Let's Have a Garden!
An Inquiry into the Benefits of Designing and Constructing a School-Based Community Garden by Elementary-Age Students

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Table of Contents

Chapter One

Introduction

Picture a schoolyard of asphalt and metal playground equipment. There is a field of short Kentucky blue grass, a few basketball hoops and some trees behind a chain link fence. Where on this playground is the place for inquiry-based or experimental learning, let alone for young imaginations to flourish?

In this research I will evaluate the benefits to students planning a community-based school garden in their urban elementary school. I propose that taking leadership in the planning process will increase overall gardening interest, self-efficacy and attitude toward school, including enthusiasm for learning, in elementary school students. In this paper I will focus proposed curriculum on fourth graders. This "ownership" of their school garden will increase subsequent expected benefits, including academic aptitude across disciplines; interpersonal relationships; and the critical early development of healthy eating habits.

Just as plants need room to grow, so do students. A school garden can be just the place for both students and education to succeed. Buckin-Sporer and Pringle (2010) describe the school garden as an "outdoor classroom oasis, attracting countless organisms, each a rich opportunity to teach students about the complex and fascinating ecosystem that we are all a part of" (p. 13). School gardens also connect us with our food. In the United States, the cultivation of food has been substantially moved onto factory farms and out of sight of most children. This leaves whole portions of young generations with little or no connection to the land or their food sources. Unfortunately, the magic of

eating peas and beans off the vine or growing a shining tomato or deep red beets is not available to most students at home.

So what would happen for the students, the teachers and the wider community if a garden were to be added next to the school building? What once was simply cracked asphalt is now an explosion of broccoli and spinach, tomatoes and green beans for students to water. Zucchinis and pumpkins spill over the sides of raised beds constructed from donated and reclaimed materials. There might be a class using their math and design skills to measure and plan additional beds. Others may be discussing which plants to grow next season. A colorful collection of student-made birdhouses decorates a grove of butterfly bushes and native flowers that have taken over part of the lawn. Another team of students is measuring earthworms and checking the temperature of the compost in order to support the hypotheses they made in science class. One group of fourth graders may be sitting next to the potato patch, writing poetry with their Spanish class. The educational consequences and benefits of a school garden have been studied from various angles and within a wide range of student demographics; most show impressive results for all involved, primarily the students themselves. These projects would ideally be implemented over a several years as the garden grows and expands.

Nature of the Problem

In this research paper I will look at the benefits to students in planning the design of a school garden in a Colorado arts and sciences-based public elementary school. Most K-12 schools in the United States do not yet have school gardens, but I believe that the process of planning a garden, even before a plant starts growing, is beneficial for students. Designing a garden is a multi-discipline project that I hope will contribute to building

lifelong skills and interests for all students involved. The benefits of design and early garden construction will be researched in this paper. I hope that the gardens these students build will continue to educate students for years to come.

Rationale of the Research

Starting a garden is not a new idea. Philosophers, such as Friedrich Froebel and Rousseau, in 18th century Europe applauded the school gardens present as educative tools (Buckin-Sporer & Pringle, 2010, p. 18). The first school garden in the United States was created in 1891 at a school in Massachusetts (p. 18). The first schoolyard gardens utilized as learning spaces became a national movement in 1918 and regained strength during World War II as a component of the victory garden boom for food production (Blair, 2009, p. 17). The trend fizzled in the 1950s, but since the 1970s the importance and popularity of schoolyard gardens has grown substantially among developed countries from the United States to Australia. It can be argued that their importance is even greater now as a means to bridging the gap between what we eat and where it is grown. School gardens offer the potential to positively change eating habits, which studies show are formed early in life (Ratcliffe, Merrigan, Rogers & Goldberg, 2011, p. 36). Additionally, gardens give students a hands-on learning center of endless possibility, located right on their school grounds.

When students create and work in a school garden, they learn "food systems ecology" (p. 18). With solid curriculum and enthusiastic teachers, children can become familiar with local food growers and see the direct benefits of composting cafeteria food scraps. The importance of understanding how much effort is necessary to grow food translates into reducing and recycling food waste. According to the Environmental

Protection Agency website (2012), in 2010 more than 34 million tons of food waste was generated in the US, less than 3% of which was composted. Food waste accounted for almost 14 percent of the total municipal waste sent to landfills that year. A component of this problem is a lack of awareness of the value of food, and ability to compost the remainder. School gardens can educate not only the students, but their teachers, parents and wider community to compost and reduce our national food waste.

School gardens offer not only a positive, healthy, experience-based learning environment and serve as a community asset, but also are shown to benefit students in scientific, social, and academic realms. Gardens provide a platform for cross-curricular learning, providing material to readily tie together standard-driven subjects with memorable and strong scaffolding.

Additional evidence demonstrates improvement among students in their attitude toward school and enthusiasm for learning, interpersonal relationships, environmental awareness, development of healthy eating habits, cultivation gardening enjoyment, awareness of food production and civic projects. School gardens have also repeatedly been linked to increased test scores across subjects (Lieberman & Hoody, 2005, p. 200)

> [G]ardening changes the status of food for all involved. When one gardens, food can no longer be viewed as a mere commodity for consumption; we are brought into the ritual of communal goodness that is found at the intersection of people and plans. Food that we grow with our own hands becomes a portal for personal transformation. (Thorp and Townsend, 2001, p. 357)

Iovina (2010) points to how gardens instill ethics in people of all ages, and calls them "a moral allegory" (p. 278). Community gardens create "spaces of discourse" and can be "hubs of social solidarity" (Ralston, 2011, p. 16). Gardens offer a space for inter-

generational learning and an opportunity to learn from community experts and master gardeners, as well as parent volunteers. According to researcher and professor Blair (2009), the "purposes of the redesigned schoolyard are academic, behavioral, recreational, social (increased sense of belonging, self-esteem, and compassion), political (the schoolyard as a visible community asset), and environmental remediation" (p. 16).

Key Terms & Definitions

Some of the important terms that will be discussed in this paper are as follows:

School gardens or outdoor classrooms are defined broadly as a teaching and learning setting outside of the school building that is used as an educational environment.

Environmental education is a broader definition for what can occur in school gardens, wild places, and also within school walls. The term was first defined by Dr. William Stapp as one that is "aimed at producing a citizenry that is knowledgeable concerning the biophysical environment and its associated problems, aware of how to help solve these problems, and motivated to work toward their solution" (Stapp, 1969, p. 30-31).

