Engaging and Maintaining a School Garden with a Garden Committee

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Engagement with the school garden at Clayton Academy is low among staff and students. School gardens give students the chance to receive hands on learning experiences outside of the classroom and have also been used to support students' social, emotional, and physical health. The problem of practice is the lack of garden use/engagement among staff and students with the school garden. Clayton Academy is part of the Pittsburgh Public School District located on the Northside of Pittsburgh and comprised of students in grades 6-12, with approximately 40-50 total students and 30 staff members. To address the lack of staff and student engagement with the school garden at Clayton Academy and ongoing challenges with sustainability, responsibility, and maintenance I formed a garden committee comprised of four teachers and one social worker that designed lesson plans to use across various curriculums and developed a schedule to maintain the school garden at Clayton Academy. My primary inquiry questions were: (1) how often and in what ways do teacher teachers and students engage in school garden, (2) how and to what extent does the garden committee develop and disseminate garden-themed curriculum for classroom lesson plans and activities, and (3) how and to what extent does the garden committee complete and coordinate efforts to maintain school garden? Measures included staff survey, garden committee meeting questions and notes, lesson plans, and a garden maintenance schedule. To analyze the data, I compared the number of teachers who used the garden in pre/post survey, coded qualitative responses for themes, and analyzed notes taken during monthly garden committee meetings as

well as counted the lessons created/modified. The analysis shows the creation of a school garden committee had a positive impact on staff and students school garden engagement.

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Preface

To my hero, my late husband CPT Jason M. West, who continues to push me even though he isn't with us anymore. I always strive to make him proud and keep his memory alive and becoming Dr. West was a dream I had and a way to honor him. To my parents for their endless love and support. I strive to make you proud of me and am grateful to have you both by my side. Thank you to my supportive friends and family members for cheering me on and encouraging me to follow my dreams. Thank you to my HPA cohort and Pitt 2019 cohort for their support and teamwork. Thank you to my committee, especially Dr. Anderson and Dr. Ross for their constant support, time, help and assistance to get me to the finish line, as well as Adia Effiong.

I want to shout out my Clayton Academy staff members who assisted me with my intervention as well as their constant support and going above and beyond for me when I needed them the most. They continue to never let me forget that I'm Dr. West as well as my family. I sincerely thank my entire support team for their love, encouragement, patience, and guidance. Without my family and friends, I would not have made it this far. To my past and future students, always reach for the stars and stay motivated!

1.0 Naming & Framing the Problem of Practice

1.1 Broader Problem Area

School gardens have many benefits to students. The focus on today's school gardens focuses on self-esteem, social skills, improving eating habits, academic achievement, and increasing garden knowledge (Yu, 2012). Poor diets have been tied to obesity and chronic disease for younger children and youth and threaten the health of adolescents (Greer et al., 2019). Garden activities at school have shown improvement in eating preferences in children. Exposure to gardens can be conducted in various ways such as hands on learning, taste tests, and cooking (Ratcliffe et al., 2011).

Schools can both help or hinder children's diet depending on what foods are offered and consumed since they spend most of their day at school. Many students receive the majority of the day's calories from school breakfast and lunch program meals, which provides a huge opportunity for schools to be part of the solution (Larson & Story, 2010). At the same time, foods and beverages sold at school from vending machines, snack bars, school stores, and fundraisers typically do not follow federal standards and are often foods high in fat and sugar. School gardens are a way to teach healthy eating behaviors and incorporate hands-on learning experiences across interdisciplinary curriculums (California School Garden Network, 2006).

One promising idea in the nutrition education community is the idea of a school garden (Heim et al., 2009). School gardens provide a novel learning environment to expose kids to new foods, increase acceptability, and allow kids to taste fruits and vegetables they have never had before. School gardens provide hands-on learning experiences, connections to the real world and

curriculum (Davis-Taylor, 2021), increase nutrition/garden knowledge, and create social relationships with peers that can benefit students for the rest of their life (Lucke et al., 2021). Benefits to school gardens also include psychological, emotional, and physical health as well. There is some evidence that school gardens can support students to perform better at school and consume fruits and vegetables they have never tried before (Fitzgerald et al., 2013).

Even though there are many promising possibilities for school gardens, they also bring about challenges. Funding is a major issue because schools often do not have a budget to purchase items or materials for the garden or to provide daily and seasonal maintenance (Yu, 2012). Another common barrier to using a school garden is lack of planning time and the perception that it takes away instructional time (Davis-Taylor, 2021). Members of schools such as teachers and staff may experience teacher burn-out and do not have the time or desire to help with the school garden (Yu, 2012). Lack of garden knowledge and experience also present challenges such as knowing when to plant and what to plant each season (Greer et al., 2019). Thus, maintaining a school garden and teacher and student engagement over time can be very difficult.

In 2018, a school garden grant was awarded to Clayton Academy from Grow Pittsburgh that helped to build a garden and integrate the garden into the existing curriculum. This has been an important step toward better serving our students' nutritional needs. However, the garden is currently underused and at-risk of not continuing following the completion of the grant cycle in 2022.

1.2 Organizational System

The Pittsburgh Public School District (PPS) is the largest of 43 school districts in Allegheny County and the 2nd largest in Pennsylvania (www.pghshools.org). PPS is a public, non-profit education system with an enrollment of 22,859 children in grades K-12. There is a total of 54 schools throughout the school district with a total number of 4,192 employees and 2,070 teachers. Every child receives a free breakfast and lunch five days a week. PPS is a very diverse district with 53% of the population being Black, 33% white, and 14% other. There are 95 native spoken languages at PPS and children come from 57 different countries with a total of 1,108 English language learners.

Health and Physical Education teachers in the district are required to have a four-year degree in the subject and be certified in Health and Physical education with the state of Pennsylvania. Students in grades K-5 require one health/gym class per school year, middle school (6-8) requires one health and one gym class per semester, and grades 9-12 requires two health courses and four gym courses in order to graduate.

Clayton Academy is an alternative education school consisting of 30 teachers and staff members for middle and high school combined. Middle and high school's curriculum consists of Math, Science, History, English, and Physical education classes. Only the high school students have Business and Art classes. Clayton Academy students wear uniforms and have norms (rules) for class, hallways, cafeteria, bus, and building.

Clayton's school garden began in 2018 through a school grant from the local organization Grow Pittsburgh (www.growpittsburgh.org). Grow Pittsburgh comes 3 times a year to assist with planting and maintaining the school garden. They provided all the equipment and tools needed to maintain the garden daily. Grow Pittsburgh has also provided cooking lessons to students with

food from the garden and the school garden has provided learning opportunities for students. Through interviews with Clayton staff members, they have stated that students do not know where food comes from, have not been exposed to fruits and vegetables, and they've never eaten some of the foods from the school garden. Some students think food comes from the grocery store; they do not know it comes from the ground. However, when they made a smoothie from produce from the school garden students actually enjoyed it and got to see how to cook with foods grown from the school garden.

1.3 Stakeholder Description & Analysis

The stakeholders involved in this problem of practice are teachers and counselors, students, parents, and volunteers.

1.3.1 Teachers and counselors

Health and physical education and science teachers along with counselors have a lot of engagement and influence in the garden; however, they do not have much power with the decision to implement time spent in the garden. They may experience negative outcomes due to additional work with schedule changes and coverages, even though this engagement could potentially have a positive impact on students. The most important thing teachers and counselors should care about is student success and what's best for them academically. The potential losses for being directed to engage in the school garden more may be a loss of independence, comfort, control, and relationships with students/administration/team leaders. Teachers may not feel comfortable with

the curriculum topic, may not want to adapt to the change, and may not want students missing their classes so they can attend the gardening lesson/activity.

1.3.2 Students

Students in grades 6-12, 70% males and 30% females make up Clayton Academy, however they have no power or control of resources. Many students do not consume fruits and vegetables willingly at breakfast and lunch; however, they often choose candy, pop, and chips from the school store. They could potentially have a negative outcome when engaging in the garden more because they will have to miss formal academic time to spend time in the school garden and many students have never seen a garden let alone worked in one, which decreases their garden knowledge and skills for working with seeds, soil, and garden tools. Students who have worked in the garden enjoy their time outdoors learning new skills and working together. The potential losses would be comfort (e.g., bending, kneeling) while working in garden, resources such as garden tools and seeds, and time such as potential loss from classroom learning.

1.3.3 Parents/Volunteers

Parents of Clayton students and volunteers from staff, community, and outside organizations such as Grow Pittsburgh could be asked to participate but this would add to their busy schedules. In the past, parents have not been involved with school activities. They are not directly impacted if the garden is not being engaged in by students, however they will benefit if students learn in the garden and might enjoy engaging and learning themselves. Parents and volunteers do not have any power in garden activities, but they are encouraged to get students more

engaged. Grow Pittsburgh, however, has been involved from the start of the school garden. They have been a great asset to Clayton's garden.

1.4 Statement of Problem of Practice

The problem of practice is that staff and students at Clayton do not engage with the school garden. Just because a school garden exists does not mean that it is used wisely and effectively. Members of schools such as teachers and staff often experience teacher burn-out and do not have time or desire to help with the school garden (Yu, 2012). Prior to the intervention, a garden committee existed at Clayton, but it was not successful due to a lack of leadership, lack of interest, no encouragement to use the garden, and COVID-19. These are a few reasons why engagement was so low. The only teachers using the garden were science teachers and former committee members when Grow Pittsburgh was in attendance and conducted garden lessons. As a health and physical education teacher, it is my job educate and empower students to make healthy choices and engaging them in a school garden can help. When students know where food comes from it bridges the gap between farm to table, it allows them to develop healthy relationships with food, form healthy eating habits, and learn about sustainability. Gardens provide physical, social, and psychological benefits as well as knowledge on nutrition, science, math, and other subjects. Engaging in a school garden can have benefits for staff, students, and community members as well. Involving various stakeholders (i.e., teachers, students, parents, volunteers) provides opportunities to maintain and sustain the garden and increase engagement with the school garden, including learning opportunities outside of the classroom.

1.5 Review of Supporting Knowledge

1.5.1 Where school gardens came from: A brief history

Gardens originated in Europe and arrived in the United States during the 1890's and school gardens began in schools during the 20th century (California School Garden Network, 2006). On a national level, school gardens formed a method of instruction not just in agriculture but in personal and civic attributes such as an appreciation of nature, self-respect, good citizenship, and hard work (Yu, 2012). During World War I and World War II, "victory" gardens took root to increase food supply; however, school gardens decreased in the 1950's because the focus of education was now on technology. In the 1970's, an environmental movement began, and school gardens gained interest again and continued to grow as a way to teach healthy eating behaviors and incorporate hands on learning experiences across interdisciplinary curriculums (California School Garden Network, 2006). Today, the focus on school gardens focuses on self-esteem, social skills, improving eating habits, academic achievement, and increasing garden knowledge (Yu, 2012).

