chicago 21” plan to redevelop low-income minority communities near the downtown (Rinaldo, 2002). Many minorities, including Puerto Ricans, were forced to move to neighborhoods farther west, including Humboldt Park. The built environments of minority communities tend to be underfunded and provide limited resources, leading to issues such as substandard housing, lack of health services, and poorly funded schools (Johnson, 2009). Beginning in the late 1990s, during the housing boom, Humboldt Park became the next target of gentrification. While many praise gentrification for reducing crime, increasing commercial business, and improving city services, these outcomes come at a price as poor and working-class residents are displaced by increased rents and property taxes (Perez, 2001, 2002). In Humboldt
Park, as buildings were torn down and replaced with high-priced condos, property taxes increased 550%, forcing many families to relocate or live in overcrowded conditions (Alicea, 2001; Rinaldo, 2002). In response to this threat of displacement, the Puerto Rican community found support with political leaders and Puerto Rican professionals to initiate the Humboldt Park Empowerment Partnership (HPEP; Flores-Gonzales, 2001). The HPEP fought to keep the rich culture and traditions within the community through their own redevelopment plan (Flores-Gonzales, 2001). This plan included an economic initiative to establish Puerto Rican businesses throughout the community and increase affordable housing. In 1995, city officials and HPEP, in a symbolic gesture to recognize the neighborhood and the Puerto Rican residents’ roots, christened a stretch of Division Street “Paseo Boricua” (Alicea, 2001; Flores-Gonzales, 2001; Johnson, 2009). Two metal Puerto Rican flags arch over the street at each end of the strip.

Today, Humboldt Park’s population is 29% Puerto Rican, 38% Black and 21% White (Areavibes, n.d.). The neighborhood environment is rich with cultural institutions and events; however, issues of poverty such as overcrowding, crime, and the designation as a food desert continue to be seen (Alicea, 2001; Rinaldo, 2002).

Youth Connection Charter School (YCCS) is a not-for-profit educational organization that was founded in 1997 and is the only Illinois charter school consortium specifically intended for at-risk students (https://yccs.us/). According to their website, “YCCS takes a holistic approach to addressing the unique challenges of students with comprehensive programs that seek to break the cycle of underachievement. Research-based strategies, models, and interventions specifically designed to reconnect students and accelerate their progress are elements of the YCCS school design.” The competency-based curriculum is tied to the Illinois Core Standards.
YCCS comprises 19 campuses (including PACHS) that strive to give students a “better chance” by providing a wide range of academic and extra-curricular activities designed to prepare every student for “college, careers and beyond” (https://yccs.us/).

Dr. Pedro Albizu Campos High School, located in Humboldt Park, includes three buildings with an enrollment of 203 students (16 to 21 years of age); 100% of them are students of color. The school began in 1972 as La Escuelita Puertorriqueña after a group of community members were concerned by a study that cited a 71.2% high-school dropout rate for Puerto Rican youth (Isidro, 1971). The school was moved to a larger location and then moved again to its current location on Division St. along Paseo Boricua. The school was renamed Dr. Pedro Albizu Campos High School after the Puerto Rican nationalist, Dr. Pedro Albizu Campos, and is now part of the Youth Connection Charter School umbrella. PACHS is dedicated to educating students who have dropped out or are at risk of dropping out. The school’s mission is “to provide a quality educational experience needed to empower students to engage in critical thinking and social transformation” (https://pachs-chicago.org/). The school takes pride in being an active learning environment that engages students in their community while challenging them to reach both education and career goals. According to the Chicago Tribune, PACHS exemplifies the power of the school environment in connecting young people with services and opportunities lacking in other areas of their lives. Over and over, educators and researchers have emphasized to us the importance of “wraparound services” – counselors, mentors, on-site childcare, programs to address trauma and depression, meals. Those services support students emotionally and physically so they can stay on track academically, graduate and live productive lives. Essentially, it’s using the in-school setting to help kids deal with out-of-school issues, such as poverty, family turmoil and gun violence. (“Chicago Forward,” January 31, 2020)
In 2011, in part because of the neighborhood research conducted by Margellos-Anast et al. (2008), PACHS expanded their active learning environment by constructing a rooftop greenhouse as an extension of its science classroom. The goal was to teach students about urban agriculture and help address the high rate of obesity and diabetes in their Latinx/Puerto Rican community (Margellos-Anast et al., 2008). Due to lack of a specific curriculum, the greenhouse has mostly been utilized for an after-school gardening club.

Based on the expressed needs of the community, the purpose of this engaged research is twofold. First, the project provided support to update the current greenhouse at Dr. Pedro Albizu Campos High School into a learning garden. Second, data was collected in the form of pre- and post-tests to determine if student attitudes toward science, attitudes toward fruits and vegetables, and food choices improved with the addition of the garden-based science curriculum.

Researcher Background/Role

I am interested in determining ways to motivate and educate students from underserved populations to prioritize their health and well-being. This interest stems from my work with two community programs: Camp Power and CATCH (Coordinated Approach to Child Health).

Camp Power is a free, collaborative summer program offered on-site to children and families living in University Village, a federally subsidized housing development in the city of DeKalb. This neighborhood has the highest concentration of poverty, police call volume, and violent crime occurrences in the city. There are 400-500 school-aged children living in University
Village, with 99% qualifying for free or reduced school lunch and 92% of families having a female head of household.

Camp Power was developed in 2014 in response to the challenges facing the children and families of University Village. In its inaugural year, the program offered daily nutritious lunch service, nutrition education, an academic academy, structured physical activities, layered mentoring, life skills training, family engagement activities, exposure to a range of community resources, and daily interaction with police officers. Over the past five years, 554 campers have participated, and 8,675 meals and 8,011 snacks were served. Campers reported that “because of Camp Power,” 76% are eating more fruit, 51% are eating more vegetables, and 56% are asking for healthy foods at home. Ninety-two percent of parents surveyed in 2018 reported an overall improvement in their child’s nutrition habits. Each year, campers participate in moderate to vigorous physical activity 55-67% of the time. In 2018, the Academic Academy reported that 81% of campers showed improvement in reading scores and 50% of campers showed improvement in math scores ─ minimizing summer learning loss. Additional outcomes include a significant reduction in police calls for service and overall crime rates (>30% reduction in 2015) as well as employment opportunities for a total of 13 University Village residents.

Camp Power made a profound impact on my view of underserved populations. I have seen firsthand how the surrounding community views the residents of University Village as being criminals, neglectful parents, and generally lazy. My experience with the program has shown me that this is not an accurate description of the population – in fact, it’s just the opposite. Many of the residents work hard to take advantage of the limited positive opportunities available to them. I need to be mindful and not make assumptions or jump to conclusions based on biases.
I may have. Because of this experience, I often feel the need to portray underserved populations in the best possible light to dispel the negative judgments of others.

Coordinated Approach to Child Health (CATCH) is a nationally accredited, school-based program that unites multiple players in a child’s life to create a community of health and prevent childhood obesity. The CATCH program aims to impact the messaging a child receives in physical education, the lunchroom, the classroom, and at home to influence a child’s lifelong choices. Two of the most important ways that CATCH creates behavior change are by enabling children to identify healthy foods and by increasing the amount of moderate to vigorous physical activity (MVPA) children engage in each day. The curriculum uses terminology for identifying healthful foods—GO, SLOW and WHOA—as a simple means of labeling food’s nutritional content. GO foods include low-fat, nutrient-dense foods such as fruits, vegetables, and whole grains. SLOW foods have some added fat or sugar but still retain some nutritional value such as applesauce or chocolate milk. WHOA foods are high in fat and/or sugar such as baked goods and fried food.

CATCH was delivered in the DeKalb School District 428 from 2012 – 2018 and the Sycamore School District 427 from 2014 – present. CATCH is provided once a month for a total of six times per year. The national CATCH curriculum provides 10-15 lessons per grade. During the 2012-2013 school year, six lessons were cherry picked from the national curriculum to present to the students. Feedback suggested that this curriculum was not meeting our needs. One of my roles within this program became curriculum development, and over summer 2013, the lessons were merged and edited to fit our needs. The lessons cover healthy eating, physical activity, and decreased screen time and were designed to spiral so that concepts are covered in
multiple grades. For example, in kindergarten the students dance to the “Heartbeat Beat” song and then put their hand over their heart to feel it beating; in third grade they do a variety of exercises and then listen to each other’s hearts through toilet paper roll “stethoscopes”; lastly, in fifth grade the students learn how to take their pulse and what is an optimal heart rate range. Each lesson has been tied to core learning standards (i.e., math, science, health) and provides hands-on activities that engage the students in the content.

Working with this program I have gained an understanding of the importance of active learning. Each year I solicit feedback from the CATCH presenters and update the lessons as needed. I have found the lessons that are primarily didactic do not resonate with the students. To combat this, I have added in games such as Jeopardy, Family Feud and Bingo to review content in a fun and engaging way. By creating an inclusive environment and using a platform familiar to students, we were able to scaffold higher learning.

My role with the Engaged Scholars Initiative at Dr. Pedro Albizu Campos High School married my experiences with Camp Power and CATCH allowing me to create a hands-on gardening curriculum for an underserved population. Although I have previous experience with students from underserved populations, I am still an “outsider” based on my ethnicity, socio-economic status, and age. I am a White, middle-class woman who is well past her high school years. In addition, I have not worked or been trained as a K-12 educator and therefore am an “outsider” with the science teachers as well. Since the teachers are primarily involved in ensuring the curriculum is appropriate and presented the material to the students, my “outsider” status did not affect the program. Both teachers have worked at PACHS for many years and are well known to the students. They have built trusting relationships with the students and were
enthusiastic about including the gardening curriculum. It is my belief that this team effort provided the framework to improve attitudes toward science and fruit and vegetable consumption as well as increase healthy eating behaviors.

Justification of the Study

This dissertation is structured according to the newly created Engaged Scholar Initiative available to doctoral students at the NIU College of Education. Chapter 1 provides an overview of the thematic concepts that organized this study: significance of the problem, social cognitive theory, engaged scholarship, community partners, and researcher background. This dissertation includes three deliverables or parts. The first part is the grant proposal to update the greenhouse into a learning garden. To improve the chances of success, potential sponsors were contacted to determine quality of fit and all stakeholders were included in the writing process.

The current greenhouse design did not allow for more than five to eight students to be working at a time. The layout included four raised garden beds (Figure 1), a hydroponics system (Figure 2), and shelving with pots (Figure 3). There was very little space for seeding and nowhere to sit and compile lab notes. To determine the best design for the greenhouse learning garden, a 45-minute focus group was held with nine students and two teachers to discuss how they envision using the space (Appendix A). A semi-structured interview approach and mostly open-ended questions were utilized throughout the focus group to encourage participants to respond freely and openly to questions (Spradley, 1979). Probing and/or follow-up questions were used, when necessary, to encourage participants to elaborate on or clarify a response.
Handwritten notes were taken during the event to highlight ideas of interest or importance.

Qualitative methods were primarily used for data collection for this component of the project; however, other artifacts such as photographs of the greenhouse, greenhouse redesign blueprints, and grant budget items were collected.

Figure 1 Four raised garden beds

Figure 2 Hydroponics
Figure 3 Shelving

The student and teacher focus group revealed that students wanted a space that not only allowed for gardening but also relaxation. Teachers wanted more organized shelving, room for potting, and the hydroponic system moved for easier access. All wanted more space to move around. Continued conversations were held with the teachers and principal to complete the grant application as well as during the design process of the greenhouse space to ensure the space will meet needs.

Throughout spring 2020, possible grant funders were researched and contacted to determine the best fit. Grants that focused on STEM education were prioritized. In May 2020, a grant was submitted to the Toshiba America Foundation to purchase supplies based on a teacher wishlist. This funder supports STEM education and after several conversations it was determined to be a match for this project. By July, no response was received from Toshiba. Multiple emails went unreturned and the voicemail box was full, leading to the belief that the pandemic changed the priorities of the foundation.
A second grant was submitted to Walmart in December 2020. This grant required submission directly to a local Walmart. At the time of submission, no local Walmart stores were accepting applications. Again, no response was received. The website indicated stores prefer to donate to their own communities. Since the store where the grant was submitted was not in the Humboldt Park neighborhood (although in Southside Chicago), it may have deterred management from approving the funds.

Additional research led to Big Green, the single largest school gardening network that has built over 200 learning gardens in Chicago. Unfortunately, Big Green does not build learning gardens in greenhouses or on rooftops. However, they do provide other resources, including potential architect firms to collaborate with.

G|R|E|C Architects were contacted due to their work with the ACE Hotel’s rooftop garden space. After discussion with several of the principal partners, it was apparent the firm had a good understanding of gardening design. A meeting was set with G|R|E|C partners, the school principal, and myself to tour the PACHS greenhouse. Afterwards, G|R|E|C confirmed they would create the updated blueprints pro bono. Several drafts were created and provided to the principal and science teachers for feedback. The final drawings met the needs of all involved (Appendix B).

A new potential funder, Costco Charitable Contributions, was then considered. This foundation focuses on health and human services, children, and education. Email communication with the funder determined this project was a good fit. The grant proposal was submitted in July 2021 and is available as a supplemental file. Unfortunately, Costco felt the
small size if the school did not allow for a large enough impact and denied funding. Work to secure funding is ongoing.

Chapters 2 and 3 include publication-ready papers that are based on the concepts from Chapter 1. Chapter 2 was prepared to be submitted to *Science and Education*. Chapter 3 was prepared to be submitted to *Health, Education and Behavior*. Both papers implement a mixed-methods quasi-experimental approach. Science achievement scores were compared between students who were exposed to the gardening curriculum and those who were not. The AASC-4 short-form survey tool was utilized to determine attitudes toward science. A modified HBS/SPAN assessment tool was used to track changes in eating behaviors and attitudes. A gardening survey and a few short interviews were conducted with select students to confirm and expand on quantitative results. Paper 1 investigates the effects of the garden-based science curriculum on science attitudes. Paper 2 examines the effects of the garden-based science curriculum on fruit and vegetable attitudes and food choices.