Service Learning is defined as "a method by which young people learn and develop through active participation in thoughtfully organized service experiences" (Ohn and Wade, 2009, p. 200).

Inquiry-Based Learning is generally defined as an educational approach that is driven more by a learner's questions than by a teacher's lessons.

Interdisciplinary curriculum is one that involves or joins two or more branches of learning. Activities and teaching strategies combine and merge fields of knowledge resulting in a more relevant and meaningful understanding for students (DeMarco, Relf & McDaniel, 1998, p. 1).

Scaffolding is derived from the socio-cultural theory of Vygotsky. The building metaphor, first described by Wood et al. in 1976 is valuable in explaining the role that not only teachers but other students can play in joint-problem solving. The help is temporary and by expanding what the student can do *with help*, then allows them to progress to accomplishing more within their domain of learning independently in future (Van de Pol, J., Volman, M., & Beishuizen, J. 2010, p. 271). Modeling how to plant a basil seedling would be is an example of scaffolding in the garden.

Delimitations:

Planning a garden would be ideal for a school that does not yet have a garden of any kind. Administrators, teachers and some parents must be committed to starting a garden. At my current school we have a steering committee, appropriately coined "The Green Team", of which I am a member. It would be my hope that all students in a school would play a role in the implementation and building of the garden during different phases. This would be a prime opportunity to study and test the benefits of designing and building a school garden meant to instill experimental, inquiry-based learning.

I anticipate that time restrictions along with funding obstacles would be encountered. For example at our school, at the time of this writing, "The Green Team" has not planned out an exact timeline. It may be necessary to start small and grow the size of the garden, along with the plants, year by year. Additionally, starting a school garden may not allow the growing of crops until the next spring, if beds and growing spaces can be prepared in time. Gardening very much depends on the climate. However, the process of beginning to design and understand the reasons for starting a school garden is the

major subject of study for this paper. Additions such as a greenhouse, butterfly gardens, a xeriscape with native plants, and permanent art installations may also come with time.

Procedures:

Prior to starting my student teaching position, I conducted research and a qualitative analysis of peer-reviewed journals, literature and articles on the subject of creating school gardens and their associated benefits. Prior to beginning the student components of planning a garden project, I would use surveys and potentially short, individual biographical interviews, to assess each student's experience with, current interest in, and basic understanding of gardens. As design plans are implemented and students have time to work alongside community volunteers to build our garden, I would re-interview and conduct surveys to track changes. The goal would be to gauge students' interest in inter-disciplinary planning activities and observe how working toward the common goal of a school garden affects student engagement and achievement in cross-curricular learning.

Organization of the Remainder of the Study:

In Chapter Two I will organize my literature research within specific categories, providing support for the creation of a school-based community garden. From books and peer-reviewed journal articles to opinion pieces and children's stories, there is a great deal of studies supporting the creation and operation of school gardens. In Chapter Three I will share ten lessons designed to support students in their educated planning of a school garden. Such a series of lessons would support an inquiry-based study of fourth grade students engaged in planning and starting a school garden. In Chapter Four, I will

reflect upon my thesis and research, finishing with recommendations and conclusions on the topic.

Chapter Two

Introduction

The research on school gardens is comprehensive, however, most studies have been conducted in the past 20 years and much additional research is needed, especially long-term studies. The opportunity for elementary-age students to work in the garden has the potential to be a life-changing experience. Consider that even to the experienced adult-gardener, each season requires attention, flexibility and ingenuity but each year there is something that amazes you. Given these considerations, my review of the associated literature has developed into a study of six specific areas of benefit that school gardens provide.

First, I looked at the academic benefits across multiple disciplines of study. Science is perhaps the place where the garden- a tangible laboratory - shines most. Given this, I looked at research specifically citing gains in scientific aptitude, most frequently determined through pre and post testing. In addition to enhancing the science curriculum, gardening has the potential to improve students' environmental awareness and build in them a respect for nature and all living things. A subcontext of this section of research is of course, building a basic understanding and appreciation for where food comes from and the effort and resources it takes to grow it. In this chapter, I will discuss the improvement in nutrition and dietary behaviors that school gardens can bring about.

School gardens are shown to improve students' self-perceptions, self-efficacy and motivation to learn as well, benefits that extend beyond the school day and the school years. In addition, I looked at research testing the improvement of social, group and leadership skills within classes that included gardening time. Perhaps the most recent component of school gardens is covered at the end of this literature review: the community aspect. This section covers the benefits of building community relationships and instilling a sense of volunteerism. This can come from donating produce to local food banks and soup kitchens, working with area gardening experts and sharing the garden with family and community members. The garden should be a focus of pride for students and faculty alike.

Academic Enhancement

It may not at first be obvious that growing tomatoes improves students' test scores and enhances instruction, but the literature shows again and again that they do. Academic enhancement is the most frequent reason for having a school garden according to a survey of greater than four thousand California school principals (Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005, p. 149). Lieberman and Hoody (1998) conducted a review of 40 schools across 12 states and found that standardized test scores and GPAs (along with a host of other benefits) were higher in 92% of the comparisons (p. 2). The benefits were especially notable in the areas of language arts, social studies, science, math and thinking skills. Emekauwa (2004) found that three years of nature-placed learning led to significant decreases in unsatisfactory standardized test scores for fourth grade students in a poor, rural Louisiana school district (p. 2). Scores improved across language arts, social studies, science and math. Given the number of variables present in

each study, it is difficult to say exactly how much a school can expect its garden to increase test scores, but based on the body of literature, it is a safe assumption that the garden will enhance students' academic experience and their test results. Gardens have been cited as providing space for necessary creative learning (Blair, 2009, p. 17) and spaces for cross-curricular learning, enabling students to make necessary connections between subjects. As one teacher said, "[t]he garden helps us draw connections across the curriculum, it is material to scaffold" (Thorp and Townsend, 2009, p. 355). The learning is authentic and experience based (p. 357). Blair writes "that experimental learning, rather than gardening per se, improves a child's chances to use higher order cognitive skills (p. 20). I agree that the garden is a tool to fill a missing hands-on, experience-based component in our current education system but would add that it is a powerful tool and if carried out over time, leaves a lasting impression on young people.