1.5.2 What is the research base for school gardens?

1.5.2.1 School gardens can support students' relationships to food and choices about food.

School gardens have been used to support students' knowledge, awareness, attitudes, and behaviors regarding healthy foods. For example, several studies distributed pre and post surveys to students after they completed garden sessions once or twice a week for approximately four months (Heim et al., 2009; Savoie-Roskos et al., 2016; Ratcliffe et al., 2011). The results were enjoyment working in the garden, learning about fruits and vegetables, taste testing, preparing

nutritious snacks with the fruits and vegetables from the garden. There was also an increase in food preference, healthy snack choices, and asking behavior for fruits and vegetables.

Garden activities at school as well as attending farmer's markets have shown improvement in eating preferences in children. Savoie-Roskos et al. (2016) completed a systematic review of 14 articles which analyzed garden interventions to determine if children's fruit and vegetable consumption increased through knowledge, exposure, and preference. The studies demonstrated an increase in dietary fiber, increased vegetable servings per day, as well as fruit and vegetables increased in 6th graders in garden groups.

Exposure to gardens can be conducted in various ways such as hands on learning, taste tests, and farmers markets. Ratcliffe et al. (2011) completed a study with a sample size of 320, 6th grade students between the ages of 11-13 in San Francisco. Garden sessions were completed once a week for an hour with 20 minutes of instruction in garden or classroom and 40 minutes of hands-on learning in garden. Garden activities consisted of exposing students to vegetables and peer and adult modeling through planting, tending, harvesting, preparing, and consuming the vegetables grown. Community events were incorporated for families and peers to model the garden activities. A taste test was also given that included five vegetables, which were carrots because they were familiar, string beans, broccoli, snow peas, and Swiss chard because it was unfamiliar. The results were an increase in identifying vegetables, vegetable preference increased, willingness to taste vegetables increased, and consumption of vegetable varieties increased in the intervention groups that had a school garden.

Similarly, there is a relationship between engagement with learning opportunities about food and changes in children's knowledge, attitudes, and behaviors about healthy foods. Although Heim et al.'s (2009) taste testing study is not specifically about school gardens, it gives helpful

insight about the importance of learning about food. In the study, students attended a farmer's market once a week where children tasted local fruits and vegetables (Heim et al., 2009). During the taste testing children were encouraged to look at, smell, and feel the fruit and vegetable so they would become familiar. The benefits of the Heim et al. (2009) study included working in the garden, learning about fruits and vegetables, taste testing, preparing nutritious snacks with the fruits and vegetables from the garden.

Nowak et al. (2012) took the farmer's market to another level and students held one at their school. The Youth Farmers Market allowed students to take produce from the garden and set up a farm stand on school grounds. Students learned how to run a business, how to purchase supplies, how to budget, and how to become a salesperson. Students interacted with community members, sold produce at a fair price, and brought healthy produce into their communities. The researchers incorporated taste education, which allowed students to taste and cook fruits and vegetables from the school garden. Most students were shocked they can eat most produce right off the vine. The authors concluded that allowing students to complete hands-on learning experiences in the garden helped them to make better food decisions on their own.

1.5.3 Additional benefits of school gardens to students

In addition to the school garden literature, there are lines of scholarship that have sought to understand the relationships between nutrition and wellness, nutrition and learning, and the act of growing one's own food and wellness. Below, key studies are summarized to identify some of the important learning opportunities that school gardens may offer students and highlight potential outcomes.

1.5.3.1 Cognition

School gardens have the potential to support students' cognition. For example, a four-hour outdoor hands-on nature program was conducted with 175, 2nd–4th grade students from five New Mexico schools that evaluated phrases and keywords according to Bloom's taxonomy of cognition (Blair, 2009). Interviews were conducted from students, teachers, and volunteers resulting in 87% of participants used application terminology, 19% analysis terminology, and 26% used synthesis terms such as problem solving, plan, integrate, test, and support. Another study by Blair (2009) involved 147 Hispanic and black middle school students in Los Angeles for ten weeks. Pre and post tests were conducted to evaluate students written and verbal responses to hands-on cognitive tests. Post scores resulted in an increase in observational, ordering, comparison, and processing skills. These two studies suggest that school gardens can support students' cognition by increasing their vocabulary and cognition skills when writing and completing verbal responses such as comparing and processing information.

1.5.3.2 Physical health

School gardens have the potential to support students' physical health. Lucke et al.'s (2019) study researched 18 South African, low-income residents who grow their own food in a community garden in Western Cape. The 18 participants were 17 women and 1 man between the ages of 21-57 years of age. The purpose was to determine motivation for and effects of a community garden on low-income gardeners who live in a high food insecurity setting. The residents were interviewed through photovoice, where they take pictures of their environment, which is how they are interviewed because of the towns access to conventional methods. Residents were given one disposable camera to take photos along with a one-page handout asking questions related to motivation to join garden and effects of garden. Participants motives were food access, increase in

knowledge of gardening, savings on food that is bought from a store, and independence on life such as developing a garden produce business and selling garden produce for money. The gardens were maintained by residents or supervised by trained staff and fruits, vegetables, and herbs were grown. The benefits of the gardens promoted physical benefits such as lower body max index (BMI) and higher consumption of fruits and vegetables.

1.5.3.3 Reduction of illness and pain

School gardens have the potential to reduce students' illness and pain. Lovasi et al. (2008) conducted a study on 4- and 5-year-old children from New York to determine if children who were exposed to a natural environment had lower asthma cases. Asthma decreased being around tree density and reduced proximity to pollution sources. Myopia improved because students were not focused on a screen and less reading time in the classroom. A study conducted among 12-year-old participants determined that these adolescents had lower cases of myopia when they spent more time outdoors (Rose et al., 2008). A similar 2009 cohort study consisting of 1249 teenage students in Singapore resulted in 5% less myopia cases when they spend more time outdoors (Dirani et al., 2009). Viewing and hearing nature sounds provide better pain control. View Through a Window study conducted in 1984 among patients who were given views of trees took fewer doses of pain medication then patients who had a view of a brown brick wall. Another study gave patients nature scene murals and nature sounds to listen to before, during, and after procedures and the results were better pain control (Ulrich, 1984).

1.5.3.4 Psychological and emotional functioning

In addition to supporting students' physical health, there are a number of potential benefits to students' psychological and emotional functioning that could be brought about through school

gardens. In one study, the authors found that school gardens created self-confidence and sense of achievement as well as decrease depression (Lucke et al., 2019). Social benefits were created from relationships formed through gardening with others and psychological benefits created from self-confidence and sense of achievement through gardens as well as a decrease in depression. Students can build on their social skills by working with volunteers and community members who assist with the garden. Lucke et al. (2019) participants from the study above in South Africa reported social benefits were created from relationships formed through gardening. In another study, the authors found that school gardens made students feel better (Childs, 2011). In this study, 72.5% of students responded positively to the garden, which increased emotional functioning. The results were students enjoyed working outdoors in groups, as well as alone.

Outdoor activity, such as that of tending a school garden, can benefit students' psychological health because it reduces stress (McCurdy et al., 2010). A 2001 Psychological Restoration study surveyed parents to compare their child's symptoms in an indoor setting versus an outdoor setting for leisure activities (Taylor et al., 2001, as cited by McCurdy et al., 2010). Four inattentive symptoms were identified which are inability to stay focused on unappealing tasks, inability to complete tasks, inability to listen and follow directions, and being easily distracted. The results of the study determined that exposure to natural settings reduced inattentive symptoms. Being outdoors allowed children to restore their attention capacity, help to think through their problems better, and reduce inattentive symptoms by providing social support outdoors instead of in the classroom. Concentration rates rise being outdoors and connect students to nature and improve attention. Exposure to natural environments can improve attention, decrease stress and mental health, and promote physical activity, which decreases obesity (McCurdy et al., 2010).

1.5.4 Overall summary of the benefits of school gardens

There is some literature on the effects of school gardens on children that suggests a positive relationship. There is a larger literature base specifying the relationships between gardening and being outdoors to benefits for the mind and body. There is also a connection between student's making healthier foods choices when given options to grow their own food, taste the food they've grown, cook the food, and serve the food in the school cafeteria.

The literature pointed to three promising approaches of supporting adolescent girls STEM identity development that I will address in the following sections. These approaches are focused on inclusive curricular practices, collaborative learning, and supportive learning environments.

1.6 Promising Approaches to Sustain School Gardens

There are three primary challenges to sustain a school garden which are funding, teacher burnout, and lack of garden knowledge. The following are examples of promising approaches to develop strategies for ongoing funding. Funds become an issue in terms of buying equipment for the garden, seeds/plants, and gardening materials. The promising approaches to receive funds for a school garden are grants, fundraisers, and donations. Garden funding can be raised through parents, administration, grants, fundraisers, educational websites, city and local businesses, and local farm bureaus (Hazard et al., 2011). There are a variety of grants that schools can apply for, particularly because of the multi-curriculum focus on math, science, and health. Resources and tools such as soil, gardening tools, and crops for the garden can be donated from local nurseries, local businesses, local garden clubs, and national corporations for a free or reduced-price including

seed swaps, receiving damaged goods or goods that cannot be sold. Funding such as grants can be accomplished more easily with the help of parents and administrators and across various school subjects. Hazard et al. (2011) examined ten schools in California to determine how schools received funds to operate their school gardens. Funds were established through grants, fundraisers, and local business support. Having parents involved as well as volunteers makes funding for school gardens successful when they assist with funds for supplies and materials.

A promising approach to prevent teacher burnout would be to develop a garden team, garden club or identify a garden coordinator containing 6-12 members consisting of staff members, administration, parents, community members, and students (Klick, 2010). Seeking help from volunteers such as parents, community members, local organizations, and staff members also helps with time management while in the garden. The responsibilities of gardens can be facilitated by a "garden coordinator," which can be a teacher, parent, volunteer, community member, or a paid position (Yu, 2012). Garden coordinators have expert knowledge on gardening and can combat the issue of lack time by maintaining the garden throughout the year. Garden clubs can also be established to maintain responsibility, as well as provide hands on curriculum opportunities (Davis et al., 2015).