**Research Questions**

**Paper 1**

Question 1: Does a school garden-based science curriculum improve students’ attitudes toward science?
Question 1: Does a school garden-based science curriculum improve students’ food choices of fruits and vegetables?

Question 2: Does a school garden-based science curriculum improve students’ attitudes toward consuming fruits and vegetables?

Question 3: Does a positive score on outcome expectations, social support, self-regulation, or self-efficacy toward consuming fruits and vegetables increase consumption of fruits and vegetables?

Methods for Answering the Research Questions

This study was designed to investigate the effect of the garden-based science curriculum on science and fruit and vegetable consumption attitudes as well as food choices. This study was approved by the Northern Illinois University Institutional Review Board (Appendix C). Prior to contact with students, a parental consent email was sent by the principal (Appendix D).

The Assessment of Attitudes in Science Constructs (AASC-4) survey (Diaz et al., 2018) is a compilation of several subscales, including perception of science teacher, self-esteem for science, fear of failure in course, value of science, enjoyment of science, motivation toward
science, attitudes of friends and peers toward science, and attitudes of family (parents) toward science (Diaz et al., 2018; George, 2000). A study by Diaz et al. (2018) used the 50-item long form to conduct an exploratory factor analysis for reduction to a 24-item short form. They found the reliability of the short form improved four of the eight subscales and can be used to identify science education interventions that have a positive impact on AASC-4. The AASC-4 short-form survey was given to all students taking a science course during the 2020-2021 school year (Appendix E). The pre-test was conducted at the beginning of the school year in September 2020 and the post-test was conducted at the end of the school year in June 2021. Statistical analysis using SPSS was conducted to determine any changes in attitudes toward science after the exposure to the garden curriculum compared to the non-gardening group (RQ1).

**Paper 2**

To determine if students’ food intake was impacted by the learning garden (RQ1), a food frequency (FFQ) was completed at the beginning of the school year in September 2020 and end of the school year in June 2021 (Appendix F). The tool was modified from the SPAN (School Physical Activity and Nutrition) Survey for nutrition behaviors. Hoelscher et al. (2010) found items assessing nutrition have acceptable to good levels of reproducibility, and food consumption items were found to have an acceptable level of correlation with a 24-hour dietary recall. The SPAN Survey is not copyrighted and may be used without written permission from the Michael and Susan Dell Center for Healthy Living at the University of Texas Health Science Center at Houston School of Public Health.
Bandura’s social cognitive theory (SCT) provides a useful basis for health promotion and behavior change (Bandura, 1998). Knowledge alone does not lead to behavior change; expected outcomes, social support, self-regulation, and self-efficacy need to be considered for lasting change (Anderson et al., 2000, 2007; Bandura, 1998). The Health Beliefs Survey (Appendix F), developed at the Virginia Tech Center for Research in Health Behaviors, measures SCT-based determinants of eating behaviors. The tool includes items related to outcome expectations, social support, self-regulation, and self-efficacy (Anderson et al., 2007). Winett et al. (2007) found the Health Beliefs Survey (HBS) eating constructs to have an adequate to high internal consistency, ranging from $\alpha=.68-.90$. Permission to utilize this tool was given by the authors (Appendix F). The tool was modified to focus on SCT constructs related to fruit and vegetable consumption. The tool was completed at the beginning of the school year in September 2020 prior to exposure to the garden curriculum and at the conclusion of the gardening curriculum in June 2021 to determine changes in SCT constructs (RQ2 and RQ3). Statistical analysis using SPSS was conducted to determine any changes in food choices and attitudes toward fruit and vegetables after the exposure to the garden curriculum compared to the non-gardening group.

Design Limitations

The original study, designed prior to the COVID-19 pandemic, planned to provide the gardening curriculum to all students at PACHS taking a science course. In summer 2020, when it was determined that PACHS would provide virtual learning for their students, a new study design was created. Funds were identified to purchase at-home gardening supplies for 25
students. Students self-selected enrollment in the gardening group and were asked to pick up supplies at the school. In addition to the regular science instruction times, the gardening group also attended an additional Friday meeting time. Only 20 students picked up and completed the gardening curriculum.

Survey tools were provided to all students taking a science course at PACHS through Google Forms, an online tool that is part of the Google Classroom suite. PACHS utilized Google Classroom for virtual learning during the 2020-2021 school year and the use of Google Forms was requested by the science teacher. Surveys rely on student compliance in answering the questions completely and honestly to create a quality data set. Google Forms does not have a method to limit the number of submissions by each student. The final data set showed several students completed the surveys two to four times. The surveys were treated as an assignment with points attached to completion; however, due to the unpredictable attendance behaviors common to this school, not all students completed the pre- and post-tests. The science teacher expressed interest in having the surveys completed, but the virtual nature of this study made it impossible to know how much encouragement she gave students to complete them. The final data set for the AASC-4 survey (N=51) had 11 students within the gardening group and 40 in the non-gardening group. The final data set for the HBS/SPAN (N=49) had 10 students within the gardening group and 39 in the non-gardening group. The small number of gardening compared to non-gardening makes finding significance difficult.
CHAPTER 2

INTEGRATION OF A GARDEN-BASED SCIENCE CURRICULUM TO IMPROVE ATTITUDES TOWARD SCIENCE

Abstract

Interest and achievement in science are lacking across the United States, especially within minority, urban students. Gardening has been shown to improve attitudes toward science through hands-on, inquiry-based instruction. The purpose of this study was to explore the effects of a garden-based science curriculum on students’ attitudes toward science. Fifty-one students enrolled in a science course completed both the pre- and post-test Assessment of Attitudes in Science Constructs (AASC-4) survey which measures students’ perception of the science teacher, self-efficacy for science, fear of failure in the class, value of science, enjoyment of science, motivation for science and attitudes of both friends and family. Of the 51 students, 11 received the gardening curriculum in addition to the standard science curriculum. None of the subscales showed significant interactions ($p < .05$) between the gardening and non-gardening groups; however, several of the profile plots showed promise, including value of science, enjoyment of science, motivation for science, and attitudes of friends and family. Subjective data through a gardening survey and interviews found that “because of the gardening program,”
understanding science concepts improved (94% strongly agreed or agreed), science grade improved (88% strongly agreed or agreed), and enjoyment in science increased (76% strongly agreed or agreed). This study shows that a hands-on gardening curriculum can provide the framework to potentially improve students’ attitudes in science.

Introduction

Education and health have changed dramatically over the centuries. In the 1900s school gardens could be found at most schools, horticulture science was a major topic, and schools were concerned with children’s underconsumption (Edwalds, 2014; Kohlstedt, 2008; Labaree, 2012). Now, the time devoted to science education has diminished and there has been a shift in the areas of science taught (Jandro, 2019; Marx & Harris, 2006). A study of American schools’ biology curriculum concluded that microbiology was taught significantly more than macrobiology. In fact, ecology, animal, and plant biology were almost absent at the high-school level (Jandro, 2019). These findings are troubling considering the need for scientifically literate graduates to fill the need within STEM (science, technology, engineering and math) careers (Chittum et al., 2017; Landivar, 2013).

In addition, students’ health has been greatly compromised due to the obesity epidemic (Abelson & Kennedy, 2004; Michimi & Wimberly, 2010; Moore et al., 2010; Ogden et al., 2016). The issue of overconsumption has replaced the fear of underconsumption (Edwalds, 2014). Schools are being tasked to provide public health initiatives to improve students’ health and well-being, including combating childhood obesity (Berezowitz et al., 2015).
Because these two issues often compete for limited time and funding, it is essential to find strategies that can straddle both academic and dietary concerns (Berezowitz et al., 2015). Garden-based science curriculum can be the bridge to produce improved outcomes in both science attitudes and healthy eating.

**Background**

**Science Curriculum**

It is well known that science literacy is lacking in the United States. The release of *A Nation at Risk* by the National Commission on Excellence in Education in 1982 and *No Child Left Behind* (Public Law No. 107-110) in 2001 left many subjects, including science, social studies, and physical education (areas not held to high stakes testing), to become a lower priority (Marx & Harris, 2006; Story et al., 2006). In fact, the pressures of this high-stakes testing have led principals to direct time and funding to mathematics and language arts. With limited time in the school day, this can push science off the daily schedule (Marx & Harris, 2006). Lee and Luykx (2005), in a study with a large school district in the southern United States, reported that in the 2-3 months prior to testing, elementary school teachers were told to only teach subjects that were included on accountability measures. In 2015, President Obama signed the *Every Student Succeeds Act* (Public Law No. 114-95) into law. This Act replaced *No Child Left Behind* and has a more flexible approach to testing and accountability and includes mathematics, language arts, and science standards for K-12 (Korte, 2015). There have been many calls for
science reform, but students continue to lack an interest in the sciences (Kanter & Konstantopoulos, 2010; Lee & Luykx, 2005). Both teachers and students have reported that science is a list of facts that have a right or wrong answer. This didactic pedagogy leads to decreases in students’ science achievement and attitudes (Kanter & Konstantopoulos, 2010). Poor attitudes may lead students away from science-related careers and/or reduced achievement may lead to students not being given an opportunity to explore these careers (Kanter & Konstantopoulos, 2010). The importance of this decrease in science exposure needs to be addressed (Kennedy, 2018). The job market is looking for employees with STEM experience, but there are not enough skilled people to fill the open positions. Furthermore, underrepresented groups are extremely lacking in the STEM fields (Kennedy, 2018). In 2011, African Americans represented 6%, Hispanics represented 7%, and women represented 26% of people employed in STEM fields (Landivar, 2013). To combat this trend, science curriculum should include less memorization and more inquiry-based, active learning (Marx et al., 2004; Marx & Harris, 2006).

Inquiry-based instruction integrates much of what is known about how children learn. This includes principles such as “the importance of prior knowledge, active construction of knowledge, and social interaction” – all key components of inquiry-based instruction (Marx & Harris, 2006, p. 469). This type of instruction allows students to learn the foundation of science, such as how research questions are created and investigated, how relevant evidence is established, and how to interpret and report results (Marx & Harris, 2006). Pedagogy that utilizes real-life active learning to facilitate motivation, engagement, and the development of positive attitudes is critical (Williams et al., 2018). This can be especially important for low-
income students of color who are disproportionately impacted by gaps in access to a high-quality science education (Chittum et al., 2017).

The Next Generation Science Standards (NGSS), authored by a consortium of 26 states, the National Research Council (NRC), the National Science Teachers Association, the American Association for the Advancement of Science, and Achieve, Inc., was adopted in 2013 and has raised the bar on science education for K-12 (NGSS Lead States, 2013). Every NGSS standard has three dimensions: content, practice, and cross-cutting concepts. This integrates content with practice that builds from grade level to grade level, preparing students for college and careers (NGSS Lead States, 2013). NGSS is congruent with inquiry-based instruction, which will require a shift in the classroom from textbook dependency to a more hands-on approach where students are central to learning (Kelley & Williams, 2014). This interactive learning can lead to increased knowledge, attitude, and self-efficacy for science.

Learning Gardens

Learning gardens encompass programs and activities where the garden is the foundation for integrated learning through active, engaging, real-world experience promoting student engagement and academic success (Williams & Dixon, 2013). One reason learning gardens are so effective is that food is universal. Students can use this pre-existing knowledge of food to create relevance for learning new science material (Duffrin et al., 2010). Furthermore, gardening gives educators the venue for teaching the importance of healthy food choices (Blair, 2009). A meta-analysis of 48 studies on garden-based learning from 1990 – 2010 showed positive effects
on science outcomes as well as a variety of outcomes that support learning, including development of self-concept, changes in eating behaviors, and positive environmental attitudes (Williams & Dixon, 2013). Most of these studies utilized the learning gardens within the science curriculum. The authors found 33 of 40 studies (83%) had positive learning outcomes. Of the 15 studies that specifically looked at science outcomes, 14 had positive effects. The overall results of the analysis found that learning gardens had a positive impact on students’ knowledge, attitudes, and behavior in elementary school (85%), middle school (83%) and high-school (91%); however, the number of studies at the high school level was the lowest.

A study with 647 students in Grades 3-5 found that students who participated in a hands-on gardening program scored higher in science achievement than those students who did not participate (Klemmer et al., 2005). They concluded that the active learning within the garden curriculum allows students to apply knowledge to real-world situations. Berezowitz et al. (2015) evaluated 12 garden programs. One criterion for inclusion was students in the K-12 grade range; however, all 12 final programs included only K-8. These authors found four studies that compared gardening with non-gardening peers: two showed improvements in science achievement and one showed improvement in math achievement.

A study by Tufts University found students in 7th-12th grades participating in gardening activities through 4-H were four times more likely to contribute to their communities, two times more likely to participate in out-of-school science programs, and two times more likely to make healthy choices (Lerner & Lerner, 2013). A study looking at varying garden types—vegetable, flower, or combination—utilized in Grades 6-8 grade science curricula found that participating in learning gardens led to positive attitudes toward science, crediting the real-world utility of
science and its applications (Kanter & Konstantopoulos, 2010). In fact, learning gardens may improve students’ attitudes toward school itself, leading to improved academic achievement across the board (Berezowitz et al., 2015).

Most research describing the benefits of learning gardens involve promoting student knowledge and attitudes toward healthy eating through exposure to fruits and vegetables (Blair, 2009). Less research has sought to measure student academic achievements and attitudes (Blair, 2009) and even fewer utilized learning gardens within a high-school curriculum (Jandro, 2019). There is a need for more research that measures both academic attitudes and food choices at the high-school level.