Science Aptitude Enhancement

Given the natural experiment that a garden is each season, it is an obvious fit for increasing students' learning in the sciences, including life, physical, and earth sciences. Smith and Motsenbocker (2005) found significantly improved science achievement test scores for students engaged in a Junior Master Gardener Program when compared with a control group (p. 439). Klemmer, Waliczek and Zajicek (2005) make the important point that effective curriculum must be used to enhance students' science achievement in garden-based learning (p. 437). In a separate study, Klemmer, Waliczek and Zajicek (2005) studied the science achievement of 647 third, fourth, and fifth grade students from Texas schools (p. 448). One group of students took part in school gardening activities as part of their science curriculum, in addition to traditional classroom learning. The control

group, who did not have any gardening in their science curriculum, scored significantly lower than the 'garden group' on the science achievement test. Interestingly, there was no statistical difference in improvement between boys and girls within the 'garden group' (p. 450-451). Smith and Motsenbocker also found the effect of gender to have no significant impact on increased student test scores following garden instruction (p. 440). Extending the science classroom outside to the garden not only enhances the academic experience, but improves science test scores for both elementary age male and female students.

Environmental Education: Awareness and Respect

As students leave our elementary schools, it is imperative that they have learned to respect the environment and have an awareness of natural systems. School gardens can be an incredible place for environmental education and it is the focus of many studies related to school gardening. Ralston (2011) reviews John Dewey's comment that "gardening is an activity that channels students' native interests in all things living into a genuine appreciation of, and even a scientific curiosity about, their environment" (p. 7). Lieberman and Hoody (1998) discuss the benefits of using the environment as an "integrating context for learning", the benefits of which include the development of knowledge, understanding and an appreciation for the environment and natural surroundings (p. 1). In 1998, Skelly and Zajicek looked specifically at the effect of an interdisciplinary garden program on the environmental attitudes of elementary students. They found that the more outdoor-related activities students participated in, the greater they scored in environmental attitude. Skelly and Bradley (2007) found 67.9% of the educators in their study of school gardens used the space to teach environmental education (p. 103). In Blair's 2009 review of the current literature, she discusses the lack

of solid evidence across multiple studies to definitively show that the increase in environmental awareness is as a direct result of school gardens (p. 21). I do agree with Blair that studies do not show consistently show a significant increase. With the large amount of variables present, the results found in past studies can be disputed and are not always definitive. For example, teachers who volunteer to include school gardens in their curriculum are often those with the greatest environmental awareness and that will be passed onto their students, perhaps with or without a garden. Lohr and Pearson-Mims (2005) conducted a nationwide survey that indicated "horticultural programs for children raised in urban surroundings… can be effective for fostering an appreciation for gardening" later in life (p. 472). However, again, the lifelong benefits of environmental, garden-based education have not been adequately studied.

Nutrition and Eating Behavior

With the alarming rise in childhood obesity and national movements in place to improve school lunches and childhood nutrition, school gardens are needed now more than ever. McAleese and Rankin (2007) call schoolyard gardens an emerging "nutrition education tool in an academic setting" (p. 662). Study after study shows that elementary school students who spend time learning in their school garden have improved eating habits, attitudes toward vegetables and are more likely to taste new vegetables (Blair, 2009, p. 18; Graham et al., 2005, p. 147; Morris and Zidenberg-Cherr, 2002, p. 91; Ratcliffe, Merrigan, Rogers & Goldberg, 2011, p. 39). As mentioned in Chapter 1, our eating habits are most often established early in life—making the elementary years a period that should not be devoid of nutritional learning (Ratcliffe, Merrigan, Rogers & Goldberg, 2011, p. 36). Building students' understanding of the value, importance and

cost of growing food helps to establish better eating habits in an engaging, hands on setting: the school garden. Unfortunately, long-term studies to determine if school gardens can reduce student obesity levels over time have not yet been published nor to my knowledge, begun. If a school garden can help to feed the school community, even for just a special salad day, a root vegetable soup served at back to school night or an autumn dessert of pumpkin pie, than its worth is even more tangible.

Increased Self-Efficacy, Motivation, Social and Group Skills in Learning

Building confidence and becoming more motivated to learn in the schoolyard garden carries directly over into the classroom and social times for students. Robinson and Zajicek (2005) looked at the effects of a one-year school garden program on elementary students and found that students in the garden program had significantly increased their overall life skills scores in the areas of "working with groups" and "self-understanding" (p. 453). In addition to the feedback students receive from fellow gardeners and teachers, the garden provides students with opportunities to interact with nature on a personal level that promotes positive behavior changes. In taking care of plants, students develop their own qualities, such as empathy toward other living things and personal responsibility (DeMarco, Relf, and McDaniel, 1999, p. 277). Additionally, students learn how to effectively work together for a desired end result of vegetable or flower success (p. 277). Thorp and Townsend point out the importance of the garden space as a place for students' and teachers' "self-expression, creativity and innovation" to occur (2001, p. 347). Multi-disciplinary garden programs have been shown to increase students' enthusiasm for learning (and teachers' enthusiasm for teaching) and to decrease

discipline issues in the classroom (Lieberman and Hoody, 1998, p. 9). In addition, the "hands on, minds on" approach improves students' communication skills (p. 6).

Dweck (2002) writes about the "self-theories of intelligence". Her theories in action have revealed the significant positive difference when students understand that they are capable of becoming smarter, that intelligence is not a fixed trait but one that can be grown with work. Students who are told that they "did a great job learning" are far more willing to put work into learning, in contrast to students who are labeled "smart" and who will not take risks in learning. Dweck does not write in regards to school gardening, however I believe her work has huge importance in the garden as well (p. 1). Teaching children that we can grow our brains through learning, much like we grow our gardens with water and sunshine, helps motivate them. If they understand that their intelligence is not fixed and can change, much like a seed changes in the right conditions, they can grow. Gardening with students should include much praise for their work and dedication, not their 'green thumbs'. I would like to see more studies done in how praising students for their work in the garden impacts their motivation and level of self-efficacy.

School Community Building and Volunteerism

The garden should be at the heart of a school and a gathering place for the wider school community. The opportunity to share a garden with the community enables the garden to be cared for year-round and for students and local gardeners to benefit from one another's work and knowledge. Seven studies reviewed by Blair (2009) found that "school gardens had a strong community-building component, promoting teamwork, student bonding, a broader range of interactions with adults and community outreach" (p.