Even though volunteers may prevent teacher burnout there is also the challenge of lack of garden knowledge among those helping. Receiving free assistance from a master gardener, garden coordinator, or garden committee (different terms but provide the same expertise) which can be a teacher, community member, or organization provides knowledge and experience when a garden is initiated. This can solve many challenges such as garden layouts and seasonal crops to plant (Hazard et al., 2011). Gardening skills are a huge challenge as well because if teachers or administrators do not have gardening knowledge, they may have difficulty knowing when to plant,

what to plant in each season, how much space is needed for certain crops, and to maintain the garden, and how to trouble shoot when issues arise (Greer et al., 2019). A garden coordinator and a garden maintenance schedule would help with these challenges as well. In Greer et al.'s 2019 review of garden sustainability article, nine of the ten schools had a full- or part-time garden coordinator. The results of the study indicated that in order for a garden to be successful a garden committee must be established and must be committed to instructional school gardens. Support needs to be given from administration and principals and having a part- or full-time garden coordinator makes a garden very successful. Garden coordinators per Smith et al. (2019) can be anyone as long as they have garden knowledge with years of experience.

1.7 Synthesis

School gardens may provide the body and mind with many benefits such as cognitive functioning, psychological functioning, as well as physical, social, and emotional functioning. A few other benefits of a school garden appear to be an increase in test scores, improved school behavior, and promoting teamwork. Gardening allows children to choose their foods by growing, cooking, and preparing the produce. There are also various types of curricula across subjects and ways to take what is learned in the garden back to school lunch or the community. There are many challenges for maintaining and sustaining a school garden but there are many promising approaches to help make the garden successful and sustainable. Some of the challenges in maintaining and sustaining a school are time, limited resources, supplies, funds teacher burnout, teacher/administration turnover rate, summer maintenance, volunteers, lack of teacher/administration support, lack of garden knowledge, and standardized tests. Even though

school gardens can be challenging, creating a garden committee can help make it a success for students, staff, parents, community members, and local organizations.

2.0 Theory of Improvement and Implementation Plan

2.1 Theory of Improvement

My theory of improvement is a set of change ideas on how to address the lack of staff and student engagement with the school garden at Clayton Academy. My driver diagram, which can be found in Appendix A, is a complete picture of what I'm trying to accomplish as a whole to reach my AIM. In order to make a change in my organizational system I need to get staff and students involved by creating a garden committee, which will develop lesson plans and integrate into classrooms. Forming a garden committee can also help with garden maintenance tasks such as logistics (e.g., watering and weeding). Two additional change ideas that can help increase garden engagement are hosting school wide garden days or garden events, which can involve families as well as Grow Pittsburgh. Involving local organizations can help to form community partnerships, which can help with garden engagement. These approaches are pieces of the system that interact to influence teacher and student engagement in the school garden.

I will know the change is an improvement by observing the school garden and how it is being used/maintained. The garden will have supplies to work in the garden as well as be free of weeds and full of produce. I will see an increase in staff and students who use the garden on a weekly basis for class using the lessons and curriculum that have been created for the school. I believe a garden committee can be successful in increasing engagement of the school garden for staff and students. This will allow staff and students opportunities to use the school garden across various curricula for years to come.

2.1.1 Aim statement

By 2024, teachers will increase their engagement with the school garden such that every student is engaged at least once a month at Clayton Academy.

2.1.2 Primary drivers

Primary drivers are key drivers that contribute directly to reaching the AIM of the driver diagram. There are four primary drivers, which are classroom integration, garden maintenance, teacher buy-in, and community partnerships. Classroom integration is a primary driver of garden engagement because as a school, instruction is always a teacher's top priority. Students' opportunities for spending time in the garden are strongly dependent on the degree to which their teachers make it a part of everyday learning practices. Garden maintenance is key to increasing engagement because without upkeep the garden will not be aesthetically pleasing or functional. Teacher buy-in needs to occur in order for the school garden to be successful and allow students the opportunity to use the school garden during class time. If teachers are interested in the school garden and know the benefits of using the school garden they will take their classes outside, which will increase engagement. Community partnerships are ideal to bring in more resources, time, and strengthen relationships between the school and community partners.

2.1.3 Secondary drivers

There are eight secondary drivers which are directly tied to the primary drivers in the theory of improvement. The secondary drivers that are related to the primary driver of classroom

integration are curriculum integration and garden fieldtrips. Integrating curriculum and garden fieldtrips would improve engagement because students and staff would be able to use the garden during class time and be outside instead of the normal classroom. The secondary drivers that are related to garden maintenance are funding and supplies and logistics such as weeding and watering. These secondary drivers are necessary to complete to care for the garden by maintaining daily and seasonal tasks. Funding will allow staff and students to apply for grants to receive supplies necessary to care for the garden, which is needed daily and seasonally. This will allow the garden to be successful each year. Targeting these secondary drivers will improve the primary driver of garden maintenance and thus promote engagement. The secondary drivers that are related to teacher buy-in are teacher perceptions of garden value and teacher knowledge of gardening. Teachers that value the garden and have garden knowledge will have an interest in using the garden for their classes which will increase engagement and help in terms of sustaining the garden. The secondary drivers comprise key community partnerships are Grow Pittsburgh, families, and other community groups. Involving Grow Pittsburgh, parents and community groups would provide volunteers to maintain the school garden, which would increase engagement and provide help and knowledge for the garden to be successful. All of these secondary drivers that help the primary drivers are able to be targeted to produce change/achieve my aim.

2.1.4 Change ideas

There are six change ideas listed in the driver diagram that impact the secondary drivers and primary drivers to achieve my overall aim of increased student and staff engagement with Clayton's school garden.

First, development of lesson plans with garden topics across subjects and scheduled time in garden can impact the secondary driver of curriculum integration which impacts the primary driver of classroom integration to achieve my aim. These lesson plans could be developed and implemented in English, science, math, health and PE, or art and would enable all school subjects' access to the garden each week to receive its benefits as well as sustain the garden over time.

A garden committee can also be used as a change idea for several secondary drivers, including funding and supplies and logistics. Creating roles for garden committee members would allow daily garden maintenance and generate lesson plans for various subjects.

The professional development change idea is associated with the secondary driver teacher perceptions of garden value and teacher knowledge of gardening. Conducting a professional development would allow teachers and counselors to see how valuable the school garden can be and would allow each teacher and counselor time to interpret their perceptions and knowledge of the garden to create teacher buy-in.

The last set of change ideas is school wide garden days and school garden events such as taste tests and cooking classes, which can be done with the support of Grow Pittsburgh and connects to the secondary drivers Grow Pittsburgh which can provide resources and families and other community groups, which can provide resources and assistance. These change ideas would increase staff and student engagement with the school garden.

2.2 Systems Measures

2.2.1 Process measures

In order for me to determine if my change worked, there were several measures that could be used that are not limited to the ones I implemented. The potential process measures that could help me understand if my change worked are developing lesson plans and activities across subjects for curriculum integration. These could be measured through monthly check-ins or surveys to determine what teacher used the garden and the lesson they completed. Formation of the garden committee could be measured by garden committee membership/meeting schedule/meeting minutes/goals and efforts. Attendance among staff and students at garden committee meetings could be documented in an Excel spreadsheet. School wide garden days and school garden events with Grow Pittsburgh could be documented in the Excel spreadsheet as well to determine who used the garden and how often each week. The last measure could be if each committee member completed their role for the garden committee as well as observing the garden maintenance through a survey.

2.2.2 Driver measures

The potential driver measure teacher's report of curriculum integration would need to be assessed in order to understand whether/how the lesson plans and garden field trips/additional time in the garden are occurring. Development of a schedule/garden care plan with staff assigned to water and weed will need to be assessed to determine logistics, funding, and supplies through a garden committee. Teacher perceptions of garden value and teacher knowledge of gardening need

to be assessed in order to understand if teachers will buy-in to using the garden weekly for class time. Documenting interactions and collaborations with Grow Pittsburgh as well as family and community groups will need to be assessed to provide evidence of community partnerships.

2.2.3 Outcome measures

The potential outcomes measures that will help me see if I'm reaching my aim are if teachers and students use the garden at least once a month and within various classroom curriculums. This will be done through monthly check-ins and various check points at grade level meetings. Increasing engagement is necessary for my aim to be successful.

2.2.4 Balance measures

The potential balance measures for students would be time away from PE classes or other academic classes when the garden can be utilized. Certain academic classes follow a curriculum and too much time spent away from class can jeopardize the lessons being taught. Energy can be taken away from the teachers and other garden committee members because we will have to balance our classes as well as maintaining the garden daily and seasonally.

2.3 Methods and Measures

2.3.1 Inquiry questions

The inquiry questions that will guide my study of implementing the change idea are:

1. How often and in what ways do teachers and students engage in school garden?
2. How and to what extent does the garden committee develop and disseminate garden-themed curriculum for classroom lesson plans & activities?
3. How and to what extent does the garden committee complete and coordinate efforts to maintain school garden?

The predictions I have are that forming a school garden committee will lead to increased integration of garden lesson plans/activities for students and teachers and an overall plan for garden sustainability which will increase overall staff and student engagement with the school garden.

2.3.2 Intervention description

I created a school garden committee at Clayton to increase garden engagement and manage monthly and seasonal garden development/maintenance tasks. The garden committee was comprised of five school staff including teachers (e.g., science, English, and health/physical education) and counselors. The committee members were responsible for creating/modifying garden lesson plans, disseminating lessons to teachers, and maintaining the school garden. A recruitment conversation for garden committee members occurred by prioritizing staff who were interested in the garden.

The garden committee met once a week for the first month and then once a month for the next three months; each committee meeting lasted approximately 20-40 minutes. During the first month committee members adapted garden-centered lesson plans. Following this time, lesson plans were implemented with a goal of one garden-engaged session per month, per committee member. Garden committee members met once a month to check-in and discuss strategies to what worked well, what did not work in the garden, who used the garden, and what they were doing in

the garden. More frequent check-ins were completed during existing grade level meetings. Four grade level check points occurred throughout the project. Each served as a reminder of my project and focused on specific content such as introducing my project and discussing pre-survey I emailed to all staff. The next check points discussed lesson plans disseminated on Microsoft Teams and I asked if there was something the garden committee could do to help staff use the garden. The last check point informed staff I would administer post-survey at the end of project.