Methods

The Northern Illinois University (NIU) College of Education partnered with the Youth Connection Charter Schools (YCCS) to create an Engaged Scholar Initiative. Doctoral students are paired with YCCS schools to create programming or provide resources where needed. YCCS is a not-for-profit educational organization that was founded in 1997 and is the only Illinois charter school consortium specifically intended for at-risk students (https://yccs.us/). This study was a partnership with Dr. Pedro Albizu Campos High School (PACHS) to help create a garden-based curriculum for their science courses. PACHS is located in the Humboldt Park neighborhood of Chicago, Illinois, and is dedicated to educating students who have dropped out or are at risk of dropping out. In the 2020-2021 school year, PACHS had an enrollment of 203 students (16 to 21 years of age); 100% of them are students of color. The school’s mission is
“to provide a quality educational experience needed to empower students to engage in critical thinking and social transformation” (https://pachs-chicago.org/). The school takes pride in being an active learning environment that engages students in their community while challenging them to reach both education and career goals.

In 2011, in part because of the neighborhood research conducted by Margellos-Anast et al. (2008), PACHS expanded their active learning environment by constructing a rooftop greenhouse as an extension of its science classroom. The goal was to teach students about urban agriculture and help address the high rate of obesity and diabetes in their Latinx/Puerto Rican community (Margellos-Anast et al., 2008). Due to lack of a specific curriculum, the greenhouse had only been utilized for an after-school gardening club.

The purpose of this study was to support the creation of a garden-based science curriculum and answer the research question: Does a school garden-based science curriculum improve students’ attitudes toward science?

This study was approved by the Northern Illinois University Institutional Review Board (Appendix C). Prior to contact with students, a parental consent email was sent by the principal (Appendix D).

Participants

Students enrolled in science classes at PACHS during the 2020-2021 school year were invited to join the gardening curriculum group. One hundred twenty students were enrolled in a
science course during this school year. Students were at various levels, from sophomores to seniors. Twenty total students elected to join the gardening group.

**Procedures**

Due to the COVID-19 pandemic, PACHS was remote teaching for the entire 2020-2021 school year. At the beginning of the school year, all students enrolled in a science course were asked to complete the Assessment of Attitudes in Science Constructs (AASC-4) survey (Diaz et al., 2018). AASC-4 is a compilation of several subscales, including perception of science teacher, self-efficacy for science, fear of failure in course, value of science, enjoyment of science, motivation toward science, attitudes of friends and peers toward science, and attitudes of family (parents) toward science (Diaz et al., 2018; George, 2000). A study by Diaz et al. (2018) used the 50-item long form to conduct an exploratory factor analysis for reduction to a 24-item short form. They found the reliability of the short form improved four of the eight subscales and can be used to identify science education interventions that have a positive impact on AASC-4. The AASC-4 short form was distributed using Google Forms to all students in September 2020 (Appendix E).

Students who signed up for the gardening group were given materials to bring home to complete the curriculum. Once a week, gardening group students attended an additional class time to receive the gardening curriculum. The goals of the gardening curriculum were: 1. to gain knowledge about urban agriculture, including cycles of water, germination and propagation, photosynthesis, ecosystem cycles, erosion, and energy; 2. to practice the scientific method; and
3. to develop skills in designing and sustaining agriculture in an urban setting. Students attended lectures, completed projects, and grew peppers, onions, tomatoes, cucumbers, melon, microgreens, and herbs.

At the end of the school year in June 2021, nine months later, all students were again asked to complete the AASC-4 short form. In addition, the gardening group was asked to complete an additional survey on their perceptions of the gardening curriculum (Appendix G). This 12-item survey asked students to rate their general enjoyment of the gardening program, their perceived support from friends and family, and the impact of the gardening program on their science learning, enjoyment, and achievement. They were also asked permission to complete a short interview about their experiences.

Results

Assessment of Attitudes in Science Constructs (AASC-4)

A total of 166 pre-test AASC-4 short-form surveys were completed. Several students completed the survey multiple times. Advice was sought and it was determined the initial exposure to the survey would be the most accurate reflection of attitudes. Additional surveys were removed by using the time stamp to determine original survey completion. One hundred and one surveys remained after eliminating multiple attempts.

At the end of the school year, 126 post-test AASC-4 short-form surveys were completed. The same procedure was used to eliminate multiple attempts and 97 survey responses remained.
Pre- and post-test surveys were then paired and deidentified. Fifty-one total paired surveys were collected, 40 in the non-garden group and 11 in the gardening group. Of the 51 paired surveys, 32 were female, 18 male, and 1 preferred not to answer; 11 were sophomores, 10 juniors, and 30 seniors.

The AASC-4 short-form required respondents to rate their agreement with the 24 statements from Strongly Agree to Strongly Disagree. The survey scale was assigned a numerical value, with Strongly Agree equal to 6 and Strongly Disagree equal to 1, allowing for a total minimum composite subscale score of 3 and a maximum score of 18. Cronbach’s alpha was used to examine the internal consistency of the subscales of the instrument. Table 1 includes the mean, standard deviation, and Cronbach’s alpha score for pre-test and post-test for each subscale. Self-efficacy for science, value of science, and motivation toward science show lower Cronbach’s alpha scores than the remaining subscales. This is similar to the results by Diaz et al. (2018), who found that although these reliability scores are lower, the overall reliability of the AASC-4 short form was improved from the long version.

A mixed-design two-way repeated measures ANOVA (split-plot ANOVA) was conducted for each subscale to compare the between-subject variable of gardening vs the non-gardening group and the within-subject variables of pre-test vs post-test. The assumption of homogeneity of variance was determined by Levene’s test of equality of error variances. Three p values were <.05, including perception of teacher pre-test (p=.026), value of science pre-test (p=.004), and enjoyment of science post-test (p=.008). All other tests had a p value >.05 and met the assumption of homogeneity of variance. Box’s test of equality of covariance matrices was not significant (p >.05) for any subscale, meeting the assumption for equality of covariance.
Table 1
Descriptive Statistics and Alpha Coefficients for All AASC-4 Variables

<table>
<thead>
<tr>
<th>Perception of science teacher</th>
<th>3</th>
<th>14.49 (2.62)</th>
<th>0.75</th>
<th>15.41 (2.28)</th>
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<tbody>
<tr>
<td>Self-efficacy for science</td>
<td>3</td>
<td>13.61 (2.59)</td>
<td>0.56</td>
<td>13.84 (2.63)</td>
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<td>Fear of failure in course</td>
<td>3</td>
<td>11.90 (3.00)</td>
<td>0.77</td>
<td>11.59 (2.66)</td>
<td>0.86</td>
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<td>Value of science</td>
<td>3</td>
<td>13.10 (2.75)</td>
<td>0.54</td>
<td>13.78 (2.50)</td>
<td>0.49</td>
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<tr>
<td>Enjoyment of science</td>
<td>3</td>
<td>14.20 (2.64)</td>
<td>0.80</td>
<td>14.24 (2.69)</td>
<td>0.70</td>
</tr>
<tr>
<td>Motivation toward science</td>
<td>3</td>
<td>14.10 (2.35)</td>
<td>0.68</td>
<td>13.47 (2.46)</td>
<td>0.72</td>
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<tr>
<td>Attitude of friends toward science</td>
<td>3</td>
<td>11.04 (3.67)</td>
<td>0.87</td>
<td>11.47 (3.43)</td>
<td>0.87</td>
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<tr>
<td>Attitude of family toward science</td>
<td>3</td>
<td>10.29 (3.91)</td>
<td>0.83</td>
<td>11.35 (3.63)</td>
<td>0.76</td>
</tr>
</tbody>
</table>

*Notes. n = 51*
The main effect of time (pre-test to post-test) was not significant \( (p > .05) \) for all subscales except attitude of family toward science. There was a significant difference between the pre-test mean and the post-test mean for attitude of family \( (F(1,49) = 6.99, p = .011, \eta_p^2 = .125) \); however, the partial eta squared showed it was not a large effect. The main effect of gardening vs non-gardening was not significant \( (p > .05) \) for any subscale, including attitude of family toward science. Table 2 shows the interaction effects for each subscale.

Table 2

AASC-4 Interaction Effects (Gardening vs. Non-gardening)

<table>
<thead>
<tr>
<th></th>
<th>Type III</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
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<td>.043</td>
<td>.006</td>
<td>.937</td>
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<td>.646</td>
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<td>Fear of failure in course</td>
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<td>1.685</td>
<td>.228</td>
<td>.635</td>
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<tr>
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<td>Attitude of friends toward science</td>
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<tr>
<td>Attitude of family toward science</td>
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<td>1</td>
<td>15.498</td>
<td>2.458</td>
<td>.123</td>
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</table>
Even though none of the subscales showed a significant interaction between time and group membership, several of the profile plots for estimated marginal means showed promise. Specifically, for value of science, the gardening group mean increased much more than the non-gardening group mean (Figure 4). For both enjoyment of science (Figure 5) and motivation of science (Figure 6), the means for the gardening group increased while the means for the non-gardening group decreased. And last, the attitudes of friends (Figure 7) and attitudes of family (Figure 8) gardening group means improved while the non-gardening group mean stayed relatively the same. Table 3 shows the pre- and post-test means for each subscale.

![Figure 4 Value of science](image-url)
Figure 5 Enjoyment of science

Figure 6 Motivation for science
Figure 7 Attitude of friends toward science

Figure 8 Attitude of family toward science
Table 3
AASC-4 Pre- and Post-Test Means by Subscale

<table>
<thead>
<tr>
<th></th>
<th>Gardening Pre-Test Mean (SD)</th>
<th>Gardening Post-Test Mean (SD)</th>
<th>Non-Gardening Pre-Test Mean (SD)</th>
<th>Non-Gardening Post-Test Mean (SD)</th>
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<tr>
<td>Perception of teacher</td>
<td>14.91 (1.58)</td>
<td>15.91 (1.58)</td>
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<td>Self-efficacy for science</td>
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<td>Fear of failure in course</td>
<td>12.09 (2.88)</td>
<td>11.09 (3.83)</td>
<td>10.83 (3.86)</td>
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<td>Value of science</td>
<td>12.91 (1.87)</td>
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<td>Enjoyment of science</td>
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<td>Attitude of friends</td>
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<td>11.33 (3.58)</td>
<td>11.35 (3.48)</td>
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<td>Attitude of family</td>
<td>9.46 (3.91)</td>
<td>12.18 (2.14)</td>
<td>10.47 (3.94)</td>
<td>11.12 (3.94)</td>
</tr>
</tbody>
</table>

Gardening Survey and Interviews

Of the 20 total students from the gardening group, 17 completed the gardening survey and three students were interviewed (Appendix H). The results from the gardening survey and student interviews support the results of the estimated marginal means profile plots. The gardening survey resulted in 100% of students strongly agreed or agreed that they enjoyed learning about growing plants; 88% strongly agreed or agreed that they enjoyed the hands-on experience of gardening; and 82% strongly agreed or agreed that they want to continue gardening at school. During the interviews, when asked about their perceived value of science, one student said that everyone there wants to learn and it makes him want to learn science.
Another student exclaimed, “I love science.” When asked how they enjoyed the gardening program, students commented:

It was hard for me at first… Some of my plants ended up dying so I was like I don’t think I’m gonna be able to do this but then Mrs. Geetha she like we had assignments and like other activities and she actually showed us how to like grow our plants and like how many days we had to plant them and it’s kind a good experience.

I feel very good in the program and I really like planting and I like to know all the procedures it takes.

It’s pretty cool that there is different ways to plant plants.

When asked specifically about science on the gardening survey, 94% strongly agreed or agreed that the gardening program helped them understand science concepts; 88% strongly agreed or agreed that “because of the gardening program” their science grade improved; and 76% strongly agreed or agreed that “because of the gardening program” they enjoy science more. Interview questions about connecting gardening to motivation in science elicited the following comments:

Every vegetable everything has something to do with your body what you’re learning your body function your brain function why you feel sad or your energy and this and that if things could be leading to your health your food even your mental health.

When you were actually doing it… You get it.

I’m getting more into it. It’s helping me to get encouraged to learn about science.

When asked if their friends and family support them being in the gardening program, only 50% and 59% (respectively) strongly agreed or agreed and 35% and 12% (respectively) disagreed or strongly disagreed. Only these two items had answers within the disagreement scale. However, during the interviews, two of the students described how their families have been involved in
gardening and would discuss their plants with them. One student has a grandfather in Puerto Rico who “has land” and “grows everything” and an uncle who is a botanist. The pride in his voice was evident as he described conversations he would have with both. These results are similar to the estimated marginal means profile plots and the main effect of time (pre-test to post-test) on the AASC-4 subscale results for attitudes of family toward science.

Discussion

Previous studies suggest that a garden-based curriculum improves both achievement and attitudes toward science (Berezowitz et al., 2015; Blair, 2009; Klemmer et al., 2005; Lerner & Lerner, 2013; Williams & Dixon, 2013). While this study did not find that a garden-based science curriculum improves attitudes toward science, qualitative data from the interviews and gardening survey showed promise. Similar to Williams et al. (2018) students reported increased engagement with science due to the hands-on component of gardening (88% strongly agreed or agreed). Both Kanter and Konstantopoulos (2010) and Williams and Dixon (2013) found that relating science to real-world experiences improves attitudes and achievement. The current study found most students felt that gardening helped clarify science concepts (98% strongly agreed or agreed) and improved their grade (88% strongly agreed or agreed) as well as increased their enjoyment of science (76% strongly agreed or agreed). The profile plots of the estimated marginal means support this as the gardening group means increased while the non-gardening group means either stayed about the same or decreased. Social support from friends and family had mixed results both on the AASC-4 as well as the gardening survey and interviews. There
was a significant difference on the AASC-4 from pre-test to post-test for support from family, but only when the data from both groups are combined. This could be due to the pandemic, where students found themselves at home and overall support from family improved because of the time spent together. The profile plots show promise as the gardening group mean increased more than the non-gardening group mean. Results from the gardening survey were mixed on perceived support from friends (50% agreed; 35% disagreed) and family (59% agreed; 12% disagreed); however, interviews demonstrated strong support from family. While this study did not find statistically significant results that the gardening group’s attitudes toward science improved compared to the non-gardening group, the profile plots, subjective feedback from the gardening survey, and interviews all show potential. Continued research that minimizes this study’s limitations should be conducted.