21, 31). More specifically, evidence suggests that a student's level of "bonding or connection to school is related to a range of important health and achievement outcomes throughout adolescence and adulthood" (Ozer, 2007, p. 854). Students who are "connected to school" have lower levels of emotional distress and demonstrate decreased risk behavior and aggression. It follows that students who are more emotionally attached to their school will follow the "prosocial values espoused by the school" and all will benefit from these social bonds (p.854). Thorp and Townsend (2001) call the schoolyard garden "a potent force in re-shaping school culture" (p. 347). School gardens inspire cooperation (Bucklin-Sporer and Pringle, 2010, p. 28) and provide a place for students to express themselves while doing something beneficial not only for themselves but for the school and wider community. In the garden, students are taking responsibility for growing their own outdoor classroom.

Conclusion

The six aforementioned areas of garden-derived benefits to students have been fairly well-researched given the more recent resurgence of school gardens. However, none of the studies look at the ownership students experience when they are involved in the planning and then the actual creation of school gardens. This is an experience that is not for one year's class only—it is possible to add new sections to the garden each year or every few years, or to redesign existing elements. The process of design and subsequent implementation should be valued in concert with preparing, planting, tending and harvesting the garden when considering student and school-wide benefit.

Chapter Three

Introduction

At the time of this paper's writing, our school is looking to the following academic year of 2013-2014 in which to begin creating the school garden. This coming spring semester of 2013, several groups of students will be working on initiating planning designs while grant applications for funding are in progress however we will not be finalizing garden plans. I will be leading a "Green Team" club after school, for which students from third through fifth grades are welcome to sign up to join. For this club I will be applying several of the lessons discussed in this chapter. If we were further along in the school garden process and in order to apply the research discussed in the previous chapters, I would begin at the start of the academic year to make gardening a part of my class on a daily basis.

To incorporate planning and developing a garden into my curriculum, I would begin by unearthing what students already know about gardening, food production and the needs of plants. This would begin with a short survey and be followed by whole class discussion. In order to look at the six categories of benefits listed above (academic enhancement; science aptitude enhancement; environmental awareness/growth in environmental respect; improvement in nutrition and eating behavior; increased self-efficacy, motivation, social and group learning skills; community building and volunteerism), I would give a short assessment and make notes about students' behavior and aptitudes throughout the course of the year. A final survey and reflection would be given in the last weeks of the school year. Lessons would be planned to bring improvement in each of these six categories. To begin the planning phase, rather than the

planting phase, not only extends the learning to the onset of the garden, but also increases student ownership of the garden and their environmental education. The idea that students need to be involved in the planning of their garden originated, for me, with the research described in Chapter Two.

Lessons following the original assessment will be designed with the goal for students to have the knowledge to effectively plan a garden space taking into consideration our unique Colorado climate. Beginning with the goal in mind, and then creating the lesson plan around that goal, will allow students to be successful in their learning goals.

Context

The following implementation is planned for a hypothetical fourth grade class in a Colorado public school on the Front Range, such as in the cities of Colorado Springs or Denver. The class would be between 22-28 students, roughly equal gender distribution, average past TCAP scores and school assessments, from two - six students on ILPs, on IEPs or who are ELLs, and two – eight students recognized as talented and gifted in various subjects. This application would best apply in a region where the gardening season extends beyond the summer months but is flexible to accommodate many regions with modification. Depending on the specific time allowed and context of the school garden process (i.e. will the garden be starting small or large, will other classes be planning their own beds, what grant restrictions are in place), changes to the suggested curriculum for the planning process would need to be made on a class by class basis.

Implementation

The following ten lessons are meant to be a starting place for working with a class to plan and later create, a school garden where one has never been before. These lessons could easily be modified to suit other grade levels. Categories from Chapter Two are referenced by numbers one though six: (1) academic enhancement; (2) science aptitude enhancement; (3) environmental awareness/growth in environmental respect; (4) improvement in nutrition and eating behavior; (5) increased self-efficacy, motivation, social and group learning skills; (6) community building and volunteerism.

Lesson 1: The Garden as a Classroom *(one class period)*

Essential Question: How are the plants in a garden the same or different than the people in our class?

Content: Discuss and introduce the needs and characteristics of a garden in relation to the needs and characteristics of a class. The end goal is for students to have a basic understanding of the needs of living plants and how to classify and describe them.

Standards: *2-Life Science 1. All living things share similar characteristics, but they also have differences that can be described and classified.*
1-Life Science 3. d) Examine, evaluate, question, and ethically use information from a variety of sources and media to investigate questions about characteristics of living things.
2-Life Science 3. There is interaction and interdependence between and among living and nonliving components of ecosystems.

Categories Targeted: 2) science aptitude enhancement; (3) environmental awareness/growth in environmental respect.

Plan: The class will begin with watching a short slideshow of garden photos and vegetable gardens at various stages of production. Following this we will begin to fill in a large K-W-H-L chart (what we know, what we want to know, how we will learn it, and

finally what we learned) on one wall of the classroom. Students will converse with their table groups and write one or two questions on a sticky note that they'll affix to the board for addition to the K-W-H-L chart. During each lesson the class will be adding to our K-W-H-L chart, answering some questions and adding many more.

Based on the discussion, the class will then rotate around to different stations, describing and classifying what they see at that station in their garden journals. Examples of stations include: worms, ladybug beetles, potted vegetables, a pumpkin, ears of corn, herb plant, soil, and water. For each station, students will do the following:

1) Draw and identify what you see
2) Is it alive?
3) What does it need to survive and flourish?
4) How is this thing different than you?
5) How is it the same as you?
6) How would this thing benefit a garden or you?

The lesson will conclude with a class discussion about what students found in their rotations and how these different things depend on one another. We will add to the K-W-H-L chart during this time and in subsequent lessons.

Assessment: Students will be assessed on their journal entries for depth of understanding and effort of response.

Lesson 2: The Garden as an Ecosystem *(two class periods)*

Essential Question: Why do humans create gardens?

Content: Our class will create a map of a garden showing the cycle of energy and flow of materials in and out of the garden. The lesson will include small group and whole class discussion along with a personal reflection from each student.