The first garden committee meeting introduced committee members to goals, expectations, and assigned roles for each member. Roles for garden committee members were assigned based on the strengths of each staff member and how they wanted to contribute to the garden. Roles included garden maintenance, curriculum leader, community outreach, and fundraising. The maintenance role developed a schedule to determine who waters the garden and other logistics (e.g., weeding) for maintaining the garden. Curriculum leader made updates to the lesson plans/activities based on committee member input, created repository of lesson plans on Microsoft teams, and disseminated lesson plans to all teachers. The committee members in charge of community outreach and fundraising began working with Grow Pittsburgh to gain resources and create connections. These connections would help fund the garden with seeds, supplies, soil, and plants, as well as form relationships with community members who could help with the garden maintenance. Supplies and equipment are necessary in order to increase engagement with staff and students, so they have a garden to use for their classrooms. Following this first meeting, the next committee task adapted lesson plans provided by Grow Pittsburgh and created a school curriculum repository that would be used by committee members and disseminated to other teachers. Grow Pittsburgh provided support to the garden committee as needed and I completed the implementation of intervention. Each committee member adapted three lessons that could be used

for different subjects. After the lesson plans were finalized, they were disseminated through Microsoft Teams to other teachers for optional (but encouraged) use. The months of October through February encompassed the intervention period.

2.3.3 Participants

Participants were Clayton school staff, including garden committee members who were recruited through a conversation with me, prioritizing staff who were interested in garden. Students were participants and they participated through staff who used the garden for their classes. This study was deemed to not meet the definition of research by the University of Pittsburgh's Institutional Review Board.

2.3.4 Measures, data collection, and data analysis

In the following section, measures, data collection, and analyses will be broken down by inquiry question.

2.3.4.1 How often and in what ways do teachers and students engage in school garden?

Measures. There are two measures for this inquiry question and the first one is a staff survey before intervention and after intervention. The survey had quantitative and qualitative open-ended questions to determine garden usage and what staff did in the garden. The survey was distributed via email and staff had one week to complete the survey via Google Forms. A similar survey was given to all staff members at the end of the intervention to determine if there was an increase in engagement of the school garden. The survey also determined staff garden usage and

what they did in the garden. Survey questions can be found in Appendix B. For example, "*Have you used the garden in the past?"* and *"How have you used the garden?"* are examples of pre-survey questions. An example of a post-survey question is *"How frequently have you used the garden in the past four months?"*

Garden committee meeting notes is the second measure. Garden committee questions were asked to garden committee members orally each month by me and can be found in Appendix C. For example, *"Have you used the garden in the past (week/month)? Why or why not?"* Attendance at garden committee meetings and garden minutes were documented over the course of four months. This was important to determine what staff members were attending meetings and engaging in the garden.

Data collection. Prior to the intervention with the school garden, all staff were emailed the Google Form survey at the end of October and given one week to reply. In February, all staff were emailed the post-survey and given one week to reply. All data were downloaded and stored in an Excel spreadsheet. Garden committee meeting questions were collected through written notes in a notebook then electronically stored in an Excel spreadsheet along with attendance records.

Data analysis. Data were analyzed within an Excel spreadsheet where I calculated descriptive statistics and compared number of teachers who used the garden pre/post survey. I analyzed frequencies for quantitative survey questions through Microsoft Excel and coded qualitative open-ended responses into categories of went well and didn't go well in the garden. This determined similarities and differences from each garden committee members' answers to determine teacher and student engagement.

2.3.4.2 How and to what extent does the garden committee develop and disseminate garden-themed curriculum for classroom lesson plans/activities?

Measures. Lesson plans/activities were provided through Grow Pittsburgh and the garden committee modified these lessons to meet middle and high school grade levels and developed new ones. Lesson plans were then disseminated to all teachers. Notes were taken during garden committee meetings regarding the process of developing lesson plans. Notes were also be taken of how lesson plans were disseminated in Microsoft Teams.

Data collection. Each committee member had one month to modify or develop two lesson plans/activities, which were provided by Grow Pittsburgh or found online. All lesson plans that were developed/modified by garden committee were saved in Microsoft Teams folder for all teachers to access. During garden committee meetings, notes were taken to determine what lesson plan/activity each committee member adapted and what class subject the lesson plan/activity related to. This was all stored in an Excel spreadsheet.

Data analysis. Lesson plans created/modified by the garden committee were counted to determine the number and type of lessons teachers used and strategies to integrate the lessons into the garden. The post-survey determined which teachers used the lesson plans/activities each month in the garden and number of students reached. I also coded note responses into categories of how lessons were developed and disseminated.

2.3.4.3 How and to what extent does the garden committee complete and coordinate efforts to maintain the school garden?

Measures. A garden maintenance schedule was created by me to ensure the garden was maintained on a weekly and seasonal basis. A way to measure this was to ask committee members if they completed their weekly tasks in the garden at garden committee meetings, by asking an

example question found in Appendix C, "What did you do in garden?" An example of the schedule determined who watered the garden monthly, who pulled weeds in the garden monthly, and what committee member organized seasonal tasks such as winterizing the garden and preparing for Spring. Efforts to maintain the garden were measured through garden committee meeting notes.

Data collection. An initial schedule was created through an Excel spreadsheet at the start of the intervention for monthly maintenance and tasks were assigned monthly during garden committee meetings. The schedule was emailed to garden committee members at the beginning of each month. Written notes were taken at garden committee meetings each month and stored electronically in an Excel spreadsheet.

Data analysis. Monthly notes from garden committee meetings and monthly maintenance tasks were analyzed to determine if garden committee completed and coordinated efforts to maintain the school garden throughout the intervention.

2.4 Timeline

1. Plan: *September-October 2021:* Recruiting faculty, planning, interview, and pre-survey
2. Do: *October:* Initiate program with faculty sign-ups for garden committee
3. Study: *October-February:* Initiation of program (4 months): observe, evaluate
4. Act: *March-April:* Analyze data, complete post survey, and program conclusions
5. Reflect: *April-June:* Summarize results and prepare final dissertation in practice document.

3.0 PDSA Results

3.1 Results IQ#1: How Often and in What Ways do Teachers and Students Engage in School Garden?

While teachers and students engaged in various garden activities the data were analyzed through a quantitative pre and post survey comparison as well as coding qualitative data from open-ended survey responses and garden committee meeting notes. At baseline, prior to the intervention, 71% of participants used the garden and at follow up 92% of participants used the garden, which increased engagement by 21% over the four-month intervention. Out of the twelve participants who completed the post-survey, 33% engaged in the garden once a month while 33% reported engaging twice a month. Participants who did not use the garden stated in open-ended survey questions it was due to winter and COVID-19 issues or they only used the garden when it was being winterized.

Figure 1 is a chart comparing the pre and post garden activities completed in the school garden. There were ten activities that participants reported in both the pre and post survey. These were plant seeds, pull weeds, water garden, harvest crops (pick produce), plant cover crop (smother weeds and improve soil), compost decayed matter (used for fertilizing), mulch (used to cover garden to enrich soil), taste tests with produce grown, cook with ingredients from the garden, and make tea from herbal leaves grown in garden. The seven activities that increased over the intervention are reported as the percentage of people who reported completing the garden activity from pre- to post-survey. Examples were making tea at 43%, planting cover crop at 19%, cooking 15%, taste testing, pulling weeds, and harvesting all coming in at 10%, and watering garden at 6%.

This increase, per garden committee meeting notes, was due to winterizing the garden as a school with staff and students where we pulled weeds and planted cover crop as well as picked produce at the end of the summer season. The three activities that decreased over the intervention were laying mulch (-33%), planting seeds (-8%), and composting (-4%). These negative percentages were a decrease in the number of participants who completed the activities during the intervention.

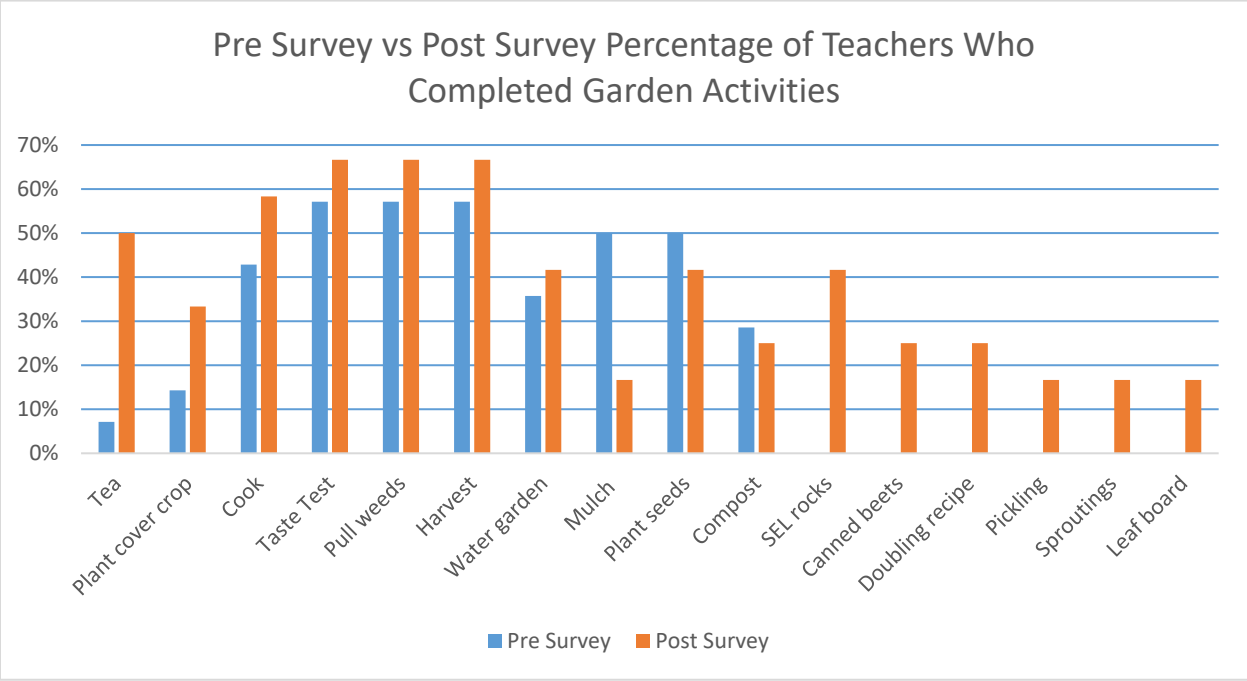


Figure 1. Pre-Survey vs. Post-Survey Percentage of Teachers Who Completed Garden Activities

During the intervention there were several entirely new lessons that were created by the garden committee. Some of these lessons were completed during small group time. Small group time was a new short daily class period lasting twenty-five minutes where students work on positive social and emotional skills and confront negative behaviors in themselves and peers. This was a school-wide change, unrelated to the intervention, however, several activities increased

because some participants chose to use small group time to incorporate a garden lesson. The single biggest change in activities completed in the garden was creating social emotional learning (SEL) rocks from the lesson Self-Expression in Garden, which was a new lesson that the garden committee created and disseminated. This lesson consisted of students painting rocks and drawing or writing social emotional sayings on their rocks (e.g., strong, powerful, or smart) that correlated with their small group time lesson that week, which focused on self-management and stress management. At baseline (before the lesson had been created) 0 participants completed this activity and at follow up 42% of participants completed this activity. There were several other lessons that were not reported in the pre-survey because they were lessons created during the intervention such as canned beets, doubling recipe and sprouting's. For the canned beets lesson, students dug up beets that were grown in the garden, then pickled the beets, and lastly canned them in jars. These beets were later eaten at our Thanksgiving and Christmas luncheons at school. The doubling recipe helped students take a recipe and work on their science and math skills by doubling it in quantity. At follow up, 25% of participants reported they completed each of these activities during the intervention. The sprouting lesson allowed students to use items destined for the garbage or recycling bin to create planters that would be perfect for the plant of their choice to thrive indoors. At follow up, 17% of participants reported they completed the sprouting's activity during the intervention.