One limitation of this study that may have made it difficult to find group differences is the small number of students within the gardening group compared to the non-gardening group. The final data set for the AASC-4 survey (N=51) had 11 students within the gardening group and 40 in the non-gardening group. Reasons for the small sample include limitations in resources, data collection procedures, and the nature of the population being surveyed. First, supplies for up to 25 students were purchased by the school to allow for the implementation of the virtual gardening curriculum, yet only 20 students self-selected to participate. In addition, because students self-selected participation in the gardening group, there was a potential selection bias. Students choosing to participate in the gardening group may have previous interest in or knowledge of gardening, making changes in attitude more difficult to discover. Second, survey tools were provided to students online through Google Forms, part of the Google Classroom
suite. Google Classroom was utilized for virtual learning during the 2020-2021 school year and the use of Google Forms was requested by the science teacher. Google Forms does not have a method to limit the number of submissions by each student. The final data set showed several students completed the surveys two to four times. Time stamps were utilized to determine first submission and all other attempts were deleted. While this method is consistent, it is impossible to know if this attempt was the most accurate reflection of attitudes toward science. The surveys were treated as an assignment with points attached to completion; however, due to the unpredictable attendance behaviors common to this school, not all students completed the pre- and post-tests. Although the AASC-4 survey has a Flesch-Kincaid reading score of 82 (easy to read), students whose primary language is Spanish may have benefitted from the survey being translated.

The results of this study show the need for continued research. Research into students’ attitudes toward science, especially with underserved, minority groups, needs to be a priority to ensure a diverse future STEM workforce. After decades of science being considered less significant than subjects held to high-stakes testing, interest and achievement have dwindled. To combat this, science curriculum needs to be hands-on and inquiry based. This study shows promise that a garden-based science curriculum that allows students to engage in the content matter can potentially provide the framework to improve knowledge as well as stimulate an interest in science overall; however, continued research with larger groups of students is needed.
CHAPTER 3

IMPACT OF A HIGH-SCHOOL GARDEN-BASED SCIENCE CURRICULUM ON STUDENT FRUIT AND VEGETABLE CONSUMPTION AND ATTITUDES

Abstract

Nutrition education during adolescence can build interest and enjoyment in healthy eating; this can be especially important for low-income, minority students living in a food desert. Gardening curriculum that is embedded into a science curriculum can increase the amount of exposure to nutrition education and potentially lead to improved fruit and vegetable consumption. The purpose of this study was to determine the effect of a gardening-based science curriculum on students’ consumption of and attitude towards fruits and vegetables. Forty-nine students enrolled in a science course completed pre- and post-test surveys modified from the Health Beliefs Survey (HBS) to measure SCT-based determinants of eating behaviors including social support, self-regulation, self-efficacy, and outcomes expectations. Additional questions were included from the SPAN food frequency survey to determine students’ consumption of fruits and vegetables. Of the 49 students, 10 received the gardening curriculum in addition to the standard science curriculum. The main effect of time (pre-test to post-test) was significant for the social support ($p=0.032$), self-regulation ($p=0.016$), and self-efficacy ($p=0.009$) subscales. None
of the main effects for non-gardening vs. gardening were significant ($p < .05$); however, profile plots of the interactions for social support, self-regulation, and outcomes expectations show promise. Gardening survey and interviews showed mixed results for social support and consumption. A larger sample is needed to determine the effect of gardening-based science curriculum on students’ consumption of and attitudes toward fruits and vegetables.

Introduction

Since the Progressive movement, led by John Dewey, when educational reform included an expansion in the social mission, health has played a role in schools (Labaree, 2012). The 1918 Cardinal Principles of Secondary Education created seven social mission goals, number one being health:

Poor public health was a problem that posed a threat to the social utility of adult members of society since it would impede their ability to be economically productive and might turn them into a public burden. The answer included teaching classes in health education, hiring school nurses, and imposing vaccination requirements for school attendance. (Labaree, 2012)

The school gardens that flourished from the 1890s well into the 20th century (Kohlstedt, 2008) were a highly visible testament to this social mission goal. It was thought that if children were not taught to be healthy, they would eventually put a burden on the nation with health costs.
Background

Childhood Obesity

During the past three decades, the United States has witnessed a dramatic increase in the prevalence of overweight and obesity that has seriously affected children. Childhood obesity rates grew dramatically from the 1980s to the early 2000s (Ogden et al., 2016). Since 2003-2004, rates have remained high and unchanged, creating a new generation of overweight and obese children and adolescents who may be at greater risk for health problems later in life (Schlosser, 2012). According to the Institute of Medicine, more than 9 million children and young adults older than 6 years are overweight or obese (Ogden et al., 2016). Almost 20% of children living in Illinois are obese, with 33% being considered overweight or obese (IDPH, 2016). According to the Dietary Guidelines for Americans, physical inactivity and diets high in fat and low in nutrient-dense foods such as fruits and vegetables, resulting in an energy imbalance, are the most important factors contributing to the increase of overweight and obesity (Michimi & Wimberly, 2010). However, what the report left off is that many societal and environmental issues, such as poverty, can limit options for healthy food and safe activity (Boero, 2012). In fact, research looking at obesity levels within several Chicago neighborhoods found that poor, minority communities such as Humboldt Park, North Lawndale, and Roseland had much higher percentages of overweight and obesity (59.6%, 64.5%, and 66.2% respectively) than the state (33%), whereas the predominantly affluent, White community of Norwood Park
was lower at 19.2% (Margellos-Anast et al., 2008). These same researchers found that children living in households with incomes less than $50,000 had significantly higher rates of obesity than households greater than $50,000. As a result of this research, several community health initiatives were created to serve the neighborhoods through culturally relevant programming (Johnson, 2009; Margellos-Anast et al., 2008).

**Fruit and Vegetable Intake**

National recommendations for fruit and vegetables are now 5-9 servings daily; however, research shows that the average consumption is 2.4 servings per day, with only 23% of Americans reporting eating more than 5 servings (Hoy et al., 2020). In a world where food is “cheap, easily accessible, varied, palatable and energy dense, all factors shown to promote overconsumption” (Wardle & Steptoe, 2005, p. 674), it is not surprising that fruit and vegetable consumption is so low. Studies have shown that diets rich in vegetables and fruits, independent of weight, can lower blood pressure, reduce risk of heart disease and stroke, prevent some types of cancer, lower the risk of digestive problems, and have a positive effect upon blood sugar which can help keep appetite in check (Hung et al., 2004). However, affordability can be a barrier to consuming fruits and vegetables. One study showed that participants managed to budget for their typical fruit and vegetable intake, whether that intake was less than 2 or greater than 3 servings, but considered purchasing additional fruits and vegetables as too expensive (Dibsdall et al., 2002). This same study found that not only do low-income households spend less on fruits and vegetables than other households, but they are also less likely than higher
income households to respond to an increase in income by spending more on these foods. In addition to affordability, factors that influence fruit and vegetable consumption include health awareness and knowledge. These same authors found education had a more important effect on purchases of fruits and vegetables than did income, suggesting knowledge of the nutritional importance of these foods may be the critical factor influencing choice (Dibsdall et al., 2002). This suggests that both education and income levels play a large role in fruit and vegetable consumption and should be given special consideration.

Much obesity research has addressed the issue of food deserts and the influences of neighborhood environments on obesity (Dibsdall et al., 2002; Flores-Gonzalez, 2001; Michimi & Wimberly, 2010; Schlosser, 2012). A food desert is defined as an area with limited access to affordable and nutritious food, particularly in lower income communities that lack funding and resources for services (Flores-Gonzalez, 2001; Michimi & Wimberly, 2010). The problem of accessibility to healthful foods is also directly linked to the competing accessibility of energy-dense/nutrient-poor products and fast food (Dibsdall et al., 2002). In 1970, Americans spent about $6 billion on fast food; in 2000, they spent more than $110 billion (Schlosser, 2012). Food desert neighborhoods that have a reduced consumption of healthy foods, such as fruits and vegetables, and increased access to energy-dense foods are susceptible to poor nutrition, increased obesity, and increased prevalence of chronic diseases such as Type 2 diabetes and heart disease (Michimi & Wimberly, 2010).
**Nutrition Education in Schools**

Schools can play an important part in promoting healthy behaviors. More than 95% of American youth aged 5-17 are enrolled in school, and no other institution has as much continuous and intensive contact with children during the first two decades of life (Lytle et al., 2006). Schools can promote good nutrition, physical activity, and healthy weights among children through healthful school meals and snacks, physical education programs, health education in the classrooms, and school health services. Adolescence is a time of growth and increased independence and therefore an important time to increase students’ interest and knowledge in nutrition, yet studies show nutrition knowledge to be deficient at this age (Roseno et al., 2017).

In the United States, most school districts (83%) require nutrition education. Although nutrition education appears to be common in schools, the amount offered is limited. Schools typically devote an average of 3.4 hours a year to teaching nutrition education (Story et al., 2009). Research suggests a minimum of 10 hours of classroom instruction is needed for medium effects on nutrition knowledge (Connell et al., 1985). It is difficult for teachers to include these additional responsibilities of health promotion and disease prevention when there is barely time to fulfill the basic academic mission. Unlike the Cardinal Principles, many of today’s educators will argue that it is not their role to remedy society’s problems. Bandura (1998) summarized this mentality, “As long as health is considered tangential to the central mission of schools, it will continue to be slighted and resisted” (p.20) Multiple studies have found that for a health
promotion program to be successful, it must be institutionalized, which includes persistence over long periods of time, requirements that participants receive multiple exposures, and support for cultural changes (Kanter & Konstantopoulos, 2010). For this to happen, educators must have a seamless method to teach both nutrition and academics.

One way to institutionalize nutrition education is to embed nutrition curriculum into subjects such as science with culturally relevant pedagogy and provide multiple opportunities for students to learn about and try healthy habits. Programs that build on children’s knowledge and skills, build self-efficacy, and provide a supportive environment may lead to behavior changes (Bandura, 1998). Such a program may not only assist students in learning about health and improving healthy habits but also have a strong impact on science achievement (Williams et al., 2018).

Social Cognitive Theory

Social cognitive Theory (SCT) proposes that learning occurs in a social context with a reciprocal interaction of the person, environment, and behavior (Bandura, 1991). The distinctive feature of SCT is the emphasis on social influence as well as external and internal social reinforcement. SCT considers the unique way in which individuals acquire and maintain behavior while also considering the social environment in which individuals perform the behavior (Bandura, 1991). The theory considers a person's past experiences, which factor into whether behavioral action will occur. These past experiences influence reinforcements,
expectations, and expectancies, all which shape whether a person will engage in a specific behavior and the reasons why a person engages in that behavior (Bandura, 1991, 2001). This theory is often used in health promotion and other action-oriented learning. Instead of teachers conveying facts to students, students can create knowledge for themselves through investigation and using real skills and tools to solve problems (Karchmer-Klein & Layton, 2006). Curriculum that is hands-on and food based can build a foundation for many disciplines, including science (Hovland et al., 2013). Therefore, garden-based programs or learning gardens can be a venue for engaging students in science and health (Williams & Dixon, 2013). A school garden can be the bridge from nutrition to science and back again.

Learning Gardens

Schools can play a critical role in addressing the nation’s childhood obesity epidemic by creating an environment that provides hands-on nutrition content through multiple courses, promotes nutritious foods, and empowers students to make healthier choices (Story et al., 2006). Learning gardens encompass programs and activities where the garden is the foundation for integrated learning through active, engaging, real-world experience (Williams & Dixon, 2013) promoting student engagement and academic success.

Rooted in SCT, exposure to learning gardens may improve attitudes and preferences for fruits and vegetables and improve science achievement (Berezowitz et al., 2015). SCT identifies factors that lead to the development of skills that can impact physical and emotional well-being as well as self-regulation of healthy habits (Bandura, 1998). Unlike many other theories of
behavior used in health promotion, SCT considers maintenance of behavior, rather than just focusing on initiating behavior. This is important as maintenance of behavior, and not just initiation of behavior, is the true goal in health promotion (Bandura, 1998). Therefore, SCT is used to ground many behavior modification programs. Just like SCT, behavior change must consider the interactions between person, environment, and the behavior.

Learning gardens can influence both behavior change and knowledge acquisition by utilizing SCT. Specific knowledge and skill sets must be developed through the curriculum (content). Although students may have no previous experience with gardening, they all have knowledge and context of food to draw upon that will allow them to create expectations (outcome expectations). Teachers will demonstrate gardening techniques (social support) and provide positive reinforcement as students build gardening skills and progress through the curriculum (self-regulation). As skills develop so will students’ confidence in gardening, as well as confidence in healthy food choices (self-efficacy).