Standards: *2- Life Science 3. There is interaction and interdependence between and among living and nonliving components of ecosystems.*
a. Identify the components that make a habitat type unique.
e. Make a plan to positively impact a local ecosystem.

Categories Targeted: (2) science aptitude enhancement; (3) environmental awareness/growth in environmental respect; (4) improvement in nutrition and eating behavior.

Plan: We will begin with a short discussion of energy flows and create a chart on the board (which students will also be writing down in their garden journal). The class will watch a 5-9 minute film about the garden as an ecosystem for visual and auditory learning enhancement. I will then teach a short lesson (15-20 minutes) on energy flows in the garden, teaching students about input and output; reviewing decomposers, producers and consumers. We will refer back to the K-W-H-L chart and add to it during this lesson.

Next, table groups will get a piece of butcher paper to fill in a T-chart while they brainstorm what gardens need and what they give, both to humans and to other species and the ecosystem as a whole. This work will reflect back on the essential question, "why do humans create gardens?" Students will then post their t-charts on one wall of the classroom.

Moving outside with journals and pencils (weather-permitting) students will then write a short journal entry to answer the essential question based on their knowledge at this time. They will also draw a picture of a garden and show at least one producer, one decomposer and one consumer (it might be them!).

Assessment: Students will be assessed on their participation, group t-chart and their journal reflection.

Lesson 3: The Garden Puzzle (*two class periods over two days)*

Essential Question: What pieces are needed for our garden to be successful?

Content: Groups will create an art project out of one-foot square puzzle pieces showing what our garden needs.

Standards: *2- Life Science 3. There is interaction and interdependence between and among living and nonliving components of ecosystems.*
b. Identify the components that make a habitat type unique.
e. Make a plan to positively impact a local ecosystem.
1-Visual Arts 2. Works of art articulate and express different points of view.
a. Discuss how characteristics of art are used in specific ways to create meaning.
1-Visual Arts 3. Prepared Graduates: Recognize, articulate, and debate that the visual arts are a means for expression.

Categories Targeted: (3) environmental awareness/growth in environmental respect; (5) increased self-efficacy, motivation, social and group learning skills.

Plan: I will talk more about the concept that there are different parts and components that all work together to make a successful, sustainable garden. For planning our garden we will need to know what components we need. Table groups will each come up with five components, which we will then list on the board. Next we will watch a movie about a school garden in California where students give a tour of their garden and explain each component.

Students will then spread out around the room with their journals to read gardening books and research ideas for our garden. Students will take notes on components and types of gardens they'd like in our garden, and be prepared to explain why.

The following day we will list out the components of a garden that students want to include in our school garden. As a class, we will choose the top 12. The class will then break into small groups of two to three students, each group taking one "piece of the puzzle". Each group will do more research on their component before beginning their art project. The puzzle pieces will be titled and have a painting of that garden component (ranging from a compost bin to a chicken coop to a tomato patch to rain clouds and a sprinkler system). The pre-cut puzzle pieces will then be put together as each group presents their piece to the class, creating a wall mural in the end.

Assessment: Students will be assessed on their presentation and their final puzzle piece. Garden journals will be checked as well for a research grade. Students will add to the K-W-H-L chart during this lesson for whole class learning assessment.

Lesson 4: Blueprint for Our Garden - Part I *(two class periods)*

Essential Question: What is the most effective shape for our garden?

Content: In this lesson we will begin to look at the best way to arrange our garden given the space we have allotted and the restrictions of the district guidelines for our grant.

Standards: *1-Mathematics 3. Prepared Graduates: Are fluent with basic numerical and symbolic facts and algorithms, and are able to select and use appropriate (mental math, paper and pencil, and technology) methods based on an understanding of their efficiency, precision, and transparency.*
a. Use place value understanding and properties of operations to perform multi-digit arithmetic. (CCSS: 4.NBT)
i. Fluently add and subtract multi-digit whole numbers using standard algorithms. (CCSS: 4.NBT.4).
iv. Illustrate and explain multiplication and division calculation by using equations, rectangular arrays, and/or area models. (CCSS: 4.NBT.6).
4- Mathematics 1. Appropriate measurement tools, units, and systems are used to measure different attributes of objects and time.
v. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. (CCSS: 4.MD.3)
1-Oral Expression and Listening 1. A clear communication plan is necessary to

effectively deliver and receive information.
a. iii. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.

Categories Targeted: (1) academic enhancement; (5) increased self-efficacy, motivation, social and group learning skills.

Plan: Given the space we have to work with and the guidelines of the district and grant application, we will need to begin planning our garden to most effectively use the space we have at our school. In groups of 3-4, students will begin mapping out the perimeter of our garden. We will have a discussion/lesson on space needed for each component (such as a 4x8' area for the compost) to give students an idea of what space is needed in the interior. Students will begin by looking at the area and perimeter of the space. Would a long rectangle, a circle, a pentagon or a square give us the most space? To answer this first question, students will map out various ground plans and use their knowledge of area and perimeter to compare the shapes. They will use geo boards and graph paper to estimate the areas for determining the area, combined with using the equation for finding area when known. Each group will be given an overhead transparency or an IPad to link to the smart board and will present why and how they came to their conclusion on the shape of the garden.

Assessment: Students will be assessed on their journal entry explanation of why their group chose the shape they did and their group's presentation.

Lesson 5: Blueprint for Our Garden - Part II *(five class periods over one - two weeks)*

Essential Question: What will our garden look like inside?

Content: In this lesson, students will begin mapping out how they'd like their garden to look. An understanding of space requirements needed for essential components of the

garden, along with non-essential elements they'd like to work in will be drawn out and explained.

Standards: *1-Mathematics 3. Prepared Graduates: Are fluent with basic numerical and symbolic facts and algorithms, and are able to select and use appropriate (mental math, paper and pencil, and technology) methods based on an understanding of their efficiency, precision, and transparency.*
a. Use place value understanding and properties of operations to perform multi-digit arithmetic. (CCSS: 4.NBT)
i. Fluently add and subtract multi-digit whole numbers using standard algorithms. (CCSS: 4.NBT.4).
iv. Illustrate and explain multiplication and division calculation by using equations, rectangular arrays, and/or area models. (CCSS: 4.NBT.6).
4- Mathematics 1. Appropriate measurement tools, units, and systems are used to measure different attributes of objects and time.
v. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. (CCSS: 4.MD.3).
2- Life Science 3. c. Identify the components that make a habitat type unique.
e. Make a plan to positively impact a local ecosystem.
1-Visual Arts 2. Works of art articulate and express different points of view.
a. Discuss how characteristics of art are used in specific ways to create meaning.
1-Visual Arts 3. Prepared Graduates: Recognize, articulate, and debate that the visual arts are a means for expression.
1-Oral Expression and Listening 1. A clear communication plan is necessary to effectively deliver and receive information.
a. iii. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.

