Discovering learning, discovering self: The effects of an interdisciplinary, standards-based school garden curriculum on elementary students in Hawai'i.

Koh Ming Wei

A Dissertation

Submitted in partial fulfillment of the requirements for the degree of

Doctor of Philosophy From

Prescott College in

Sustainability Education

May 2012

Joan Clingan, Ph.D.
Committee Chair

Pramod Parajuli, Ph. D.
Committee Member

Katherine Tibbetts, Ph.D.
Committee Member

Dilafruz Williams, Ph.D.
Committee Member

ABSTRACT

This study evaluates the effects of an interdisciplinary standards-based school garden-based education program on student learning. The objective of the program is to help students learn to be self-directed learners, community contributors, complex thinkers, quality producers, effective communicators, and effective/ethical users of technology. For the State of Hawai'i Department of Education these are known as General Learner Outcomes.

A group of third, fourth and fifth grade Gifted and Talented students were taught 1 hour classes two times a week in the Discovery Garden at the Kohala Elementary School for one semester from August 2011 through December 2011. The theoretical framework for the curriculum and pedagogy of the semester long program was synthesized into the *Pedagogy of Food* which is based on learning by doing using structural-developmental theory; learning through relationships using social cognitive theory; and learning through metacognition using human development. The six General Learner Outcomes were chosen as the objectives and measurements of the study.

The students completed a pre- and post-survey on how they viewed themselves as learners, contributors, producers, communicators, thinkers, and users. The students also participated in focus groups where they were asked about what and how they learned in the program. Teachers, school administrators, and parents were interviewed in depth for their opinion and observation of the impact of the program.

The findings of this project were prefaced by lessons learned from the pilot study of this program, conducted from October 2010 through May 2011, and then organized into themes

under the headings of the six General Learner Outcomes. Conclusions, challenges and recommendations for further research were provided in the final chapter.

ACKNOWLEDGMENTS

In July 2010, I was at a crossroad. I had to close a small Waldorf inspired school at which I founded, directed, and taught. Nancy Redfeather and Betsy Cole of The Kohala Center suggested I work with Danny Garcia, Principal of Kohala Elementary School to develop an integrated school garden program. The moment I visited Kohala Elementary School and met Danny, I fell in love with the potentiality of the place. Kohala Elementary School was a long drive from home. However, every time I got there the whole school community, from the very littlest child to the very hard-working custodians greeted me with so much *aloha* and enthusiasm it made every mile worthwhile. This project would not have been possible without the support of the Kohala Elementary School community – students, teachers, parents, administration, extended family, and community. *Kōkua aku, kōkua mai pēlā ihola ka nohona ʻohana*. *Mahalo nui loa*.

To those who truly believe that everything can be taught in the garden, and to those who have documented all learning garden educational efforts, I am honored to be a recipient of your open sharing and giving. Your work and names are such a major part of this study. Thank you for sharing freely your wisdom, knowledge, experiences, and green thumbs. To Amanda Rieux, Mala'ai Culinary Garden, Waimea Middle School, *mahalo* for freely sharing the garden protocol. Who could imagine the impact of two minutes of silence?

I would like to express my gratitude to all my dissertation committee members. Since there were two reiterations of the dissertation proposal, there were two sets of amazing and knowledgeable experts. To those who helped me launch the process: Dr. Christopher Houghton-Budd – I found a way to talk about Steiner's work in my voice; Dr. Ron Whitmore – ontology, epistemology, and methodology; and Dr. Matt Hamabata - write, write, write. To those who

guided me to the next phase: Dr. Katherine Tibbetts - *Lawe i ka ma'alea a ku'ono'ono;* and Dr. Dilafruz Williams – from Wendell Berry, *One of the most important resources that a garden makes available for use, is the gardener's own body. A garden gives the body the dignity of working in its own support. It is a way of rejoining the human race.* And to the two who have with me since day one: Dr. Pramod Parajuli – life is deep and delicious; and Dr. Joan Clingan – your eagle eye for detail is priceless. Thank you all.

To Bobby Grimes, whose family name sealed your fate to always be part of the *ʻāina*, thank you for your support, love, and for "telling it like it is."

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DEDICATION

for my father,

my first teacher

PREFACE

Danny Garcia, the newly appointed principal of Kohala Elementary School, looked out over a shallow valley that ran along the south end of his school. He wondered what lay under the thick mat of cane grass and Christmas Berry trees. Intrigued, Danny began asking his staff and faculty who had been at Kohala Elementary School much longer than he, if that area did in fact belong to the school, and if it did, how was the space used. To his surprise, many of the veteran teachers and staff recalled a garden growing in that shallow valley. They in turn began asking the elders of the community.

Soon, these elders approached Danny with stories of gardening in the gulch (as they fondly called it).

Over there, we planted vegetables.

Down there, we ran cattle.

Oh here…here we had grass and sat to have lessons outside.

Yes, I remember gardening in the gulch. It was a real good experience.