Berezowitz et al. (2015) evaluated 12 school gardening programs (K-8) and found that 71% of programs that measured fruit and vegetable intake showed improvement. Another study by Tufts University found students in 7th – 12th grades participating in gardening activities through 4-H were two times more likely to make healthy food choices (Lerner & Lerner, 2013). A study with primarily Latino/Hispanic 9-year-old students (87%) found that increases in gardening behaviors significantly predicted increased intake of dietary fiber (Landry et al., 2019). An analysis of 12 quantitative studies on the impact of school gardens on learning found significant results in nine of the studies (Blair, 2009). All nine revealed a positive difference in test measures between gardening students and non-gardening students. The same author found
that gardening improved elementary student preference for vegetables as snacks in two of the studies and improved fruit and vegetable consumption in one of the studies (Blair, 2009). However, gardening was no more effective than simple nutrition lessons in conveying nutrition knowledge. Most research describing the benefits of learning gardens focuses on the elementary-school level, less on middle school and even fewer at the high-school level (Jandro, 2019). There is a need for more research that measures learning garden outcomes at the high-school level.

Methods

The Northern Illinois University (NIU) College of Education has partnered with the Youth Connection Charter Schools (YCCS) to create an Engaged Scholar Initiative. Based on interest and skill set, doctoral students are matched with YCCS schools to create programming or provide resources where needed. Founded in 1997, YCCS is the only Illinois charter school consortium specifically intended for at-risk students (https://yccs.us/). This study is a partnership with Dr. Pedro Albizu Campos High School (PACHS) to evaluate a garden-based science curriculum on student attitudes and consumption of fruits and vegetables. PACHS is located in the primarily Puerto Rican Humboldt Park neighborhood of Chicago, Illinois, and is considered a food desert. PACHS is dedicated to educating students who have dropped out or are at risk of dropping out. In the 2020-2021 school year, PACHS had an enrollment of 203 students (16 to 21 years of age); 100% of them are students of color, and 100% qualify for the free or reduced school lunch program. The school’s mission is “to provide a quality educational experience
needed to empower students to engage in critical thinking and social transformation” (https://pachs-chicago.org/). The school takes pride in being an active learning environment that engages students in their community while challenging them to reach both education and career goals.

In 2011, PACHS expanded their active learning environment by constructing a rooftop greenhouse as an extension of its science classroom. The goal was to teach students about urban agriculture and help address the high rate of obesity and diabetes in their Latinx/Puerto Rican community (Margellos-Anast et al., 2008). Due to lack of a specific curriculum, the greenhouse had only been utilized for an after-school gardening club.

The purpose of the current study was to support the creation of a garden-based science curriculum and answer the following research questions:

Research Question 1: Does a school garden-based science curriculum improve students’ food choices of fruits and vegetables?

Research Question 2: Does a school garden-based science curriculum improve students’ attitudes toward consuming fruits and vegetables?

Research Question 3: Does social support, self-regulation, self-efficacy, or outcomes expectation toward consuming fruits and vegetables increase consumption of fruits and vegetables?

This study was approved by the Northern Illinois University Institutional Review Board (Appendix C). Prior to contact with students, a parental consent email was sent by the principal (Appendix D).
Participants

One hundred and twenty students were enrolled in a science course at PACHS during the 2020-2021 school year. Students were at various levels, from sophomores to seniors. All students enrolled in science were invited to join the gardening curriculum group; 20 students elected to join the group.

Procedures

Due to the COVID-19 pandemic, PACHS provided remote teaching for the entire 2020-2021 school year. At the beginning of the school year, all students enrolled in a science course were asked to complete the Health Beliefs Survey of eating behaviors and the SPAN food frequency assessment as a pre-test survey. The survey tool was distributed using Google Forms to all students in September 2020.

Students in the gardening group were given materials to take home to complete the curriculum. Once a week, gardening group students attended an additional class time to receive the gardening curriculum. The goals of the gardening curriculum were: 1. to gain knowledge about urban agriculture including cycles of water, germination and propagation, photosynthesis, ecosystem cycles, erosion, and energy as well as sustainable food systems and the nutritional components of food; 2. to practice the scientific method; and 3. to develop skills in designing and sustaining agriculture in an urban setting. Students attended lectures, completed projects, and grew peppers, onions, tomatoes, cucumbers, melon, microgreens, and herbs.
At the end of the school year in June 2021, nine months later, all students were again asked to complete the Health Beliefs Survey and SPAN food frequency assessment as a post-test survey. In addition, the gardening group was asked to complete an additional survey on their perceptions of the gardening curriculum.

**Assessment Tools**

Bandura’s social cognitive theory (SCT) provides a useful basis for health promotion and behavior change (Bandura, 1998). Knowledge alone does not lead to behavior change; expected outcomes, social support, self-regulation, and self-efficacy need to be considered for lasting change (Anderson et al., 2000, 2007; Bandura, 1998). A study by Anderson et al. (2007) found outcome expectations related to satisfaction with cost and taste of healthier foods contributed to sustained behavior changes. Other researchers have found perceived social support from family and friends (a precursor to self-efficacy in SCT) has been associated with better nutrition behaviors (Ford et al., 2000; Steptoe et al., 2004). Self-regulatory behavior, such as goal setting, has been associated with healthier fruit and vegetable intake in adults (Anderson et al., 2007). Self-efficacy is the leading social cognitive determinant of consistent healthful eating. Strong self-efficacy for preparing and eating healthy foods has been shown to create lasting changes (Anderson et al., 2000, 2007). Individuals with strong social support, higher self-efficacy, and more favorable outcome expectations will ultimately be more likely to implement the self-regulatory strategies essential to adopting and maintaining healthier eating patterns, even in the face of environmental barriers (Anderson et al., 2007; Bandura, 1998).
The Health Beliefs Survey (HBS), developed at the Virginia Tech Center for Research in Health Behaviors, measures SCT-based determinants of eating behaviors (Appendix F). The tool includes items related to social support, self-regulation, self-efficacy, and outcomes expectation (Anderson et al., 2007). Winett et al. (2007) found the Health Beliefs Survey eating constructs have an adequate to high internal consistency, ranging from $\alpha=.68-.90$. Permission to utilize this tool has been given by the authors (Appendix F). The tool was modified to focus on SCT constructs related to fruit and vegetable consumption as well as the addition of a food frequency tool. The food frequency tool was modified from the SPAN (School Physical Activity and Nutrition) Survey for nutrition behaviors (Appendix F). Hoelscher et al. (2010) found items assessing nutrition have acceptable to good levels of reproducibility, and food consumption items were found to have an acceptable level of correlation with a 24-hour dietary recall. The SPAN Survey is not copyrighted and may be used without written permission from the Michael and Susan Dell Center for Healthy Living at the University of Texas Health Science Center at Houston School of Public Health.

The gardening survey (Appendix G) is a 12-item survey that asked students to rate their general enjoyment of the gardening program, their perception of fruit and vegetable intake, their willingness to try new foods, and family support and use of the produce grown through the gardening program. They were also asked permission to complete a short interview about their experiences (Appendix H).
Results

HBS/SPAN Survey

A total of 168 pre-test HBS/SPAN Surveys were completed. Several students completed the survey multiple times. Advice was sought and it was determined the initial exposure to the survey would be the most accurate reflection of attitudes. Additional surveys were removed by using the time stamp to determine original survey completion. One hundred and eight surveys remained after eliminating multiple attempts.

At the end of the school year, 96 post-test HBS/SPAN Surveys were completed. The same procedure was used to eliminate multiple attempts and 83 survey responses remained. Pre- and post-test surveys were then paired and deidentified. Forty-nine total paired surveys were collected, 39 in the non-garden group and 10 in the gardening group. Of the 49 paired surveys, 30 were female, 18 male, and 1 preferred not to answer; 8 were sophomores, 10 juniors and 31 seniors.

The Health Beliefs Survey is divided into four subscales for social support (5 questions), self-regulation (12 questions), self-efficacy (6 questions), and outcomes expectations (20 questions). Respondents were required to rate their agreement with the statements for social support, self-regulation, and outcomes expectations from “strongly agree” to “strongly disagree.” The survey scale was assigned a numerical value with “strongly agree” equal to 6 and “strongly disagree” equal to 1, allowing for a total minimum composite social support subscale score of 5 and a maximum score of 30, a total minimum composite self-regulation subscale score of 12 and
a maximum score of 72, and a total minimum composite outcomes expectations subscale score of 20 and a maximum score of 120. Self-efficacy subscale questions required respondents to rate how certain they felt they were able to complete tasks related to fruit and vegetable consumption on a scale of 1 to 10, allowing for a total minimum self-efficacy subscale score of 6 and a maximum score of 60. Post-test composite scores for each subscale were compared to pre-test composite scores. Prior to conducting analyses, the scores for the 12 questions under outcomes expectations (noted by an asterisk in Appendix F) were reverse coded, so all questions trended in the same direction. For example, a response of “strongly agree” = score of 6 to the question, “The food I eat will not taste good,” indicated a more negative view of fruit and vegetable consumption, whereas, “My health will improve,” indicates a more positive view of fruit and vegetable consumption. The remaining subscales all trended the same way, requiring no recoding.

The SPAN food frequency portion of the survey required respondents to determine how often they consumed different types of fruits and vegetables in the last 3 months from “less than once per week” to “more than 2 times per day.” The survey scale was assigned a numerical value with “less than once per week” equal to 1 and “more than 2 times per day” equal to 6, allowing for a total minimum composite subscale of 10 and a maximum score of 60. Post-test composite scores were compared to pre-test composite scores.

SPSS statistical software was used for statistical analysis. Cronbach’s alpha was used to examine the internal consistency of the subscales of the instrument. Table 4 includes the mean, standard deviation, and Cronbach’s alpha score for pre-test and post-test for each sub-scale. This study found the subscales from the Health Beliefs Survey to have adequate to high internal
consistency, similar to the study by Winett et al. (2007). In addition, like Hoelscher et al. (2010), the SPAN food frequency survey has a high internal consistency.

Table 4
Descriptive Statistics and Alpha Coefficients for All HBS/SPAN Variables

<table>
<thead>
<tr>
<th></th>
<th>No. of Items</th>
<th>Pre-Test</th>
<th>Pre-Test Alpha</th>
<th>Post-Test</th>
<th>Post-Test Alpha</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBS Social Support</td>
<td>5</td>
<td>18.24 (4.32)</td>
<td>0.73</td>
<td>20.31 (5.08)</td>
<td>0.85</td>
</tr>
<tr>
<td>HBS Self-regulation</td>
<td>12</td>
<td>48.07 (9.41)</td>
<td>0.79</td>
<td>51.95 (9.94)</td>
<td>0.85</td>
</tr>
<tr>
<td>HBS Self-efficacy</td>
<td>6</td>
<td>38.91 (13.91)</td>
<td>0.82</td>
<td>43.86 (13.46)</td>
<td>0.87</td>
</tr>
<tr>
<td>HBS Outcome Expectations</td>
<td>20</td>
<td>77.14 (12.39)</td>
<td>0.83</td>
<td>76.15 (12.89)</td>
<td>0.85</td>
</tr>
<tr>
<td>SPAN Food frequency</td>
<td>10</td>
<td>28.00 (11.67)</td>
<td>0.90</td>
<td>28.79 (11.95)</td>
<td>0.94</td>
</tr>
</tbody>
</table>

Notes. n = 49

A mixed-design two-way repeated measures ANOVA (split-plot ANOVA) was conducted for each HBS subscale and the SPAN food frequency to compare the main effects for the between-subject variables of gardening vs the non-gardening group and the main effects for within-subject variables of pre-test vs post-test. The assumption of homogeneity of variance was determined by Levene’s test of equality of error variances. Two scores showed $p < .05$; social support post-test ($p = .047$) and self-regulation pre-test ($p = .038$). All other tests showed $p > .05$ and met the assumption of homogeneity of variance. Box’s test of equality of covariance
matrices was not significant \((p > .05)\) for any subscale, meeting the assumption for equality of covariance.

The main effect of time (pre-test to post-test) was significant for the HBS social support \((F(1,47) = 4.89, \ p = .032, \ \eta_p^2 = .094)\), HBS self-regulation \((F(1,47) = 6.43, \ p = .016, \ \eta_p^2 = .117)\) and HBS self-efficacy \((F(1,47) = 7.49, \ p = .009, \ \eta_p^2 = .137)\) subscales, indicating a significant increase in mean scores from pre-test to post-test for all students; however, the partial eta squared for each shows a small to medium effect. The main effects of time (pre-test to post-test) for the SPAN food frequency \((F(1,47) = .013, \ p = .91, \ \eta_p^2 = .000)\) and HBS outcomes expectations \((F(1,47) = .05, \ p = .82, \ \eta_p^2 = .001)\) were not significant. Main effects of gardening vs non-gardening were not significant \((p > .05)\) for any subscale, indicating that the addition of the garden-based curriculum did not significantly increase mean scores from pre-test to post-test.

Table 5 shows the interaction effects for each subgroup.

**Table 5**

| HSB/SPAN Interaction Effects (Gardening vs. Non-gardening) |
|---------------------------------|-----------------|-----------------|-----------------|-----------------|
|                                  | Type III        | Partial Eta Squared |
|                                  | Sum of Squares | df | Mean Square | F | Sig. | | |
| HBS Social support               | 52.239          | 1  | 52.239      | 1.925 | .172 | .039 |
| HBS Self-regulation              | 87.813          | 1  | 87.813      | 1.160 | .287 | .024 |
| HBS Self-efficacy               | .028            | 1  | .028        | .000  | .984 | .000 |
| HBS Outcome Expectations        | 19.986          | 1  | 19.986      | .249  | .620 | .005 |
| SPAN Food frequency             | 21.714          | 1  | 21.714      | .251  | .619 | .005 |

Even though none of the subscales showed significant interaction between time and group membership, several of the profile plots for estimated marginal means showed promise. For social support, the gardening group mean increased while the non-gardening group mean stayed relatively the same (Figure 9). For self-regulation, the gardening group mean increased more than the non-gardening group mean (Figure 10) and the gardening group mean slightly increased while the non-gardening group mean decreased for outcomes expectations (Figure 11). The HBS self-efficacy means for both the gardening group and the non-gardening group increased at about the same rate. Of note, the SPAN food frequency non-gardening group mean increased while the gardening group mean decreased. Table 6 shows the pre- and post-test means for all subscales.