3.1.1 Pre-survey responses

The next several sections discuss open-ended responses for the pre- and post-survey questions for what went well while using the school garden, what didn't go well while using the school garden, and comparisons for similarities and differences in responses (Tables 1 and 2).

Open-ended responses on the staff survey and garden meeting notes were coded after the intervention for categories based on similar responses from each participant. After the categories were created, I counted the similar responses to get a final count for each code. A total of fourteen participants completed the pre-survey, including five garden committee members (Table 1). The pre-survey question "What went well [in the school garden]?" was asked to participants and the following answers were provided. Four participants indicated that student engagement went well. For example, one participant answered the question by simply writing "*student engagement*." Three other participants reported enjoyment working in the garden. For example, "*students enjoyed the activities*." Five participants reported that students enjoyed taste tests and cooking with the produce went well. For example, one participant answered the question by writing "*cooking and taste testing*." Two participants stated students gained knowledge of where food comes from for what went well. One teachers' perception is that some students did not know that food is produced from a seed, grown, harvested, and shipped to supermarkets for sale. For example, one participant stated "*The garden exposes our students to enjoy being outside and to appreciate and understand the extensive process on how we receive our food. The students enjoyed the different tasks that are required in planting and harvesting. They seemed to enjoy it all*." The last set of answers for what went well was team building by three participants. An example that one participant wrote was *"team building by working on garden together."*

The pre-survey question "What went didn't go well [in the school garden]?" was asked to participants and the following answers were provided. Three participants indicated that time didn't go well. For example, one participant answered the question by simply writing *"time/not enough."* Others reported weather. For example, *"cold weather."* Two participants reported lack of interest didn't go well. For example, one participant answered the question by writing "*some students are*

not interested in helping with the garden." Two participants stated maintenance didn't go well and an example was *"pulling weeds and watering the garden are areas of challenge."* One participant stated transition didn't go well an example was *"usually the transition from classroom to garden and back."* The last comment was all went well by four participants and one stated *"it all went well from beginning to end."*

Table 1. Open-Ended Pre-Survey Questions, Assigned Codes, and Participant Responses

Question	Code (Number of Participants)	Example Responses
What went well with the school garden?	Student engagement (4)	"Student engagement"
	Enjoyment (3)	"Students enjoyed the activities"
	Team building (2)	"Team building by working on garden together"
	Taste test/cook (3)	"Cooking and taste testing"
	Food knowledge (2)	"Students gained an understanding of their food"
What didn't go well with the school garden?	More time (3)	"Time/not enough"
	Maintenance (2)	"Pulling weeds and watering the garden are areas of challenge"
	Lack of interest (2)	"Some students are not interested in helping with the garden"
	Weather (2)	"Cold weather"
	All went well (4)	"It all went well from beginning to end"
	Transition (1)	"Usually the transition from classroom to garden and back"

3.1.2 Post-survey responses

The following data is based on open-ended post-survey data responses to the question "What went well [in the school garden]?" and can be found in Table 2. A total of twelve participants completed the post-survey including five garden committee members. Four participants stated a change in the learning environment went well. For example, one participant answered the question by writing "*change in learning environment and daily routines.*" Three participants stated connections to real world examples in the school garden during the intervention went well. For example, one participant wrote "*Students are very engaged with the content. They find it exciting to get out of the classroom or use material they grew to make something. Students have also harvested herbs, dried them, and used them to make tea. Students have explored and tasted new foods. It allows kids to get out of their comfort zone and have new and amazing experiences with nature*." Teamwork was stated by three participants as to what went well during the intervention. An example was *"the team effort that went into making sure the garden was put together well."* Two participants stated collaboration among teachers and staff went well. An example was *"It was nice to collaborate with coworkers in order to provide our students with a lesson and exposure to the garden."* The last example was all went well by four participants and an example was *"everything."*

The following data is based on open-ended post-survey data responses to the question "What didn't go well [in the school garden]?" and can be found in Table 2. Three participants stated time didn't go well. For example, one participant answered the question by writing "*needing more time in the curriculum to devote to this type of lesson.*" Two participants stated weather didn't go well. For example, one participant wrote "*planning activities can be difficult when the weather is uncooperative*." Low growing production was stated by two participants as to what didn't go

well during the intervention. An example was *"garden has a low production growing season."* Two participants stated consistency for what didn't well. An example was *"we didn't have time to expose the students on a consistent basis."*

The open-ended pre- and post-survey responses were not very similar for what went well, however there were a lot more similar responses to what did not go well. Codes for similar responses of what went well in the pre compared to post-survey were teambuilding in the pre-survey and teamwork in the post-survey as well as student engagement in the pre-survey and connections to real world examples in the post-survey. At both time points, four participants responded that everything went well. Codes for similar responses of what didn't go well were time and weather in both pre- and post-survey.

Table 2. Open-ended post-survey questions, assigned codes, and participant responses

Question	Code (Number of Participants)	Example Responses
What went well with the school garden?	Change in learning environment (4)	"Change in learning environment and daily routines"
	Connections/real world examples (3)	"Students made connections to the garden and science topics to cement real world examples"
	Teamwork (3)	"The team effort that went into making sure the garden was put together well"
	Collaboration (2)	"It was nice to collaborate with coworkers in order to provide our students with a lesson and exposure to the garden"
What didn't go well with the school garden?	More time (3)	"Needing more time in the curriculum to devote to this type of lesson"
	Weather (2)	"Planning activities can be difficult when the weather is uncooperative"
	Low growing production (2)	"Garden had a low production growing season"
	Consistency (1)	"We didn't have time to expose the students on a consistent basis"
	All went well (4)	"Everything"

Survey data were analyzed, which determined the number of staff and students who used the garden (results not shown). The number of students that used the garden throughout the intervention during class time and small group time were five to ten students at 58% and one to five students at 42%, which was reported by participants through the post-survey. According to

the pre and post survey as well as garden notes, time, weather, and maintenance were also issues with garden engagement. I predicted that most staff did not use the garden prior to the intervention with their students but they may have used the garden with their classes at least once a year to help prepare the garden for a season change, such as winterizing or preparing for spring. Through the post-survey data, it can be determined that staff and students did not use the garden and if they did it was only once a year, which matched my prediction.

3.2 Results IQ #2: How and to What Extent Does the Garden Committee Develop and Disseminate Garden-Themed Curriculum for Classroom Lesson Plans/Activities?

To answer this inquiry question, the garden committee met weekly to modify or create lesson plans/activities and took notes of the lesson plan process and made a list of the lessons. At the start of the intervention, I was given a list of lesson plans by our Grow Pittsburgh representative that the organization uses for their garden lessons. I looked over the lessons, printed out the list and the garden committee met and discussed what lessons aligned with our curriculum and grade levels. Additional lesson plans that were not shared from Grow Pittsburgh were found from various garden education websites online by googling garden lesson plans. The websites that were used to find garden lesson plans were Whole Kids Foundation and Kids Gardening. One example of a garden lesson was “Self-Expression in Garden,” described previously. Another lesson was making tea. We picked mint from the garden and Grow Pittsburgh brought tea bags, honey, and cups for the lesson. Before the lesson, I dried out the mint leaves then students placed the leaves in the tea bags. Students then boiled water and placed tea bag in their own cup.

Committee members shared that the common obstacle faced in developing lesson plans were finding middle and high school garden lessons, since most lesson plans garden committee members found were designed for elementary level. When the Grow Pittsburgh representative gave the garden committee the garden lessons they used, the representative explained that most of their lessons are for elementary students.

In total, garden committee members modified or created seventeen lessons. Table 3 includes the titles and subject areas for the garden-themed lessons created by the garden committee members. Garden committee members independently modified or created lesson plans based on existing school curriculum, tailoring to grade levels. One week after modifications, garden committee members met to introduce the lessons that they found. During this meeting, each garden committee member gave feedback and suggestions for revisions. Each committee member was very helpful and very supportive through the process. Each of the five garden committee members modified or created three lesson plans, for a total of fifteen lesson plans. Over the course of the intervention, committee members continued to find additional garden lessons. It was a group consensus to include the last two lessons for a total of seventeen garden lessons for the intervention. There were seven subject areas covered in the lessons and some lessons could be used across several different subject areas.

After lesson plans were created and modified within a month of the start of the intervention, they were uploaded onto Microsoft Teams by the vice principal. After all lesson plans were uploaded, I sent an email to all staff with the location of the lesson plans, the members of the garden committee, and a note to contact the garden committee if they have any questions or concerns.

To determine who used lesson plans throughout the intervention, the post-survey asked participants "Did you use lesson plans?" Out of twelve participants who completed the post-survey, 58% used lesson plans throughout the intervention. The majority of the lesson plans (83%) were shared from the garden committee, 8% were found online, and 8% were from Grow Pittsburgh.

Originally, I predicted that each committee member would create or modify two lessons each, and that the lessons would be in their subject matter, but the committee members went above the total lessons and lessons were in more than three subject areas. I did not think that most lessons that were developed or modified could be used for more than one subject area. However, most of the lessons can be used across various subjects, such as Math, History, Health, Science, and English, which is great because teachers can collaborate and work on the garden together.