Categories Targeted: (1) academic enhancement; (5) increased self-efficacy, motivation, social and group learning skills.

Plan: The class will go over the twelve essential components that we decided upon in lesson 3 and refer back to our wall garden puzzle. Students will go back into their groups and will decide a range of area (in square feet) that their component requires. These areas will be listed on the board. Groups will then begin mapping out their gardens based on the perimeter that the class chose as most effective in the previous lesson. Each group will make a map of the garden on a large piece of drawing paper, complete with measurements and labels for each component. Design elements they'd like to see in the

garden will be added at this time. Students will be given several periods to work on this design, adding a title, color and any captions they'd like for explanation of their ideas. The class will have student-run meetings to discuss current thoughts and have students answer each other's questions that have arisen in the planning process.

Each group will present their poster and findings to the class with students giving them feedback and asking questions. Groups that have moved faster will use a computer program to make a technical blueprint of their garden or create a 3-D scale model of their design with labels using foam board as a base and various materials for garden elements.

Assessment: Students will be assessed based on their group presentation, their participation in class discussion and their use of area in planning their garden to include all twelve essential components.

Lesson 6: Blueprint for Our Garden - Part III

(five class periods over one to two weeks)

Essential Question: What will our garden look like inside?

Content: In this lesson the class will begin to design our garden as a whole, taking input from all groups to create a master plan. The teacher and any other staff who will be helping plan the garden will ideally take part in one of more of these periods).

Standards: *1-Mathematics 3. iv. Illustrate and explain multiplication and division calculation by using equations, rectangular arrays, and/or area models. (CCSS: 4.NBT.6).*
4- Mathematics 1. Appropriate measurement tools, units, and systems are used to measure different attributes of objects and time.
v. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. (CCSS: 4.MD.3).
2- Life Science 3. c. Identify the components that make a habitat type unique.
e. Make a plan to positively impact a local ecosystem.
1-Visual Arts 2. Works of art articulate and express different points of view.
a. Discuss how characteristics of art are used in specific ways to create meaning.

1-Visual Arts 3. Prepared Graduates: Recognize, articulate, and debate that the visual arts are a means for expression
1-Oral Expression and Listening 1. A clear communication plan is necessary to effectively deliver and receive information.
a. iii. Pose and respond to specific questions to clarify or follow up on information, and make comments that contribute to the discussion and link to the remarks of others.

Categories Targeted: (1) academic enhancement; (5) increased self-efficacy, motivation, social and group learning skills.

Plan: Groups will rotate around to meet with one another to discuss what elements they want to include in the final garden and what elements we will not have room for at present. The class will come together and discuss four to six more components they'd like to see in the garden (such as bird houses, a bean trellis tepee etc). Working in three groups containing members of each original planning group, with the assistance of staff members and parents who will be contributing), the class will come up with three master designs. These will compared and a master plan made with the whole class working together. This will be our working master plan. During these periods, the class will be stopping for mini-lessons to discuss the virtues of raised beds versus in ground plots and other design element options. Short videos focusing on different components of the garden will be interspersed with the planning as well. In the end our class will have a working master plan with which to present to the district for funding application. Several students will be chosen to make a video of the master plan that will be shown to the committee if it is not possible for a small or large group to be present at the district-funding meeting to propose the plan.

The class will add design element questions (and answers) to the K-W-H-L chart during this series of lessons.

Assessment: Students will be assessed on their participation and contribution to the planning.

Lesson 7: Blueprint for Our Garden - Part IV *(four class periods over one week)*

Essential Question: What will our garden look like inside?

Content: In this lesson we will discuss our master plan in depth and students will write a descriptive, multi-paragraph essay to the essential question. They will also draw out their rendition of the master plan, adding in details of which crops they would like to grow. These pieces will be revised, typed and printed to create one chapter of our class' "Garden Book" and printed back to back with each student's labeled garden plan. Area of garden plots and number of plants (multiplied) will be a component of the drawn out plan.

Standards: *1-Mathematics 3. iv. Illustrate and explain multiplication and division calculation by using equations, rectangular arrays, and/or area models. (CCSS: 4.NBT.6).*
4- Mathematics 1. Appropriate measurement tools, units, and systems are used to measure different attributes of objects and time.
v. Apply the area and perimeter formulas for rectangles in real world and mathematical problems. (CCSS: 4.MD.3).
2- Life Science 3. c. Identify the components that make a habitat type unique.
e. Make a plan to positively impact a local ecosystem.
1-Visual Arts 2. Works of art articulate and express different points of view.
a. Discuss how characteristics of art are used in specific ways to create meaning.
1-Visual Arts 3. Prepared Graduates: Recognize, articulate, and debate that the visual arts are a means for expression

Categories Targeted: (1) academic enhancement; (5) increased self-efficacy, motivation, social and group learning skills.

Plan: During one writing period, students will write a descriptive piece to the prompt of our essential question: "What will our garden look like inside?" They will revise and edit (alone and with peers) this five to seven paragraph piece. Students will then type their final writing pieces and these will be compiled in a book. Additionally, students will

draw out their filled in version of the master plan: What would you like planted in each bed? What kind of fruit trees would you like to see in the garden? What is your preferred compost method and why? These labeled drawings will be shown side by side with their writing in the book. Students will read their essays to one another in small groups to share. One or two essays with important teaching applications will be shared with the class. The class will revisit and add to the K-W-H-L chart during this lesson.

Assessment: Students will be assessed on their final essay and drawing. Writing will be graded as per writing curriculum parameters.

Lesson 8: Planting Plan - I

Essential Question: What plants are suited to our garden and our needs?

Content: In this lesson, we will begin learning about the specific plants/varieties that grow well in our region and are best suited for our garden. The class will be grouped into research pairs to investigate the virtues of a wide variety of possible plants that we might include in our garden.