Figure 9 Social support
Figure 10 Self-regulation

Figure 11 Outcomes expectations
Table 6
HBS/SPAN Pre- and Post-Test Means by Subscale

<table>
<thead>
<tr>
<th></th>
<th>Gardening Pre-Test Mean (SD)</th>
<th>Gardening Post-Test Mean (SD)</th>
<th>Non-Gardening Pre-Test Mean (SD)</th>
<th>Non-Gardening Post-Test Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HBS social support</td>
<td>24.30 (4.47)</td>
<td>29.00 (2.87)</td>
<td>24.67 (5.04)</td>
<td>25.74 (6.87)</td>
</tr>
<tr>
<td>HBS Self-regulation</td>
<td>46.60 (11.74)</td>
<td>54.40 (9.77)</td>
<td>47.69 (8.90)</td>
<td>50.79 (10.40)</td>
</tr>
<tr>
<td>HBS Self-efficacy</td>
<td>39.40 (11.20)</td>
<td>45.10 (9.74)</td>
<td>37.92 (14.96)</td>
<td>43.54 (14.34)</td>
</tr>
<tr>
<td>HBS Outcome Expectations</td>
<td>69.00 (12.64)</td>
<td>69.60 (11.92)</td>
<td>71.10 (10.58)</td>
<td>69.46 (11.25)</td>
</tr>
<tr>
<td>SPAN Food frequency</td>
<td>28.70 (7.93)</td>
<td>27.80 (10.43)</td>
<td>27.67 (12.42)</td>
<td>29.10 (12.27)</td>
</tr>
</tbody>
</table>

Using the final non-paired post-test data (83 completed surveys), a multiple linear regression was used to predict the scores on the SPAN food frequency tool based on the four subscales of the HBS tool: social support, self-regulation, self-efficacy, and outcomes expectation. The data was inspected for influential cases through standard residuals, leverage values, Cook’s distance and covariance ratio (CVR) and no case was considered influential on more than two tests. The assumption of homoscedasticity and multicollinearity were also met. With the assumptions met, the regression model was assessed. The total regression model was significant (F(4,78) = 3.104, p = .02), indicating a good fit to the data. However, the value of $R^2$ shows that only 13.7% of the score on the SPAN food frequency tool is predicted by social support, self-regulation, self-efficacy, and outcomes expectations. When evaluating each variable, self-efficacy was a significant predictor of the SPAN food frequency score. All other
subscales were not significant \((p > .05)\). Table 7 shows the regression coefficients for each subscale.

Table 7
Regression Coefficients: Predicting Fruit and Vegetable Consumption from Social Support, Self-regulation, Self-efficacy, and Outcomes Expectations

<table>
<thead>
<tr>
<th></th>
<th>Unstandardized Coefficients</th>
<th>Standardized Coefficients</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>11.44</td>
<td>.897</td>
<td>1.275</td>
<td>.206</td>
</tr>
<tr>
<td>Social Support</td>
<td>.195</td>
<td>.281</td>
<td>.695</td>
<td>.489</td>
</tr>
<tr>
<td>Self-regulation</td>
<td>.092</td>
<td>.129</td>
<td>.716</td>
<td>.476</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>.246</td>
<td>.095</td>
<td>2.592</td>
<td>.011</td>
</tr>
<tr>
<td>Outcomes Expectation</td>
<td>-.018</td>
<td>.082</td>
<td>-.223</td>
<td>.824</td>
</tr>
</tbody>
</table>

Notes: DV: Fruit and Vegetable Consumption

**Gardening Survey and Interviews**

Of the 20 total students from the gardening group, 17 completed the gardening survey and three students were interviewed. The results from the gardening survey and student interviews support the results of the ANOVA and estimated marginal means profile plots. The gardening survey resulted in 100% of students strongly agreed or agreed that they enjoyed
learning about growing plants; 88% strongly agreed or agreed that they enjoyed the hands-on experience of gardening; and 82% would like to continue gardening at school. Questions about support from family and friends confirmed the significant main effect of time (pre-test to post-test), as 59% and 50%, respectively, strongly agreed or agreed that they receive support. However, only 29% strongly agreed or agreed that the produce grown was eaten by their family. Interviews with students also had mixed results. When asked if the produce grown helped with their family’s food budget, responses ranged from positive to negative:

Helps not just me but my family upstairs and my family downstairs.

Instead of going to the store and buying the product, I just want to grow it and eat it from home, instead of spending money and going to buy it.

My family already grows peppers and other plants.

No, my family doesn’t like that.

Questions related to self-efficacy show that 93% of gardening survey respondents strongly agreed or agreed that “because of the gardening program” they are willing to try new foods. During the interview, one student stated “Yeah, I would want to try something different, like eggplant, because I’ve never tried that,” and another said the gardening program “opened his eyes.” These results and statements confirm the significant main effect of time (pre-test to post-test) for self-efficacy as well as the linear regression results for self-efficacy being a significant predictor of the SPAN food frequency score.

When asked if eating fruits and vegetables was important to them and their families, 82% strongly agreed or agreed. This supports the profile plot for outcomes expectation.
Although there were no significant interactions for the SPAN food frequency and the profile plot showed a decrease in consumption of fruits and vegetables for the gardening group, the gardening survey resulted in 65% strongly agreed or agreed that “because of the gardening program” they eat more fruits and vegetables.

Discussion

Many studies have shown that increased exposure to gardening increases fruit and vegetable intake (Berezowitz et al., 2015; Blair, 2009; Landry et al., 2019; Lerner & Lerner, 2013). This study did not find that a garden-based science curriculum increased students’ food choices of fruits and vegetables (RQ1). In fact, the profile plots for the estimated marginal means showed the opposite was true – students in the gardening group reported eating fewer fruits and vegetables on the post-test compared to the pre-test. Although the SPAN Survey has been shown to have a high internal consistency by both Hoelscher et al. (2010) and this study, it is possible that the nuance of the questions and responses was lost on students with English as their second language. The Flesch-Kincaid score for the SPAN food frequency portion of the survey was 67. This is considered “fairly easy to read” but “might be slightly difficult for people for whom English is not their first language.” When asked specifically if their intake increased “because of the gardening program,” 65% of students strongly agreed or agreed on the gardening survey. The Flesch-Kincaid score for the gardening survey was 73, which is considered “fairly easy to read for a broad audience.” A potential response bias should also be considered as it is
possible that the students completing the gardening survey were subject to social desirability bias and answered what they believed to be the correct answer.

When determining if a school garden-based science curriculum improves students’ attitudes toward consuming fruits and vegetables (RQ2), results from the HBS were considered. Significant interactions for social support, self-efficacy, and self-regulation were reported from pre-test to post-test. However, when comparing the gardening group to non-gardening, these subscales did not show a statistically significant interaction, meaning that the addition of a garden-based science curriculum did not improve students’ attitudes toward consuming fruits and vegetables. However, the profile plots for social support and self-regulation subscales showed similar trends, with the gardening group mean increasing more than the non-gardening group mean. The profile plot for outcomes expectations showed the gardening group mean increased while the non-gardening group mean decreased. This shows promise that the gardening group did increase knowledge of the benefits of consuming fruits and vegetables. The gardening survey corroborated this with 82% strongly agreed or agreed that eating fruits and vegetables is important. These results are different from Blair (2009), who found that gardening did not improve nutrition knowledge more than basic nutrition lessons. The research by Blair (2009) was primarily with elementary grades; this study may show the importance of gardening at the high-school level.

To address RQ3, does social support, self-regulation, self-efficacy, or outcomes expectation toward consuming fruits and vegetables increase consumption of fruits and vegetables, the linear regression showed that only self-efficacy significantly predicted fruit and vegetable consumption. The gardening survey and interviews reinforced these findings with
93% strongly agreed or agreed they are willing to try new foods. All these results underscore the importance of self-efficacy as a determinant of healthful eating. This is consistent with previous studies that cited strong self-efficacy being shown to create lasting behavior changes (Anderson et al., 2000, 2007).

There are several limitations to this study. First, students were able to self-select into the gardening group, creating a potential selection bias. Students who joined the gardening group may have already had experience and/or interest in gardening, making changes in attitudes more difficult to determine. Second, due to limited resources and the virtual nature of the school year, the gardening group size was limited, and data collection was affected. Supplies for up to 25 students were purchased by the school to allow for the implementation of the virtual gardening curriculum, but only 20 students self-selected to participate. The survey tools were disseminated through Google Forms, part of their Good Classroom, as requested by the science teacher. Google Forms does not limit the number of survey submissions by each student; therefore, the final data set showed several students completed the surveys two to four times. While the use of time stamps to determine first submission is a consistent method, it is impossible to know if this attempt was the most accurate reflection of attitudes and consumption. In addition, due to the unpredictable attendance behaviors common to this school, not all students completed the pre- and post-tests. The final data set for the HBS/SPAN Survey (N=49) had 10 students within the gardening group and 39 in the non-gardening group. These small sample sizes make finding significant results difficult. Last, the survey was only provided in English; students whose primary language is Spanish may have benefitted from the survey being translated.
Even though the outcomes of this study did not show significant results of improved attitude and consumption by the gardening group, it did have significant results for self-efficacy when evaluating the whole group. The gardening curriculum at PACHS should continue to focus on building gardening skills and connecting them to nutrition content that can enable an increase in self-efficacy for creating healthy eating habits. Additionally, the program should find ways to improve social support, self-regulation, and outcomes expectations as these have all been linked to improved food choices (Anderson et al., 2000, 2007). The return to in-person instruction should encourage group work and discussion to foster social support; consistent feedback and positive reinforcement from the teacher can improve self-regulation; and enhanced curriculum focusing on the relevance of consuming fruits and vegetables to good health can further develop outcomes expectations.

This study also shows the need for continued research. High school is an important time for nutrition education, but research shows limited time is devoted to this topic (Jandro, 2019; Lytle et al., 2006; Roseno et al., 2017; Story et al., 2009; Williams et al., 2018). Schools that embed a gardening curriculum into science courses with culturally relevant pedagogy and provide multiple opportunities for students to learn about and try healthy foods may improve the attitudes and consumption of this group (Bandura, 1998; Berezowitz et al., 2015; Blair, 2009; Landry et al., 2019; Lerner & Lerner, 2013). Institutionalizing nutrition education into a science course can help ensure time given to this topic is adequate for behavior change (Bandura, 1998; Kanter & Konstantopoulos, 2010). This study showed promise that the use of a garden-based curriculum within science courses can potentially provide the framework to improve both attitudes and consumption of fruits and vegetables; however, continued research is needed.
CHAPTER 4

SUMMARY

This dissertation, through the Engaged Scholar Initiative, was a partnership with Dr. Pedro Albizu Campos High School to improve the learning environment of the rooftop greenhouse as well as evaluate the effectiveness of a garden-based science curriculum. Chapter 1 discussed the architectural plans and grant work for updating the greenhouse into a learning garden. The principal and science teachers provided feedback with each draft to ensure the final blueprints met their expectations. A grant submission to fund the project was also included as a supplemental file.

Chapter 2 evaluated how the garden-based science curriculum impacted students’ attitudes for science. While the results were not statistically significant, they did provide promise that with a larger group of students completing the gardening curriculum, improvements could be seen. The gardening survey indicated students’ interest and enjoyment with the gardening curriculum and the majority felt the curriculum improved their understanding of science concepts and improved their overall grades. The subsequent interviews showed how excited the students were to discuss the gardening program. One student had all her plants ready to show off when the interview began. She talked animatedly about how proud she was of their
successful growth. She referred to the gardening program as “challenging” but “worth it.” She had one more year at PACHS and was looking forward to using the greenhouse once classes resumed in person. Another student described how the entire group was ready and willing to learn and their enthusiasm encouraged him to “do his best” in science. This can be significant for the students at PACHS who may have competing priorities due to family obligations and life choices. One student was in his sixth and final year of high school. He described his complicated path and reflected that options such as the gardening program showed him how much his teachers and the school wanted him to succeed. These positive attitudes expressed in the interviews are important for this age group (especially minority, urban students) as they begin to make career decisions. Potentially improving science attitudes at the high school level may lead to future STEM career choices.

Chapter 3 evaluated how the garden-based science curriculum impacted students’ attitude toward fruits and vegetables as well as their actual consumption of fruits and vegetables. Again, this study did not show statistically significant results between the gardening group and non-gardening group; however, self-efficacy was shown to be a significant predictor of the SPAN food frequency score. Qualitative data collected illustrates students’ positive attitudes toward the gardening program. All three of the students who were interviewed discussed how they ate the produce that was grown through the gardening program and were now willing to try new foods. One student stated she was pleased that she could grow the food instead of needing to purchase it at the store. Another student bragged about how much his family was now growing. Conversations with his relatives in Puerto Rico validated the importance of eating fresh produce. The subjective data collected shows the importance of gardening at the high-school level to
improve knowledge and awareness of healthy eating. The teen years are a time when students become more independent in making food choices. By instilling the importance of consuming fruits and vegetables at this age, it could lead to life-long healthy habits, possibly helping to reduce the rate of overweight and obesity.

Future Work

While this study showed some promise that a garden-based science curriculum could improve attitudes toward science, attitudes toward fruit and vegetable consumption, and overall consumption of fruits and vegetables, there are several enhancements that could be made to improve the program and its outcomes. First, increase the exposure to the garden-based science curriculum. The COVID-19 pandemic resulted in virtual learning for the 2020-2021 school year, which limited the experience of the garden-based science curriculum to a small number of students. The return to in-person instruction along with the remodel of the greenhouse will lead to increased, high-quality exposure to the garden-based curriculum. Future work with larger student numbers can help determine if a garden-based science curriculum can significantly improve attitudes toward science and fruit and vegetable consumption.