Now Danny was on fire. His experience as a Social Studies teacher and parent of 9- and 5-year-olds informed his pedagogy of what he termed as *exploratory learning*. He had a vision of a school garden in the gulch. A school garden where children could apply math skills and conduct science experiments, where they could draw and paint under the tress, and learn Hawaiian chants and hula on the grass. Danny saw a safe and creative place where students could practice skills such as tool use, cooperation, critical thinking, and problem solving. He envisioned an intergenerational garden space where elders could work with the young ones, sharing knowledge, expertise, and wisdom. An orchard with fruit trees planted by this year's first

graders, and harvested by their children 30 years later. A garden to explore what it means to be *pono* (upright, good). Danny also saw a school garden that could provide the school cafeteria with healthy, nutritious, and grown on–site produce.

The staff and faculty recalled Danny sharing his vision with them. Danny recalled them cheering, *Yay!*

The Kohala community is a small community and the word of Danny's vision spread. In the early summer of 2010, on a Friday, two volunteers showed up with a tractor. This is a retelling of the events that followed.

The volunteers offered, "We'll clear whatever you need, Mr. Garcia. Just show us!"

Danny made an executive decision right then. Act first, ask later. "Ok. Please clear this here and that there…" The men got immediately to work.

The following Monday, Danny excitedly walked over to the south end of his school. Four acres of cleared land greeted him. No cane grass, no Christmas Berries, just sienna brown exposed soil. He walked further down and heard the tractor. The volunteers were still at it! Danny thought to himself, "Oh my! All I wanted was one acre of cleared land. This is nuts!" He finally caught up with them. "Aloha! What happened here?" Danny asked.

One of them sheepishly replied, "Well, put a tractor in my hands and I am in heaven. A boy on a big toy. We just thought that you could use different areas to do all the different things you want. There is no way you can do all that on one acre. For your vision, Danny, you need at least 4 acres. So, since we have the tractor we just thought…well, we'll get it done now…uh…is it ok?" Danny could not help but smile. "It's fantastic!" he said. "But you need to stop now."

Later in the summer, several high school students from Kohala High School led by three community members fenced in an area 85 feet by 70 feet approximately in the middle of the 4

acres. They also built a small platform to be used as an outdoor classroom. Kohala High School shares the campus with Kohala Elementary School, and many Kohala families have children in both schools. The fencing and platform building the summer of 2010 were the first of similar collaborations between the two schools in the elementary school garden.

Over the summer, Danny worked with Nancy Redfeather, the Director of the Hawai'i Island School Garden Network, to raise the funds for a garden teacher in his school beginning the fall of 2010. He wanted this person to use the garden to teach science and math and to incorporate other core subjects. He also wanted the school garden to be a place where his students could learn *pono* behavior, practice teamwork and cooperation, be responsible and reliable, creative and contributing. Finally, he wanted this garden to be a community space.

When I got to the Discovery Garden of the Kohala Elementary School in August 2010, 4 acres of bare soil greeted me. I could see twisting funnels of precious topsoil being swept away by the strong Kohala trade winds and specks of light green shoots dotting the area. I could also see Danny's vision very clearly: The fenced-in area will be the space for each grade to have their own garden bed. An area on the left of the fenced in area for a lawn and eventually a *hale* (pavilion) where there could be hula performances, music, plays and such. An area to the right of the fenced in area for the intergenerational garden and the orchard site. I could see that the garden was perfect for gravity fed irrigation. We could collect water off the roof of the school buildings and channel it down.

On my first day at Kohala Elementary School the third grade teachers invited me to their team meeting. They wanted to be the first ones to get a time and space in the garden. We created a third grade garden plan. Pretty soon, everyone else was on board. There was no mandate, no coercion, and no extra compensation. The teachers knew that the school garden at Kohala

Elementary School was contextually appropriate and an opportunity for the children to get outside and *do something with their hands*. This open discussion with the teachers made me reflect on my relationship with gardens and with food.

I am a gardener. I garden for three basic reasons:

1. I love to eat. I love to eat colorful, tasty, fresh, crunchy, juicy, and fragrant food.
2. I have no choice. The State of Hawai'i imports up to 85% of its food (Page, Bony, & Schewel, 2007, p. 6). If the barges stop bringing food to the islands, the stores will be out of food in about 7 days (Page et al., 2007). Growing food to feed my family is not a choice; it is imperative.
3. For my sanity. "It is said that without intimacy with nature, humans become mad" (Greenway, 1995, p. 127).

As I reflected, I could see how the Universe or Providence brought me to Kohala Elementary School and how this opportunity was going to support my professional, intellectual, and emotional growth.

The children I teach in the garden appear to love it as well. They tell me that they have a good time and that they like learning in the garden. They readily eat from the vines and stalks. Many older children know that we import most of our food, which is an additional expense, and rather unsustainable. They share stories about how gardening helps their families save money. Many of these children happily give up recess to come to work in the school garden. The teachers I work with tell me that their students are calmer in the garden. They use the garden as an incentive, a reward for work well done. Thus, this is a study of the learning experience of students in the school garden.