Standards: *3. Writing and Composition 1. The recursive writing process is used to create a variety of literary genres for an intended audience*

a. Write opinion pieces on topics or texts, supporting a point of view with reasons and information. (CCSS: W.4.1)

i. Introduce a topic or text clearly, state an opinion, and create an organizational structure in which related ideas are grouped to support the writer's purpose. (CCSS: W.4.1a)

ii. Provide reasons that are supported by facts and details. (CCSS: W.4.1b)

Categories Targeted: (3) environmental awareness/growth in environmental respect; (4) improvement in nutrition and eating behavior; (5) increased self-efficacy, motivation, social and group learning skills.

Plan: This lesson will begin with a discussion of growing zones and types of plants that will be suited to our garden. A discussion on the range of fruits and vegetables we could grow will result in starting a list on the board. We will also learn about growing seasons and consider how to plan for a bountiful garden throughout the growing season. Mini lessons will be presented having students plan what they want to cook and what we would need to plant to have the right ingredients. Students will then write their own "growth recipe" in their garden notebooks to the prompt: "What would you like to cook and how will you grow it?" Responses might include a pizza or lasagna garden, a salad garden, an omelette garden (complete with chicken coop), or maybe a blackberry pie garden. Students will be encouraged to use their imaginations and write about what ingredients they would need that they can't grow in their garden.

Students will begin with a class period to look through seed catalogs and, working in groups of two or three, make a collage of plants that we could potentially grow in our Colorado school garden. They will need to create a key with names of the types and varieties of each plant that appears on their collage. Each group will arrange the plants in the organizational method of their choice. Collages and keys will be presented to the class. Each student will write a short reflection on what they learned from their seed/plant catalog search in their garden journals.

In the last piece of this lesson, students will write another "growth recipe" which can be for the same dish or for a different one than they planned before. For this recipe they will need to make a growing list, a buying list (of no more than five items), and write out a recipe. This project will require each student to research the plants they want to grow and choose specific varieties to grow (hypothetically). The teacher or parent helpers will check each student's draft prior to printing. Final drafts will be accompanied

by a painting of their final product and added as a "student cookbook" chapter in the class' "Garden Book". In this lesson the class will add plant specific notes to the K-W-H-L chart.

Assessment: Students will be assessed on group collages and presentations, their garden journal writings and their final growth recipe essay and painting.

Lesson 9: The Three Sisters Garden *(Two class periods and additional work time)*

Essential Question: What are the roles of the three plants in a three sisters garden?

Content: In this lesson, we will learn about the origins of the "Three Sisters Garden" as an example of garden planning by other cultures (past and present). Later in the unit we will also learn about specific garden systems in other cultures (such as rice paddies, potatoes fields, cassava, barley and palm coconuts).

Standards: *3- Writing and Composition 1. The recursive writing process is used to create a variety of literary genres for an intended audience.*

c. Write poems that express ideas or feelings using imagery, figurative language, and sensory details.

2- Geography 2. Connections within and across human and physical systems are developed.

a. Describe how the physical environment provides opportunities for and places constraints on human activities.

Categories Targeted: (1) academic enhancement; (3) environmental awareness/growth in environmental respect; (4) improvement in nutrition and eating behavior; (5) increased self-efficacy, motivation, social and group learning skills.

Plan: This lesson will begin with reading a story about the three sisters garden and learning how this historical interdependence of beans, squash and corn sustained cultures in difficult growing conditions. Each student will plant six starts (two of each of the triad) to have their own three sisters garden. They may take these home and plant them in a garden or see how they grow and survive in their original pot. Will that pot provide them with the space they need?

The class will learn about the haiku poetry and will then write haikus about their three sisters garden. As an extension, students can create a collage painting using actual seeds on a painting they create of a three sisters garden. Haiku's will be written neatly on index cards and this project will be displayed on the hall bulletin board. The class will be revisiting the K-W-H-L chart during this lesson.

Assessment: Students will be assessed on their haikus and art work, based on their effort and understanding.

Lesson 10: Our Garden, Our Community (*nine class periods over three weeks*)

Essential Question: What role will our garden play in our community?

Content: Students will research a community garden and its effect on the surrounding community. Students will suggest ways that our school garden can become an essential part of creating community around our elementary school. Students will present a PowerPoint presentation sharing their research and ideas. Students will specifically address how the garden has impacted the nutrition of the school or community where it is based and share their ideas for additions to that community garden.

Standards: *1- Oral Expression and Listening 1. A clear communication plan is necessary to effectively deliver and receive information.*

3. Writing and Composition 1. The recursive writing process is used to create a variety of literary genres for an intended audience.

4- Research and Reasoning 1. Comprehending new information for research is a process undertaken with discipline both alone and within groups.

Categories Targeted: (4) Improvement in nutrition and eating behavior; (5) increased self-efficacy, motivation, social and group learning skills; (6) community building and volunteerism.

Plan: We will begin the lesson with a guest speaker sharing slides and information about the impacts of a community garden in our area. Students will also learn, through film and multi-media, about a community garden in a third-world country that is positively impacting it's community. Students will each choose a community garden to research and create a PowerPoint presentation on that garden. Students will need to look at the difficulties that the garden organizers faced, how they overcame them, the components of the garden, the community impacts of that garden and hopes that the community has for their garden in the future. Students will write an opinion piece about the garden and what they feel could be added to the garden or what components of that garden should be included in our school garden.

Students will publish their essays and create yet another chapter in our garden book. Each student will present and discuss their PowerPoint presentation. Each student will also send a letter to the gardeners they profiled sharing their thoughts and any praise or suggestions.

Class meetings will be held daily to discuss what students are finding in their research and for students to debate components of the gardens they are researching.

Assessment: Students will be assessed on their opinion piece essays, written letters and their PowerPoint presentation (the slides and their presentation). Students will also be given a participation grade for their role in class discussions.

Additionally, the entire class will review the K-W-H-L chart at the end of this lesson, adding knowledge and more questions.

Conclusion

In Chapter Three, I laid out a series of ten lessons, some with an extended format, to introduce and educate a fourth grade class in planning a school garden. In Chapter Four, I will review the thesis of this project and discuss issues that might arise with the implementation of a garden planning unit for a fourth grade class in Colorado. I will reflect on whether or not my thesis would be confirmed through implementation of these lessons. I will discuss, in detail, what recommendations I have for extension or changes in the curriculum. To conclude, I will offer recommendations for future research in the area of school gardens and reflect on how this research process will influence my teaching, plans and professional growth and development endeavors in the future.