Profile plots showed potential, especially for value, enjoyment, and motivation toward science, as well as social support, self-regulation, and outcomes expectations for consuming fruits and vegetables. Therefore, hands-on, engaging activities that focus on increasing knowledge and perceived value of both science and healthy food choices should be continued and emphasized in future garden-based science curricula. Social support, especially friends, can
be a potential indicator of positive attitudes toward both science and fruit and vegetable consumption. The return to in-person instruction should encourage group work and discussion to foster this social support.

A high mean score for self-efficacy for consuming fruits and vegetables was a significant predictor of healthy food consumption. This is especially important since this age group has some control over food choices. Studies have shown that self-efficacy for science can improve both science attitude and achievement, which could lead to an increase in interest in STEM fields (Berezowitz et al., 2015; Williams & Dixon, 2013). This may be especially important for underserved, minority youth; therefore, future garden-based science curricula should continue to focus on improving self-efficacy for both science and fruit and vegetable consumption.

The theories and concepts central to engaged scholarship can also help guide future work at PACHS. Building a community of practice (CoP) that utilizes the wealth of knowledge of the science teachers, the students, and the community can build a strong social network (Lave & Wenger, 1991; O’Brien & Battista, 2019). A study by Fletcher et al. (2011) found that eating behaviors and health status were similar among teen friend groups. A review by Smith and Christakis (2008) found “studies of social network influences on health, the role of social support in determining individual health, and spillover effects of illness from one person to others have all documented the interconnectedness or interdependence of health among socially tied individuals” (p 420). Teens are highly influenced by peers (Fletcher et al., 2011) and this study found that social support is an important factor (although not statistically significant) for positive attitudes toward both science and healthy eating.
Since real-world, hands-on experience through a garden-based science curriculum has the potential to improve perceptions of science and increase fruit and vegetable consumption in high school students, the program should be continued in person at Dr. Pedro Albizu Campos High School as well as with at-home activities to build a CoP and social networks.

Community Dissemination

The G|R|E|C Architecture firm has promoted their work with this project on their social media and tagged PACHS on Instagram and Facebook. Once grant funding is secured, the updated greenhouse will be publicized on the sponsor’s website, if appropriate. After completion of the greenhouse update, photos and the results of this study will be available on the school’s website and the YCCS’s website, if approved. To share the information with a wider audience, the Chicago Tribune will be contacted since they have had recent interest in Dr. Pedro Albizu Campos High School. A journalist will be invited to the school for photos and interviews with students and teachers. Additionally, an event could be held to showcase the new greenhouse redesign. Community members, parents, and YCCS administration will be invited; science students will provide tours of the garden and prepare recipes that highlight the produce grown in the garden. The goal of this publicity will be to encourage more community partners to work with Dr. Pedro Albizu Campos High School.
Final Thoughts

Overall, I learned a lot by working with a community high school through the Engaged Scholarship Initiative. The biggest lesson was the need to remain flexible and keep community priorities and values at the forefront. Working with this group, which included the principal, science teachers, and students, led to an improved method for teaching science with embedded nutrition concepts, but it was not without its challenges. The COVID-19 pandemic forced a change in how the curriculum would be presented as well as the number of students that would be included. Several versions of the study design needed to be prepared for the proposal as the mode of teaching for the 2020-2021 school year was unknown. When PACHS determined it would provide remote learning for the school year, the study design was quickly determined so as not to delay its start. Information about the gardening program was relayed to students to self-select enrollment and at-home gardening supplies were identified, purchased, and distributed. This group needed to work together to ensure these steps were completed swiftly. The teacher and student focus group prior to the start of the school year identified priorities for both the greenhouse and the curriculum. As both were being designed, these priorities were integral to ensuring needs were met.

The benefits of engaged scholarship outweighed these challenges as the result is a garden-based science curriculum that can be conducted within the updated greenhouse design. Each member of the group brought their own strengths and expertise allowing for bidirectional learning, sharing of resources, collective decision making, and outcomes that are beneficial to the
community. Since this project was a priority for the principal, science teacher, and school community, the program has a high probability of being sustained.

As higher education continues to emphasize the need for real-world, experiential learning, engaged scholarship should become a predominant method for teaching research. Universities should continue to develop partnerships to engage in research for the public good (Johnson, 2017). By allowing faculty and students the opportunity to research, learn, and work side by side with community members, they can bridge the theory/practice divide and achieve more than working alone. Specifically at PACHS, engaged scholarship opportunities exist for decreasing food insecurity, increasing trauma-informed care, increasing student advocacy to reduce social injustices, and promoting inclusivity, among others. Hopefully, this work will be one of many Engaged Scholarship Initiative projects at PACHS and the Youth Connection Charter Schools.
REFERENCES


Lerner, R. & Lerner, J. (2013, March 12). The positive development of youth: Comprehensive findings of the 4-H study of positive youth development. 4-H Positive Youth Development and Mentoring Organization. https://4-h.org/about/research/


APPENDIX A

FOCUS GROUP GUIDE
Student/Teacher Focus Group Interview Guide

1. Have you utilized the greenhouse in the past?
   a. Was it for class? The gardening club? Or personal?
   b. Did the space meet the needs of you and/or group?
   c. What issues did you have, if any?
2. What would entice you to use it more?
   a. During class?
   b. In between classes or at lunch?
   c. After school?
3. What barriers are there to using the greenhouse space?
4. In a perfect world, how would you use the space?
   a. Would you want to see this produce used for lunch?
   b. Would you want to take any produce home to your family?
5. In a perfect world, what would the space include?
   a. Tables/chairs/music/others?
6. What other resources do you need to be successful in utilizing the greenhouse?
   a. To teach?
   b. To grow produce?
   c. To maintain the greenhouse?
7. What types of produce would you like to see grown in the greenhouse?
   a. Fruit
   b. Vegetable
   c. Herbs
   d. Microgreens
   e. Others
8. Would you want to see this produce used for lunch? Would you want to take any produce home to your family?
9. Other suggestions?
RE: Permission to use blueprints

Elizabeth Fragoso <fragoso@grecstudio.com>
Mon 9/13/2021 1:10 PM
To: Nancy Prange <nprange@niu.edu>

Absolutely, go for it!

From: Nancy Prange <nprange@niu.edu> Sent: Saturday, September 11, 2021 10:28 AM
To: Elizabeth Fragoso <fragoso@grecstudio.com> Subject: Permission to use blueprints

Hi Elizabeth –

I hope all is well with you. I am continuing to look for local grants/funders to hopefully have the greenhouse complete before the end of the year.

I am finishing up writing my dissertation and would like to include the blueprints as an appendix and I know this work is copyrighted for architects. Would you give me permission to include the PACHS greenhouse blueprints in my dissertation? If so, I will include the email giving permission within the appendix.

Thanks!

Nancy

Sent from Mail for Windows
APPENDIX C

IRB APPROVAL LETTER
Approval Notice
Initial Review

28-Jul-2020

TO: Nancy Prange (01235602)
School of Health Studies


Your Initial Review submission was reviewed and approved under Member Review procedures by the Institutional Review Board on 28-Jul-2020. Please note the following information about your approved research protocol:

Protocol Approval period: 28-Jul-2020 - 27-Jul-2021

It is important for you to note that as an investigator conducting research that involves human participants, you are responsible for ensuring that this project has current IRB approval at all times. If your project will continue beyond the above date, or if you intend to make modifications to the study, you will need additional approval and should contact the Office of Research Compliance, Integrity, and Safety for assistance. In addition, you are required to promptly report to the IRB any injuries or other unanticipated problems or risks to subjects or others.

Please note that the IRB has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

Informed Consent:

Unless you have been approved for a waiver of the written signature of informed consent, this notice includes a date-stamped copy of the approved consent form for your use. NIU policy requires that informed consent documents given to subjects participating in non-exempt research bear the approval stamp of the NIU IRB. This stamped document is the only consent form that may be photocopied for distribution to study participants.

If consent for the study is being given by proxy (guardian, etc.), it is your responsibility to document the authority of that person to consent for the subject. Also, the committee recommends that you include an acknowledgment by the subject, or the subject’s representative, that he or she has received a copy of the
consent form.

You are responsible for retaining the signed consent forms obtained from your subjects for a minimum of three years after the study is concluded.

Continuing Review:

Continuing review of the project, conducted at least annually, will be necessary until data collection is complete and you no longer retain any identifiers that could link the subjects to the data collected. Please remember to use your protocol number (HS20-0360) on any documents or correspondence with the IRB concerning your research protocol.

Closing the Study:

Please note that a final report submission should be created in the record in lieu of an annual continuation form if data collection has ended and the data are free of identifiers. The final report is a separate submission form in the list of options in the InfoEd record, and it may be submitted prior to the annual review deadline.

With all of this said, the IRB extends best wishes for success in your research endeavors!
APPENDIX D

PARENT CONSENT LETTER
Parent Permission Email Message for SCIENCE COURSES

SUBJECT: Parent Permission for a Minor to Participate in a Research Study

Title of Study: Seeds of Knowledge: Integration of a Learning Garden into Science and Health Curriculum at Albizu Campos High School, a Youth Connection Charter School

Investigator: Nancy Prange, Northern Illinois University, College of Education 815-753-386

Dear Parent/Guardian:

Your child is enrolled in either a science course and has the opportunity to participate in a research study. Please read the following information carefully.

KEY INFORMATION:
- This is a voluntary research study on students’ attitudes toward science and food choices after exposure to the new garden curriculum.
- 1-2 surveys will be given prior to starting the gardening curriculum and at the conclusion of the curriculum.
- The benefits include students participating in a hands-on gardening curriculum to help improve science understanding and attitude as well as improve student food choices. Students will be asked to provide their school ID to match the pre- and post-test scores, a risk of participating is that information regarding an individual student’s scores could be seen by an unintended party.

DESCRIPTION OF THE STUDY: The purpose of this study it to determine if a school-based gardening curriculum improves attitudes and achievement in science and/or student food choices. If you agree to allow your child/ward to be in this study, your child/ward will be asked to do the following things: participate in 1-2 surveys during the school day prior to beginning the gardening curriculum and again at the end of the curriculum. Each survey will take 10-15 minutes to complete. Students enrolled in science courses will be asked questions about their attitudes towards science and complete a food frequency survey. Whole class achievement scores in science will be compared to last year’s class (prior to the garden curriculum). Students enrolled in health courses will only complete the food frequency survey.

RISKS AND BENEFITS: Your student will be asked to provide their school ID to match the pre-test and post-test scores. Although all data will be kept secure, a risk of participating is that information regarding an individual student’s pre/post test scores could be seen by an unintended party. Once surveys are paired; your students ID will be removed. Science achievement scores will not have identifiers.
The benefit of participating in this study is the opportunity to participate in a hands-on gardening curriculum that may improve both science attitude and achievement and/or food choices.

CONFIDENTIALITY:
The records of this study will be kept strictly confidential. Research records will be kept in a locked file, and all electronic information will be coded and secured using a password protected file.

YOUR RIGHTS: The decision to allow your child/ward to participate in this study is entirely up to you. You may refuse to have your child/ward take part in the study at any time. Your decision will not result in any loss of benefits to which you are otherwise entitled. Your child/ward has the right to skip any question or research activity, as well as to withdraw completely from participation at any point during the process.

You have the right to ask questions about this research study and to have those questions answered before, during, or after the research. If you have any further questions about the study, at any time feel free to contact the researcher, Nancy Prange at nprange@niu.edu or by telephone at 815-753-6386 or Dr. Laura Johnson at lrjohnson@niu.edu or by telephone at 815-753-5494. If you have any questions about your child/ward’s rights as a research participant that have not been answered by the investigators or if you have any problems or concerns that occur as a result of your child/ward’s participation, you may contact the Office of Research Compliance, Integrity, and Safety at (815)753-8588. If you have any problems or concerns that occur as a result of your child/ward’s participation, you can report them to the Office of Research Compliance at the number above.

Please notify the school if you do not wish your student to participate.

Thank you for your support!

Sincerely,

Melissa Lewis
Principal, Dr. Pedro Albizu Campos High School
APPENDIX E

ASSESSMENT OF ATTITUDES IN SCIENCE CONSTRUCTS (AASC-4)
Student ID: _____________________

Science Survey

Thank you for completing this survey on your thoughts about science. By completing the survey, you give your consent/assent to participate in this study. The survey should take approximately 10 minutes and your answers will be confidential.

- Taking part in this survey is up to you and will not affect your grades in school or your ability to take part in any school activities.
- If you do not want to answer a question, you can skip it.
- You may stop taking part in this survey at any time.

INSTRUCTIONS: Please read the questions carefully and check the box that best fits your answer.