Table 3. Titles and Subject Areas of Garden-Themed Lessons Created/Modified by Garden Committee Members

Lesson Title	Subject Area						
	Science	Math	English	History	Health	Art	Business
Self-Expression in Garden					X	X	
Making Tea	X						
Sprouting's	X				X		
Doubling Recipe	X	X			X		
Growing Poems			X				
Garden to Give		X	X	X	X		
Create a School Garden Business		X					X
Soil vs. Water	X						
Compost Your Way	X						
Growing Garden Comparisons	X	X					
Discover Community Gardens: Seedfolks			X	X	X		
Host a Community Planning Event					X		X
Kindness in The Garden					X	X	X
Exploring Food Forests	X	X		X			
Food Begins with a Plant	X				X		
Measuring Sun Position: Yearly Change		X					
Remembering Memorial Day			X	X			

3.3 Results IQ#3: How and to What Extent Does the Garden Committee Complete and Coordinate Efforts to Maintain the School Garden?

To answer this inquiry question, a garden maintenance schedule was created (Table 4) and garden committee meeting notes were taken to determine who was completing their maintenance tasks. In order to create a schedule, I researched different garden maintenance schedules, found ones that looked simple to follow, and feasible for our school. I adapted these existing schedules by removing tasks that did not apply to our garden and added tasks we did need that were not listed. I then created a proposed monthly schedule that took a maintenance task and assigned which month the task would need to be completed. Garden maintenance tasks are scheduled on a monthly basis; however, certain tasks need to be completed weekly such as watering the garden. Committee members who have that task for the month know that it needs to be completed weekly. Committee members volunteered for the task they wanted to complete at monthly garden committee meetings. Each committee member was responsible for one to two maintenance tasks per month, depending on the month. The finalized garden maintenance schedule was emailed to all garden committee members and posted in the cafeteria and each garden committee member's classroom. The months of October through February encompassed the intervention period.

Winter clean-up and spring clean-up are listed on the schedule in order to prepare the garden for the next season. Eight students and nine staff members participated in the winterizing garden activity as a group, per garden notes. As part of this activity, we winterized the garden by harvesting the produce that needed to be removed, such as fresh herb leaves for the tea lesson. Then we planted seeds that could withstand the cold months (e.g., garlic), pulled weeds, laid cardboard down as a barrier from the grass, and put mulch on top of the cardboard. We also covered

garden beds with straw as a protective barrier from the snow and leaves. The watering hose was also put away, so it did not crack during the cold winter months.

Table 4. Monthly Garden Maintenance Schedule

Maintenance Task	Month											
	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept
Care of Plants												
Monitoring												
Pruning (if needed)												
Deadhead plants												
Fertilization												
Watering (as needed)												
Garden Beds												
Seeding												
Weeding (as needed)												
Mulching												
Harvesting												
Soil Testing												
Leaf Removal												
Cover crop												
Pest Management												
Monitoring												
Winter cleanup												
Spring cleanup												

Note. Intervention months are highlighted.

To determine if garden committee members were completing their monthly maintenance tasks, I asked committee members questions during monthly committee meetings. Full garden

committee meeting questions are available in Appendix C. Participants were asked "*Did you complete your weekly/monthly tasks in the garden? If not, why not?*" Throughout the four-month intervention, two out of five committee members completed their tasks each month such as watering, leaf removal, and planting cover crop. Three out of five committee members did some tasks some months but not every month. Some completed their tasks for two or three months but not every month. For example, if their task was to water the garden or remove leaves, they did not complete their maintenance task for the month. The response for not completing the tasks was "they forgot" or "lack of time." When asked "*Is there something that could have helped you complete your tasks?*" the response was some members asked for an email reminder to all participants to remind them to complete their tasks. This did not align with my prediction, as I predicted all participants would complete their monthly maintenance tasks. I told committee members that in the future I would send out email reminders once a week to check the maintenance schedule to remind members to complete their tasks.

4.0 Learning and Actions

4.1 Discussion

My overall aim for my theory of improvement (Appendix A) was that by 2024, every teacher will increase their engagement with the school garden such that every student at Clayton Academy is engaged at least once a month with the school garden. The implemented change idea for this single PDSA cycle sought to advance the garden committee's ability to expose all students once a month to the school garden. Even though a garden committee was previously in place at the school, the garden was still not being used on a regular basis, and teachers were not encouraged to use the garden during class time. I re-created a garden committee that modified/created lesson plans for all teachers to use in hope that garden engagement would increase each month. Several key findings emerged from the results. Results of the data collected from pre and post surveys, notes from garden committee meetings, and lesson plans modified/created revealed important insights for these inquiries. The major patterns that were found were that there were several activities that were completed during the intervention, which increased engagement. These activities occurred because of the lessons that the garden committee created at the beginning of the intervention. There were a lot more similar open-ended responses to what did not go well than what went well in the pre- and post-survey. This section explains the key findings and their implications for practice and next steps. The following sections review findings and how the data aligns with previous research and literature on school gardens.

4.1.1 Key finding #1: Designating regular meeting times with students and staff may allow students to engage more often in garden lessons and activities.

A common barrier cited in the literature for not using a school garden is lack of planning time and it takes away instructional time (Davis-Taylor, 2021). The incorporation of small group time into the school day and planning lessons during monthly garden committee meetings effectively took these barriers away. Garden activities increased because some participants chose to use small group time to incorporate a garden lesson. When initially planning the intervention, this class time did not exist in the school schedule. The change was made to the schedule by administration because Clayton has a new set of guidelines to follow with our new accreditation from Alternative Education for Disrupted Youth (AEDY). The organization sets guidelines that we have to follow, and this additional small group time was developed to meet this requirement. I set dates for students and garden committee members to complete garden activities two times a month in November and December during small group time, which led to more students engaging in garden activities during the intervention.

There were three science teachers who incorporated garden lessons into their classes as well during the intervention, which helped to increase engagement. Research shows that the school garden is most often used for academic instruction (Landry & Logue, 2017) with hands-on learning allowing students the opportunity to make real world connections to academic content (O'Brien, 2019). Gardens bring a connection to nature for students and staff and a greater awareness of the world around them (Yu, 2012). This is aligned to my findings, in that three teachers stated that connections/real world examples were what went well when using the garden with their students.

Setting up a designated date and time to complete lessons created by the garden committee members was successful in exposing students to garden lessons/activities. During garden

committee meetings, committee members would discuss what garden lesson to use during small group time and what supplies or materials were needed prior to setting a date for the lesson to occur. Throughout the intervention, there were several lessons that were completed during small group time such as Self-Expression in Garden (SEL rocks) and tea making. Students not only learned about social emotional issues, but they applied the lesson to the garden and were then exposed to the garden when they placed their rocks throughout the garden.

4.1.2 Key Finding #2: Providing lesson plans to staff increases engagement with the school garden.

During the intervention, there were seventeen lesson plans that were created by garden committee members. After they were created, lessons were disseminated to all teachers and staff through a Microsoft Teams folder to access and use these lessons at their convenience. Research states that integrating lessons into the existing classroom curriculum can improve garden usage making it the norm rather than the exception (Hoover et al., 2021). During the intervention, the garden committee created a separate time to do garden activities, which doesn't correlate with what the research states in terms of integration. Even though we didn't follow the literature completely, we did have science teachers incorporate garden lessons. We made our unique small group time work to our advantage. In the end both methods worked to increase engagement.

At the end of the intervention, more than half of participants used lesson plans. Participants reported that the majority of the lesson plans that they used came from those created by the garden committee. If more teachers besides science teachers use the lessons created by the garden committee into their curriculum, it will become the norm at Clayton. When students use the garden, it provides an alternative method for students to learn critical skills via an experimental and

kinesthetic lesson (Hoover et al., 2021). Students at Clayton are sent here due to their negative behavior(s) at their home school and providing experimental and kinesthetic lessons will allow them the use their hands and minds in a more positive manner. Allowing students to get involved physically with a lesson and allowing them to do more than just sit in a desk may be more engaging and enjoyable. Providing hands-on lessons and exposure with the school garden will hopefully help staff and students to engage in the garden more often and make it a norm since learning outdoors can help with critical skills such as problem solving, analysis, observation, reflection, and decision making.

The seventeen garden lessons varied in class subject. Research states that science is the primary subject taught in the garden, followed by math and language art (Landry & Logue, 2017). At Clayton, we had eight science lessons, six math lessons, and four English lessons created by the garden committee. This aligns with the research in that these were the top three subject areas. However, we also created eight Health lessons—just as many as science. There is not much research on health lessons when it pertains to school gardens, only on the benefits pertaining to social, emotional, and physical health. Exposure to natural environments can improve attention and mental health, decrease stress, and promote physical activity (McCurdy et al., 2010). Creating eight Health lessons may enable students to reap these benefits, as well as engage in the school garden.

Garden committee members modified/created lessons in all subject areas so all teachers could have access to lessons that already aligned with their curriculum. Research suggests that garden curriculum should be integrated in the daily school curriculum to generate a positive student learning experience in the garden (Hoover et al., 2021). Providing teachers with lesson plans should take away any hesitation or barriers of not knowing what to do in the garden and

increase their willingness to experiment in the garden. Research states that a barrier for teachers using the garden is the need for additional planning time and support staff, and location of the garden (Davis-Taylor, 2021). Clayton's garden is located on-site, we have support staff, such as team leaders, who are responsible for behavior issues on each floor, and garden committee members, who created lessons to help teachers. In the end, establishing a garden committee helped to increase engagement in Clayton students and staff by providing lesson plans and incorporating activities during science classes and scheduled small group time.

4.1.3 Key Finding #3: Creating a garden maintenance schedule did not mean it was consistently completed all the time.

I created a garden maintenance schedule at the beginning of the intervention but not every garden committee member completed their tasks. There were five garden committee members and less than half of them completed their tasks every month. The reasons for not completing their tasks were time and they forgot. They also recommended sending email reminders for their monthly tasks. The literature states that seasonal maintenance is a challenge and creating a garden maintenance schedule may help to sustain the garden, but this did not occur during the intervention. O'Brien (2019) states a garden committee needs to be very organized about the schedule for maintenance—who is responsible, and when, which will minimize the demands for maintaining/sustaining the garden.

4.2 Next Steps and Implications

Given the key findings, my next steps are described below in hopes to increase engagement with the school garden once a month for every student at Clayton Academy. Adding students to the garden committee is something I want to incorporate in the future, which is one of my next steps for the garden committee. This could benefit the garden committee/engagement efforts because it will give students leadership roles and take some of the maintenance burden off of staff members. Eligible students would be those who show initiative with their behavior and/or demonstrate an interest in the school garden. Student tasks could include finding lessons to do in the school garden, helping maintain the garden by watering, weeding, and harvesting produce, and collaborating with teachers and peers as garden committee members. Once they join the garden committee, they could be rewarded with classroom breaks where they go in the garden to relax or go out in the garden at lunch time to eat or decompress. Students can be rewarded with hosting events at school such as cooking classes and create projects from garden produce. I also envision students creating monthly newsletters that detail monthly events in the garden, activities that are completed in the garden, and include healthy recipes to make food and snacks at home. These newsletters could be sent home to parents/guardians and include this information for future funding donors with grant submissions. Students can also host garden events with families so parents/guardians can see how their child interacts with the garden. At these events students can cook with the produce grown from the garden and have parents/guardians taste test healthy foods. At these events, recipes can be provided for foods to make with garden produce.