Chapter Four

Introduction

In this study I researched the benefits for students planning a community-based school garden in a suburban elementary school. In my thesis, I proposed that taking leadership in the planning process would increase overall gardening interest, self-efficacy and attitude toward school, including enthusiasm for learning, in elementary school students, specifically fourth graders. This "ownership" of their school garden would increase subsequent expected benefits, including academic aptitude across disciplines, interpersonal relationships, and the critical early development of healthy eating habits.

Through completion of my research, and writing of a garden-planning curriculum, several issues may arise when bringing this curriculum (or one of a similar nature) to the classroom. I recognize that this is a time-intensive curriculum, and time is a commodity in short supply in today's 21st century classroom. Fitting planning a garden, and eventually working in a garden, into the daily schedule, already packed with math, reading, writing, social studies and encore classes, is a challenge. This unit also requires a commitment from the teacher to learn or familiarize himself or herself with the information to effectively teach the lessons. For these lessons to be effectively shared with teachers across the nation, it would be necessary to write a simplified teacher's guide, complete with resources and examples. Were I to write a standardized curriculum to meet common core standards for the nation, I would shorten these ten lessons to create a more condensed unit of study, perhaps one that led students to planning out a potted or rooftop garden. The lessons laid out in Chapter Three were written for fourth graders, but

the unit could easily be rewritten to be appropriate for grades K-6 and modified to meet grade-specific common core standards.

Another issue with this curriculum is that it focuses only on planning the school garden. Once the school garden is in place, the unit would need to be modified greatly for future classes to fully benefit from all that they can learn from the existing garden. The series of ten lessons, described above in Chapter Three, is an introduction into the school garden, but when students are planting and harvesting from *their* garden, that is when even more connections with garden-based learning can be made.

From growing up in a gardening family, shopping at growers' markets, and having a few years of practice as an independent adult, I have a decent knowledge of gardens. Kids are amazingly resourceful, but as humans, we often assume we know many things that we don't and move forward in various levels of intrepid ignorance. As gardeners say, "well, next season is always the best season." It may take experience in implementing the lessons and adjusting as necessary, to know the areas of misunderstanding or lack of understanding need to be addressed in this unit. So, as with the yearly tomato patch, it may be that each new class working with such a curriculum would have an improved experience.

Reflection

Given the qualitative nature of this study, my thesis cannot be supported or confirmed by data at this time. However, research points to the multiple benefits across subjects and social realms, for students engaged with gardening and food production. From my work this year in an arts and science-integrated elementary school, I see how involvement at the onset of a project plays into an increased level of motivation for students. The

intrinsic value of planning a school garden for students would, I believe, lead to future generations of students benefitting not only from the garden but also from the kid-friendly design. Kids think differently than adults. They see some things we don't and find ways to solve problems that would not have occurred to us.

If other schools were to implement this garden-planning unit in the future, I would simplify the lessons somewhat to consist of smaller projects. I do believe that a simplified version of this unit would be easily and successfully implemented into schools. The amount of preparation, planning, research and time that teachers already commit to the required academic subjects, is immense. Because I would like this garden-planning unit to be highly accessible and not a "burden" to teachers already working well past their paid hours, I believe a shorter unit would be more successfully adopted.

I wonder if, in coming years, it will become standard for schools in the United States to incorporate a curriculum covering gardening and basic food production. Not only are these important concepts in themselves, but as discussed in Chapter Two, studies show that garden-based curriculum and experience benefits students across subject areas. I suggest this since more and more students do not understand where food comes from or how it is to grow one's own food. Given that a huge percentage of our youth are raised far away from fertile gardens, bringing gardening back into the schools may just be part of the answer to fully educating our youth.

Conclusion

Based on my research for this paper and experience in the elementary school setting, I would offer the following recommendations for future inquiry: First, carry out quantitative studies on the benefits of garden planning. How does initial involvement

affect future motivation in the garden and across subjects? Second, what knowledge is essential for students to have about gardens as they plan a school garden, and what can be learned as they go?

I would recommend that future researchers use student interviews to understand students' growth in knowledge and motivation when involved in the garden planning process. As a researcher, I would also look at teachers' impressions how each student grew through the garden-planning process. I would take all student assessment data as well and use it to assess academic growth or decline across the research group. Has this group grown more in their academics compared to a control group that did not have a garden-planning unit? Creating a quantitative study with reduced variables would be one of the greatest challenges as many things in and out of school affect student learning.

As a future full-time elementary school teacher, this project will influence my teaching a great deal. Already, as an intern teacher, I will be using some of these lessons in my two-month long weekly after school "green club" meetings. I will be working with a group of third, fourth and fifth graders to prepare for a school garden coming next year. We will be working on a design model to be proposed to the Green Team Committee at our school (of which I am a member). Additionally, students will be starting plants from seed to grow a potted garden at school and take home small "patio gardens" for harvesting through the summer and fall. My research has given me increased confidence in the value of school gardens. This research paper could be used as support for grant applications for funding a school garden or convincing a reluctant administration to back the creation of a school garden.

Seeking out continuing education seminars on school gardens and bringing in experts to speak to interested team members are two ways that I will continue my

education in community-based school gardens. Several local clubs offer classes on various aspects of gardening in our region and the public is allowed to attend. It would also be important to spend more time touring school gardens already in place along the front range of Colorado. My goals would be two-fold: first, to see design plans and interview students and educators about their favorite elements of the garden; second, to learn how the gardens are being connected to in school curriculum. Were I to be hired as an elementary or middle school science teacher, I would make the school garden the centerpiece of our learning and embark on season or year long studies with my students to utilize their science notebooks in a real-world application.

I believe that if students are involved from the start, then the garden will grow from their fruitful ideas and their motivation will encourage families and the community to support and tend to a school garden. Active, hands-on learning with real-world application can create lasting positive impacts on students that I expect students will take with them through their academic and post-academic careers. I still remember planning, building, planting, weeding, watering and observing in my elementary school xeriscape garden. Those are experiences I will work hard to bring to each of my classes moving forward.

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