I am:

☐ Male
☐ Female
☐ Transgender

I am a:

☐ Sophomore
☐ Junior
☐ Senior

<table>
<thead>
<tr>
<th></th>
<th>A. Strongly agree</th>
<th>B. Agree</th>
<th>C. Somewhat agree</th>
<th>D. Somewhat disagree</th>
<th>E. Disagree</th>
<th>F. Strongly disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>I want to know more about science.</td>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>2.</td>
<td>I can learn about science.</td>
<td></td>
<td></td>
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<td>3.</td>
<td>I can do science experiments.</td>
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<td>4.</td>
<td>I think science is cool.</td>
<td></td>
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<td>5.</td>
<td>I need to learn science to do well in other subjects.</td>
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<td>6.</td>
<td>My friends like science.</td>
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<td>7.</td>
<td>My teacher likes science.</td>
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<td>8.</td>
<td>My friends like to talk about science.</td>
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<td>9.</td>
<td>My family likes science.</td>
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<tr>
<td>10.</td>
<td>It is important to know science to get a good job.</td>
<td></td>
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<tr>
<td>11.</td>
<td>My family likes to do science experiments at home.</td>
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<tr>
<td>12.</td>
<td>My teacher likes teaching science lessons.</td>
<td></td>
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<tr>
<td>13.</td>
<td>Science is fun.</td>
<td></td>
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<tr>
<td>14.</td>
<td>My teacher likes to show me science experiments.</td>
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<tr>
<td>15.</td>
<td>Learning science often makes me nervous.</td>
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<td>16.</td>
<td>I want to be good at science.</td>
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<td>17.</td>
<td>I need a lot of help with science.</td>
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<tr>
<td>18.</td>
<td>I like to learn science with my family.</td>
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<tr>
<td>19.</td>
<td>Science is too hard.</td>
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<tr>
<td>20.</td>
<td>I like to do science experiments in school.</td>
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<tr>
<td>21.</td>
<td>I need to learn science for what I want to be when I finish school.</td>
<td></td>
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<tr>
<td>22.</td>
<td>My friends think science is cool.</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>23.</td>
<td>I can be a scientist when I’m older.</td>
<td></td>
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</tr>
</tbody>
</table>
CODE:
Perception of Teacher = questions 7, 12, 14
Self-efficacy = questions 2, 3, 23
Fear of Failure = 15, 17, 19
Value of Science = 10, 21, 24
Enjoyment of Science = 4, 13, 20
Motivation toward Science = 1, 5, 16
Attitudes of Friends toward Science = 6, 8, 22
Attitudes of Family toward Science = 9, 11, 18
RE: Health Beliefs Survey

Eileen Bill <eileen@vt.edu>
Wed 7/8/2020 9:45 AM

To: Nancy Prange
CRHB Health Beliefs with Factor Loadings.doc
384 KB

Hi, Nancy!

This is the last paper pencil version of the Health Beliefs Survey used in our research. You will see the Food Beliefs portion is gauged toward food purchases, our outcome measure. The document includes the factor analysis-based scoring approach. You'd need to revise the survey to reflect the age of your participants and the target nutrition-related behaviors in your intervention.

Best regards,

Eileen Bill

On Tue, Jul 7, 2020 at 8:45 PM Nancy Prange <nprange@niu.edu> wrote:

Dr. Anderson-Bill

I appreciate any help you can provide!

Best

Nancy

On Jul 7, 2020, at 3:57 PM, Richard Winett <rswinett@vt.edu> wrote:

Nancy. Thank you for your interest. I am referring your questions to Eileen Anderson-Bill who developed the scales.
Richard
Dr. Winett –

I hope this email finds you well during this unprecedented time.

I am an doctoral student in Educational Psychology at Northern Illinois University. I am completing an Engaged Scholarship dissertation with an alternative high school in Chicago. The project includes writing grants to renovate the current green house into a learning garden, writing science and health curriculum to include the garden and evaluating both science attitudes and achievement as well as eating behaviors. I have grounded all of this work in the Social Cognitive Theory.

In my research I came across several articles you authored with Dr. Eileen Anderson that utilized a Food Beliefs Survey. I would like to ask your permission to use the scale for my study. I did find a version of it on Virginia Tech website within a thesis titled “Weight Gain Prevention: Identifying Targets for Health Behavior Change” in Young Adults Attending College” but from your articles, it seems to have been adapted. Would you be able to share the original tool? If so, I do have a few additional questions. When you utilized the tool, did you keep the questions grouped by social support, outcomes expectancy, self-efficacy, etc? Or did you randomize the questions? I’d like to keep the tool as similar to the original as possible to keep the validity.

Thank you for your time!

Best
Nancy

Nancy Prange, MS,RDN,LDN
Doctoral Candidate, Educational Psychology
Northern Illinois University

Sent from Mail for Windows 10
HEALTH SURVEY

Thank you for completing this survey on your fruit and vegetable intake. By completing the survey, you give your consent/assent to be in this study. The survey should take approximately 15 minutes and your answers will be confidential.

- Taking part in this survey is up to you.
- If you do not want to answer a question, you can skip it.
- You may stop taking part in this survey at any time.

INSTRUCTIONS: Please read the questions carefully and check the box that best fits your answer.

Name:

School ID:

I identify as:

- [ ] Male
- [ ] Female
- [ ] Transgender
- [ ] I prefer not to say

I am a

- [ ] Sophomore
- [ ] Junior
- [ ] Senior
INSTRUCTIONS: Tell us about your food intake.

<table>
<thead>
<tr>
<th>In the last 3 MONTHS, how often do you eat . . .</th>
<th>Less than once per week</th>
<th>About 1 time per week</th>
<th>2-3 times per week</th>
<th>4-6 times per week</th>
<th>Once per day</th>
<th>2 or more times per day</th>
</tr>
</thead>
<tbody>
<tr>
<td>100% fruit juice like orange, apple, grape (not soda or other drinks like Kool-Aid or fruit punch)</td>
<td></td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>fresh fruit like bananas, apples, oranges, mangos, etc. (do not include juice)</td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>canned fruit or smoothies (do not include juice)</td>
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<tr>
<td>green salad (like lettuce, spinach) or any green vegetables like spinach, green beans, broccoli, or other greens tomatoes or salsa fresca</td>
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<tr>
<td>vegetable soup, stew with vegetables or other main dishes with vegetables</td>
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<tr>
<td>starchy vegetables like potatoes, corn, or peas (do not count French fries, fried potatoes, potato chips, or any other type of chips)</td>
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<tr>
<td>carrots, squash, sweet potatoes, or any other orange vegetables</td>
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<tr>
<td>other vegetables like peppers, zucchini, asparagus, cabbage, cauliflower, cucumbers, mushrooms, eggplant, celery, or artichokes</td>
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<tr>
<td>beans such as pinto beans, baked beans, kidney beans, refried beans, or pork and beans (do not count green beans)</td>
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</tr>
</tbody>
</table>
Health Survey, part 2 of 4

**INSTRUCTIONS:** Use this scale to tell us if you agree with the following statements.

<table>
<thead>
<tr>
<th>Statement</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>My family eats 5 servings of fruits and vegetables every day.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>My closest friends eat 5 servings of fruits and vegetables every day.</td>
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<td></td>
</tr>
<tr>
<td>My family have told me they want to eat more fruits and vegetables.</td>
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</tr>
<tr>
<td>My closest friends have told me they want to eat more fruits and vegetables.</td>
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<tr>
<td>If my family and closest friends ate more fruits and vegetables, so would I.</td>
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<tr>
<td>100% fruit juice is available in my home.</td>
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<tr>
<td>Fruits are available in my home.</td>
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</tr>
<tr>
<td>Vegetables are available in my home.</td>
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<tr>
<td>I am likely to try a new fruit or vegetable.</td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>I would eat more fruits and vegetables if . . .</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>they took less time to prepare.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>I knew how to choose FRESH fruits and vegetables.</td>
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</tr>
<tr>
<td>I knew how to prepare them.</td>
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<tr>
<td>they were more filling.</td>
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</tr>
<tr>
<td>the restaurants I went to served them.</td>
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<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
I would eat more fruits and vegetables if . . .

| I thought about them more when looking for something to eat. | Strongly Agree | Agree | Somewhat Agree | Somewhat Disagree | Disagree | Strongly Disagree |
| They didn’t contain too much sugar for me. | | | | | | |
| They didn’t cost too much money. | | | | | | |

Health Survey, part 3 of 4

These questions ask how CERTAIN you are that you can do different things to eat more fruits and vegetables on most days in lots of different situations. Think about times when it will be easy to do these things and when it will be harder.

When deciding how sure you are you can do these things, we want you to think about doing them:

- **ALL or MOST of the time**, not just once or twice.
- For a long time...until next year...or even longer!
- In a lot of different situations – like when you are...
  - deciding what to eat when at home, alone, watching TV or doing chores…
  - eating with your family…
  - eating out with friends or at a party …
  - at a fast-food restaurant…

INSTRUCTIONS: Use any number from 0 to 10 on the following scale to tell how certain you are that you can – all or most of the time:

0 = I am certain I CANNOT

10 = I am certain I CAN

<table>
<thead>
<tr>
<th>How certain are you that you can …</th>
<th>How certain? (0-10)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FRUITS AND VEGETABLES</strong></td>
<td></td>
</tr>
<tr>
<td>1. bring fruit to work or school for a snack every day?</td>
<td></td>
</tr>
<tr>
<td>2. eat at least 5 servings of fruits and vegetables every day?</td>
<td></td>
</tr>
<tr>
<td>3. eat vegetables (like carrot or celery sticks) for a snack?</td>
<td></td>
</tr>
<tr>
<td>4. eat fruit for a snack?</td>
<td></td>
</tr>
<tr>
<td>5. have a side salad instead of French fries when dining out?</td>
<td></td>
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<tr>
<td>6. drink fruit or vegetable juice at meals?</td>
<td></td>
</tr>
</tbody>
</table>
Health Survey, part 4 of 4

Now, tell us what you expect will happen when you eat more fruits and vegetables.

**INSTRUCTIONS:** Use this scale to tell us if you agree the following will happen.

<table>
<thead>
<tr>
<th>If I eat healthier foods every day, I expect:</th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I will have more energy.</td>
<td></td>
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<tr>
<td>I will feel healthier and happier.</td>
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<tr>
<td>I will live longer.</td>
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<tr>
<td>*I will be hungrier.</td>
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<tr>
<td>*I will be unhappy and irritable.</td>
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<tr>
<td>My health will improve.</td>
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<tr>
<td>*I will miss eating the foods I love.</td>
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</tr>
<tr>
<td>I will have healthier skin, hair, or teeth.</td>
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<tr>
<td>I will be less likely to get cancer or heart disease.</td>
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</tr>
<tr>
<td>*Shopping for healthy foods will be a lot of trouble.</td>
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<tr>
<td>*I will be bored with what I have to eat.</td>
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<tr>
<td>*I will have to change a lot of my favorite foods.</td>
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<tr>
<td>*I won’t be able to eat the same foods as the rest of my family.</td>
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</tr>
<tr>
<td>*I will have to spend too much time keeping track of what I eat.</td>
<td></td>
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<tr>
<td>*The food I eat will not taste good.</td>
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<tr>
<td>*It will take too long to prepare meals and snacks.</td>
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<tr>
<td>*I will have to plan my meals too far in advance.</td>
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</tr>
</tbody>
</table>
If I eat healthier foods every day, I expect:

<table>
<thead>
<tr>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I will be doing what I know I should.</td>
<td></td>
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<tr>
<td>*I won’t be able to stick with it – I’ll just go back to my old habits.</td>
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</tbody>
</table>

THANK YOU!
Thank you for taking the time to complete the survey.
APPENDIX G

GARDENING SURVEY
GARDENING SURVEY

Thank you for completing this survey on your thoughts about the gardening program. By completing the survey, you give your consent/assent to be in this study. The survey should take approximately 10 minutes and your answers will be confidential.

• Taking part in this survey is up to you.
• If you do not want to answer a question, you can skip it.
• You may stop taking part in this survey at any time.

INSTRUCTIONS: Please read the questions carefully and check the box that best fits your answer.

Name:

School ID:

I identify as:

☐ Male
☐ Female
☐ Transgender
☐ I prefer not to say

I am a

☐ Sophomore
☐ Junior
☐ Senior
INSTRUCTIONS: Please rate your agreement to the following statements.

<table>
<thead>
<tr>
<th></th>
<th>Strongly Agree</th>
<th>Agree</th>
<th>Somewhat Agree</th>
<th>Somewhat Disagree</th>
<th>Disagree</th>
<th>Strongly Disagree</th>
</tr>
</thead>
<tbody>
<tr>
<td>I enjoyed learning about growing plants.</td>
<td></td>
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<tr>
<td>I enjoyed the hands-on experience of gardening.</td>
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<tr>
<td>The gardening program helped me understand science concepts.</td>
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<tr>
<td>Because of the gardening program, my science grade has improved.</td>
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<tr>
<td>Because of the gardening program, I enjoy science more.</td>
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<tr>
<td>I want to continue in the gardening program.</td>
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<tr>
<td>My friends want to be in the gardening program.</td>
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<tr>
<td>My family encouraged me to be in the gardening program.</td>
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<tr>
<td>Because of the gardening program, I eat more fruits or vegetables.</td>
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<tr>
<td>Because of the gardening program, I am willing to try new foods.</td>
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<tr>
<td>My family was able to eat the produce I grew.</td>
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</tr>
<tr>
<td>It is important to me and my family to eat fruits and vegetables.</td>
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</tr>
</tbody>
</table>

If you would be willing to participate in a short interview about your responses, please enter your contact information.

THANK YOU!
Thank you for taking the time to complete the survey!
APPENDIX H

INTERVIEW GUIDE
Student Interview Guide

1. Introductions of self and students.
2. Can you describe the gardening curriculum? What did you learn? Was it interesting? Was it challenging?
   a. Please give an example.
3. How do you feel about science?
   a. How does the gardening program contribute to those feelings? Please give an example.
4. What barriers were there to completing the gardening program?
5. What types of produce was grown in the greenhouse?
   a. Fruit
   b. Vegetable
   c. Herbs
   d. Microgreens
   e. Others
6. Tell me how you feel about produce. What was favorite?
   a. How has attitude about produce changed?
   b. Are you eating more? Are you willing to try new foods?
      i. Did your family eat the produce? Did this help your family meet food needs?
      ii. Did your family contribute to your experience with the gardening program?
7. Anything else you want to tell me about using the greenhouse garden?