Another step that I want to incorporate is to continue with the garden maintenance schedule but get other teachers and community volunteers involved who show an interest other than garden committee members. Even though the garden maintenance schedule was not completely successful

throughout the intervention, it holds garden committee members accountable for completing tasks. When the tasks are not completed, we can determine who was not able to successfully maintain their garden task and assign another committee member or staff to complete the task, so the garden continues to look its best. This will hopefully help the garden to be maintained on a regular basis since it had flaws during the intervention. The intervention occurred during winter months so my hope is that getting others involved, sending out weekly email reminders, and having nicer weather will eliminate the issues of maintenance that occurred during the intervention.

I also want the garden committee to continue scheduling monthly meeting times for students and staff to engage in garden lessons/activities. These may not be able to be completed during small group time since after my intervention another change in the schedule occurred and small group time was moved to first period (7:41am – 8:06am). This is a barrier due to darkness at certain times of the year, late arrivals, and teachers with divided responsibilities. However, these meeting times can occur during class times or scheduled times that the garden committee determines with approval from administration. Scheduling a time to engage in the garden was very successful and something that will hopefully continue to increase engagement and make it more consistent.

The three steps described above are what I envision for the future, and they align with my driver diagram and theory of improvement. One of my secondary drivers is curriculum integration and aligns with the primary driver classroom integration, which will help to continue engagement with the garden by scheduling monthly meeting times for students and staff to use the garden. The garden committee already created a maintenance schedule, which is aligned with the primary driver garden maintenance. If this schedule can become more successful by adding students to the committee, engagement will hopefully continue to increase.

4.3 Implications for Practice

As a scholar practitioner, I have learned that there are proper steps that need to be implemented in order for a garden to be successful. Based on the findings, I recommend developing a garden committee consisting of staff, teachers, and students who have prior garden knowledge or who show an interest in working with the garden. An approach to prevent teacher burnout would be to develop a garden team containing 6-12 members consisting of staff members, administration, parents, community members, and students (Klick, 2010). I also recommend for other schools wishing to engage in a school garden develop lesson plans that all teachers can use that coordinate with the school curriculum. Integrating lessons into existing classroom curriculum can improve garden usage making it the norm rather than the exception (Hoover et al., 2021). For Clayton, determine a weekly or monthly time when garden lessons will be embedded into the classes' curriculum. The last and final step is to have fun and use the garden as much as possible not only for lessons but for breaks from the classroom, a quiet place to go to where students and staff can clear their heads, and as a place to learn outside of the classroom. As one participant stated in their open-ended survey response answer for what went well in the school garden *"change in learning environment and daily routines."* Working outside provides many benefits as stated above and can do so many positive things to the mind, body, and soul.

School garden committees can be a vital part of increasing engagement because they can develop and provide lesson plans to use, schedule times when teachers can use the garden, and develop a maintenance schedule so the garden will thrive at its best. Garden committees can be great resources for teachers who want to use the garden as a classroom.

Setting a regular weekly time frame for students to engage with the garden has many benefits. Teachers do not have to worry about classroom disruptions, burnout, or refusal to use the

garden themselves because they do not have interest or knowledge of the garden. When garden time is embedded into the school day schedule, students get to interact with each other and develop social skills, experience nature, get a break from their traditional indoor classroom, and they can work on their emotional and physical wellbeing just by being outdoors. Outdoor activity such as that of tending a school garden, can benefit students' psychological health because it reduces stress (McCurdy et al., 2010). School gardens can also make students feel better (Childs, 2011). When garden times are set there is already a set group of staff members who are willing to participate and enjoy being in the garden. This also allows the garden committee to incorporate garden lessons that are relevant to curriculum or seasonal topics. Weekly and monthly time in the garden or indoors during winter months allows students to experience a different type of lesson, which is beneficial for their mind and body.

Will a garden be as successful if there is not a set weekly schedule? Prior to my intervention, teachers, and students did not have a designated time where they were expected to the use the school garden. In order for a school garden to be successful, garden lessons may have to be embedded into the curriculum with a set weekly time frame with staff members who are willing to engage in garden activities. I do not believe that lesson plans alone made my intervention successful for increased garden engagement. It was a combination of having colleagues who wanted to help me because they knew the intervention was important to me and it was my persistence to push garden lessons/activities into small group time. Having staff members who were willing to help took the burden off of me to make the garden committee successful and garden engagement a priority.

Developing a garden maintenance schedule can help to sustain the garden successfully. The garden committee can develop a schedule and make sure daily and monthly tasks are

completed so the garden looks it best and does not need a lot of work for seasonal tasks, such as winterizing or preparing for Spring. A maintenance schedule prevents teacher burnout, a garden that is wild with weeds, dry from lack of watering, and keeps the garden organized and thriving with produce. Schedules allow for garden committee members to be held accountable if they do not complete their daily or seasonal tasks. Tasks can also be voluntary, which allows for committee members to complete tasks they enjoy or rotational so committee members can experience different maintenance tasks. Keeping a garden maintained makes for continued use for teachers and staff for years. Regarding my role in the garden committee, I was the one who made the maintenance schedule, and I was the one who did most of the work throughout my intervention. I was involved in 90% of the garden activities, which took up a lot of my time. So, in order for sustainability to be realistic long term, I need garden committee members to step up and take more initiative to get maintenance tasks completed without me pushing and reminding them.

Grow Pittsburgh has been involved with the garden from its inception in 2018. However, their involvement is more limited after year two, which occurred during COVID-19, so it was extended a little longer until this school year. They can provide supplies and consultation but will not come out to complete garden activities three times a year. As far as my next steps, we will continue to consult with our Grow Pittsburgh representative as needed but the garden committee will have to step up and maintain the garden on our own by using the garden maintenance schedule and seeking help from other staff members as well as students.

There were twenty staff members who were emailed the survey and only fourteen participants completed the pre-survey and twelve the post-survey. There is some sampling bias regarding the 21% increase in garden engagement. The participants who did not complete the survey were individuals who did not care for the garden, did not want to engage in the garden, or

just didn't care to take the survey because it was an additional task. If all staff members completed the survey the garden engagement portion would probably not have been as much as 21%. In terms of engagement for those staff members who did not complete the survey, I would have to track them down and persuade them to complete the survey and offer to incorporate a garden lesson into their classrooms with them. In order to keep the garden successful, used, and maintained, staff and garden committee members need to continue garden engagement as much as possible, so the garden does not fail and become non-existent.

5.0 Reflections

Improvement science experiments with rapid tests of change for quick, efficient, and useful feedback that informs systems on whether a change is an improvement (Byrk et al., 2015). This improvement inquiry was the first phase of a plan, do, study, act (PDSA) cycle. Determining the problem by researching and designing the intervention was the "plan," implementing the change idea was the "do," the quantitative analysis of the survey data and coding qualitative data was the "study," and analyzing and revising the change idea/next steps, lessons learned, and the implications for practice was the "act." I feel that this first change idea was successful in improving engagement with the school garden among garden committee members and students. An improvement occurred because I had support from my administration as well garden committee members. I am hopeful to achieve my overarching aim, which is increasing teacher and student engagement of the school garden at least once a month throughout my intervention by May 2024.

Being a leader does not mean knowing more than anyone else and throughout this intervention I learned that I have to take the good with the bad from myself as well as others. I need to learn from my peers and listen to others. I cannot be the only one who has the answers. I had to be able to accept feedback from my peers even if it was not good because it was very useful. As a leader, I had to learn to be more confident and to take initiative and embrace change. As an improver, I had to learn that some people will not complete your tasks or get involved unless they are rewarded. I had to learn how to generate ideas and question, question, question peers. For example, when we were designing lesson plans, I had to continue to question my peers if the lesson was appropriate, would we really be able to use the lesson in our classrooms, will students enjoy the lesson, and will teachers actually use the lesson? I've always been a team player but not one

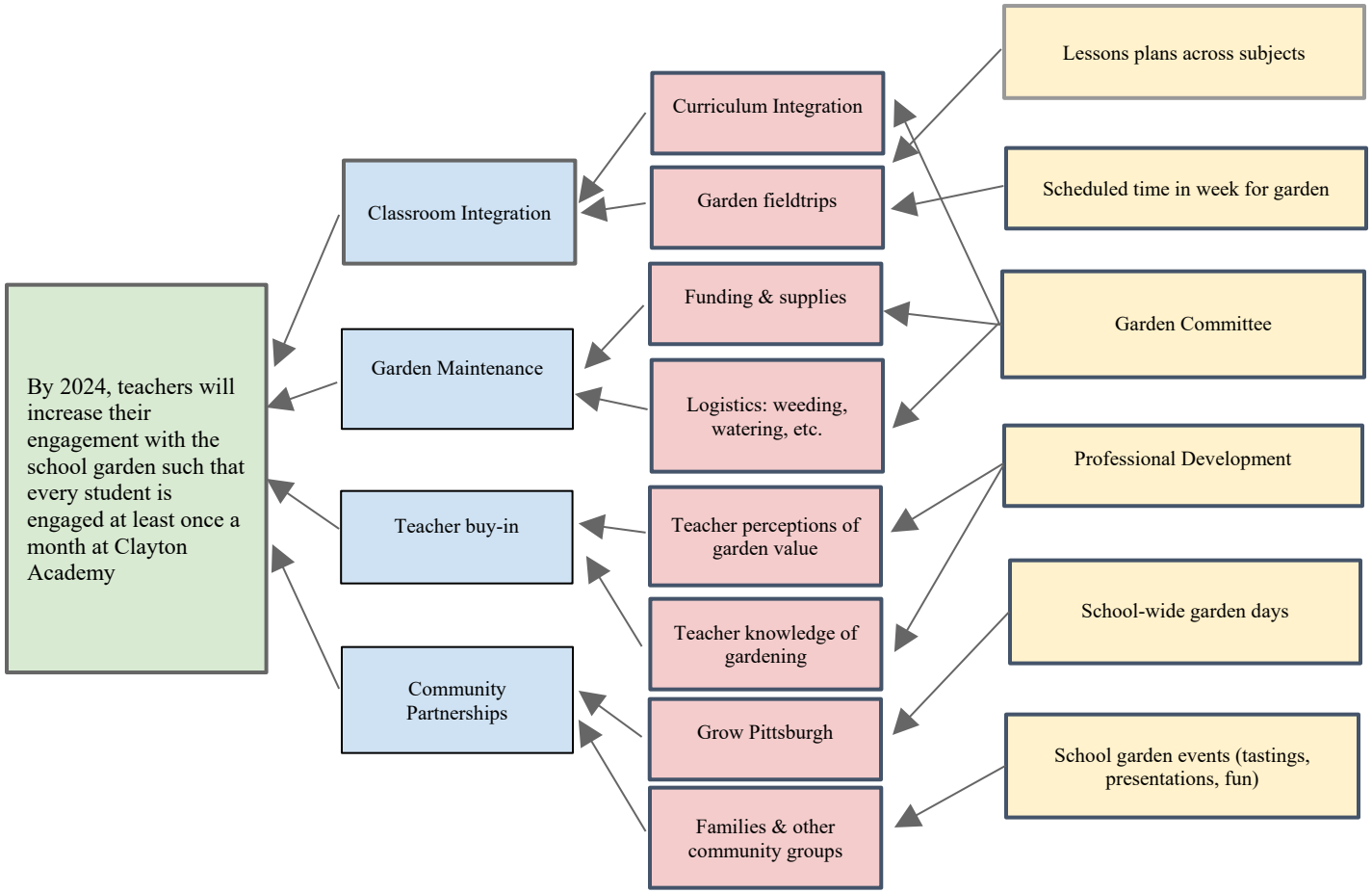
that usually leads or improves, so I had to learn how to take risks and accept change. I had to rely on others to help me develop lesson plans that were beneficial and appropriate to our student population and hope that they were giving it their all when developing the lesson. What I learned about improvement is that it takes time, lots of effort, persistence, dedication, and relying on others to participate and help along the way.

I began the intervention head strong and positive that I would have the support I needed from staff, but that was not always the case. I knew that some staff members would not care to complete the survey or engage in the garden because either it was not something they enjoyed or because it was an additional task. Staff members I thought would help me did not. I think it was because it was an additional task such as taking a pre-survey and they do not want to complete anything extra that is not a requirement. Some teachers said they forgot about the survey, or they did not check their email often enough to know that an email was even sent. I did have colleagues from school help me with my data, forming graphs, and helping with my written materials when I had technology issues, which was so awesome! When it comes to numbers, I'm not your go to person, so to have the help of colleagues from work made me want to push on, analyze my data, and finish writing. It was a team effort, for which I'm grateful.

The intervention was completed during the winter months, which is not an ideal timeframe to complete garden lessons and activities. So, I had to adapt and look for teachers to help me complete indoor garden activities. It was a team effort that I was thankful for and creating the garden committee allowed these lessons and activities to flourish. I will apply improvement to other problems of practice going forward as a scholarly practitioner. Specifically, I will collaborate with stakeholders in my organization, build relationships with students and staff to better understand their needs, work with outside community organizations to seek assistance for future

improvements, and continue to complete small changes to make a positive change in the overall system. Changes do not have to be big, but they must be feasible in addressing a persistent problem that matters to the organization. I also know that it is ok to fail, because in failing we learn. Continuing to ask "why," will help improvements to contribute to lasting change in the system. Not every organization faces the same challenges but identifying problems of practice and implementing small change ideas can make a huge difference for all those involved.

Appendix A Driver Diagram: Theory of Improvement for Engagement with Clayton School Garden



Appendix B Pre/Post Staff Survey

Survey administrator script:

Please take a short survey about the school garden. Please answer each question with a "yes" or "no" response and answer open ended questions in detail with your experiences in the school garden.

What is your role (teacher, counselor, administration)?

What grade do you teach?

What subject do you teach?

Pre-Survey Questions

- Have you used the school garden in the past?
    - Yes
    - No
- Have you used the school garden during class?
    - Yes
    - No
- What have you done in the school garden? Check all that apply
    - Plant seeds
    - Pull weeds
    - Water the garden
    - Harvest/Pick crops
    - Taste tests
    - Cook with produce
    - Plant cover crop
    - Compost
    - Mulch
    - Other
- What went well?
- What didn't go well?

Post-Survey Questions

- Have you used the school garden in the past four months?
- How frequently have you used the garden in the past four months?
    - Once a month
    - Twice a month
    - Once a week
    - Other
- What have you done in the school garden?
- Did you use lesson plans?
- What resources (lesson plan/activities) did you use?
    - Shared from garden committee
    - Found online
    - Grow Pittsburgh
    - Other
- What went well?
- What didn't go well?
- How many of your students engaged in garden lessons/activities in your classroom?

Appendix C Garden Committee Meeting Questions

The following questions will be asked orally by the intervention experimenter during weekly or monthly garden committee meetings.

- Have you used garden in the past (week / month)?
- What did you do in garden?
- What went well?
- What didn't go well?
- Did you use lesson plans?
- Does anyone need our help using the garden/lesson plans?
- Did you complete your weekly/monthly tasks in the garden?
- If not, why not?
    - Forgot
    - Lack of time
    - Other
- Is there something that could have helped you complete your tasks?
    - Email reminders
    - Text messages
    - Other

Bibliography

Blair, D. (2009). The child in the garden: An evaluative review of the benefits of school gardening. *Madison, 40*(2), 15–38.

Byrk, A. S., Gomez, L., Grunow, A., & LaMahieu, P. (2015). *Learning to improve: How America's schools can get better at getting better.* Harvard Education Publishing.

California School Garden Network. (2006). *Gardens for learning: Creating and sustaining your school garden* (2nd ed.).

Childs, E. (2011). *Impact of school gardens on student attitudes and beliefs* [Master's Thesis, Iowa State University]. https://doi.org/10.31274/etd-180810-2822

Davis, J. N., Spaniol, M. R., & Somerset, S. (2015). Sustenance and sustainability: Maximizing the impact of school gardens on health outcomes. *Public Health Nutrition, 18*(13), 2358–2367.

Davis-Taylor, S. (2021). *Elicitation of teacher beliefs related to school garden experiences* [Unpublished Master's Thesis]. Auburn University.

Dirani, M., Tong, L., Zhang, X., Chia, A., Young, T. L., & Rose, K. A. (2009). Outdoor activity and myopia in Singapore teenage children. *British Journal of Ophthalmology, 93*(3), 997–1000.

Fitzgerald, A., Heary, C., Kelly, C., Nixon, E., & Shevlin, M. (2013). Self-efficacy for healthy eating and peer support for unhealthy eating are associated with adolescents' food intake patterns. *Appetite, 63*(1), 48–58.

Greer, A. E., Rainville, K., Knausberger, A., & Sandolo, C. (2019). Opportunities for School Garden-Based Health Education in a Lower-Income, Diverse, Urban School District. *American Journal of Health Education, 50*(4), 257-266.

Hazard, E. L., Moreno, E., Beall, D. L., & Zidenber-Cherr, S. (2011). Best practices models for implementing, sustaining, and using instructional school gardens in California. *Journal of Nutrition Education and Behavior, 43*(5), 409–414.

Hoover, A., Vandyousefi, S., Martin, B., Nikah, K., Hockett Cooper, M., Muller, A., Marty, E., Duwalt-Epstein, M., Burgermaster, M., Waugh, L., Linkenhoker, B., & Davis, J. (2021). Barriers, strategies, and resources to thriving school gardens. *Journal of Nutrition Education and Behavior, 53*, 591–601.

Heim, S., Stand, J., & Ireland, M., (2009). A garden pilot project enhances fruit and vegetable consumption among children. *Journal of the American Dietetic Association, 109*(7), 1220–1225.

Klick, R. (2010). *Planning sustainable school gardens: people.* https://garden.org

Landry, A. S., & Logue, B. K. (2017). Survey of principals regarding perceived benefits and barriers of school gardens. *The Journal of Child Nutrition & Management, 41*(1).

Larson, N., & Story, M. (2010). Are 'Competitive Foods' Sold at School Making Our Children Fat? *Health Affairs, 29*(3), 430–435.

Lovasi, G. S., Quinn, J. W., Neckerman, K. M., Perzanowski, M. S., & Rundle, A. (2008). Children living in areas with more street trees have lower prevalence of asthma. *Journal of Epidemiol Community Health, 62*, 647–649.

Lucke, S., Mamo, E., & Koenigstofer, J. (2019). Exploring the meaning of growing food in community gardens in South African township residents: A photovoice study. *Health & Place, 55*, 165–176.

McCurdy, L. E., Winterbottom, K. E., Mehta, S. S., & Roberts, J. R. (2010). Using nature and outdoor activity to improve children's health. *Current Problems Pediatric Adolescent Health Care, 5*, 102–117.

Nowak, A. J., Kolouch, G., Schneyer, L., & Roberts, K. H. (2012). Building food literacy and positive relationships with healthy food in children through school gardens. *Childhood Obesity, 8*(4), 392–395.

O'Brien, M. (2019). *What is project-based learning?* https://www.definedstem.com/blog/what-is-project-based-learning

Ratcliff, M. M., Merrigan, K. A., Rogers, B. L., & Goldberg, J. P. (2011). The effects of school garden experiences on middle school-aged students' knowledge, attitudes, and behaviors associated with vegetable consumption. *Health Promotion Practice, 55*(1), 36–43.

Rose, K. A., Mogran, I. G., Ip, J., Kifley, A., Huynh, S., & Smith, W. (2008). Outdoor activity reduces the prevalence of myopia in children. *American Academy of Ophthalmology, 115*, 1279–1285.

Savoie-Roskos, M. R., Wengreen, H., & Durward, C., (2016). Increasing fruit and vegetable intake among children and youth through gardening-based interventions: A systematic review. *Journal of the Academy of Nutrition and Dietetics, 117*(2), 240–248.

Smith, S., Null, D., & Zimmerman, K., (2019). Understanding teacher perceptions of school gardens and food access in rural food deserts. *NACTA Journal, 63*(2), 208–214.

Taylor, A. F., Kuo, F. E., & Sullivan, W. C. (2001). Coping with ADD: The surprising connection to green play settings. *Environmental Behavior, 33*, 54–77.

Ulrich, R. S. (1984). View through a window may influence recovery from surgery. *Science, 224*(46/47), 420–421.

Yu, F. (2012). *School garden sustainability: Major challenges to the long-term maintenance and success of school garden programs* [Unpublished Master's Thesis]. University of Delaware. http://udspace.udel.edu/handle/19716/12045