CHAPTER I

INTRODUCTION

A Zen roshi is dying.
All of the monks gather – an eagerness restrained – around the deathbed,
hoping to be chosen as the next teacher.
The roshi asks slowly, "Where is the gardener?"
"The gardener," the monks wonder aloud, "he is just a simple man
who tends the plants, and he is not even ordained."
"Yes," the roshi replies, "but he is the only one awake.
He will be the next teacher."

Zen Story

Creating, designing, and implementing school gardens for learning has become widespread in recent years (Desmond, Grieshop, & Subramaniam, 2004; Ozer, 2007; Parajuli, Dardis, & Hahn, 2008; Ratcliffe, 2007; Robinson & Zajicek, 2005; Walizcek, 1997; Williams & Brown, 2010, 2012). One of the more well-known proponents of school gardens in the United States is current First Lady, Michelle Obama, who led the plowing up of a section of the White House lawn in March 2009 for a 1,100 square foot garden where students from nearby schools can garden and discover eating fresh vegetables (Superville, 2010). Other prominent school garden proponents include Alice Waters with her Edible Schoolyard movement in Berkeley, California (Desmond et al., 2004; Murphy, 2003), and Delanie Eastin, former California State Superintendent of Schools, who launched a major effort in 1995 to encourage "a garden in every school" (Desmond et al., 2004, p. 36).

Today school garden and garden-based learning programs are found all over the United States and the globe, with the Learning Gardens program in Portland, Oregon (Parajuli et al., 2008; Williams & Brown, 2012); Gardens for Life program in England, Kenya, and India

(Bowker & Tearle, 2007); Multicultural School Gardens in Australia (Cutter-Mackenzie, 2009); and the Kizaki Proletarian Farmers' School in Japan (Rothstein, 2010).

Several dissertations have been written about the benefits of school garden-based education programs on the health and nutrition of school children (Hazzard, 2010; Ratcliffe, 2007). Research provides concrete evidence of the benefits of how vegetable gardening affects young people's food consciousness and eating habits (Libman, 2007; McAleese & Rankin, 2007; Morris, Neustadter, & Zidenberg-Cherr, 2001; Morris & Zidenberg-Cherr, 2002; Murphy, 2003), of how garden-based programs can be used to combat childhood obesity (Libman, 2007), and how garden programs can maximize healthy development (Ozer, 2007). Poston, Shoemaker, and Dzewaltowski (2005) indicated that garden-based nutritional lessons and activities have greater impact on student behavior than traditional classroom lessons.

In the study by Graham, Beall, Lussier, McLaughlin, and Ziedenberg-Cherrr (2005) *Use of school gardens in academic instruction*, investigators found that the most frequently taught subjects in school learning gardens were science (85% of the schools surveyed), environmental studies (70%), nutrition (66%), language arts (60%), and math (59%). Other educational purposes of school gardens throughout its recorded history include use as an outdoor/living classroom to amalgamate and apply the theories and principles of place-based learning (Sobel, 1996, 2004, 2008); experiential learning (Kolb, 1984); constructivist learning (Subramanian, 2003); naturalistic learning (Gardner, 1999); environmental education (Braus & Wood, 1993; Disinger, 1998; Miller, 2007); and sustainability education (Williams & Brown, 2010, 2012).

To meet the growing demand for school garden coordinators and teachers, several training programs were developed in the recent years. The Occidental Arts and Ecology Center in Northern California developed a school garden teacher training and support program that has

trained more than 500 educators (N. Redfeather, personal communication, January 9, 2011; Occidental Arts and Ecology, 2000 – 2009). The Learning Gardens Institute supports the Growing Gardens 35 hour School Garden Coordinator Certificate Training in Portland Oregon (Parajuli et al., 2008; Growing Gardens, 2006 -2012). In Hawai'i, The Kohala Center, Kamuela, Big Island, was awarded an *Agriculture in the Classroom* USDA grant in October 2011 to create and implement a school garden teacher certification program for Hawai'i educators (N. Redfeather, & B. Cole, personal communication, August 10, 2011; Center for Ecoliteracy, 2004 - 2012).

School garden-based education programs in Hawai'i schools is a relatively new movement, and has recently received some local attention and publicity (Dahm, 2010; Stanton, 2010). The school garden movement has strong links to the food sovereignty movement (Pomaikai McGregor, 2007; Yee, 2012) and to the Hawaiian Cultural Renaissance (K. Ching, personal communication, 02/01/11).

While there is no denial from many educators and parents that school gardens are beneficial in many ways to children, empirical research into the impact of these gardens is limited (Mayer-Smith, Bartosh, & Peterat, 2007, p. 78; Ratcliffe, 2007, p. 11; Williams & Dixon (in review). Recommendations to conduct "inquiry on school gardens [that] extend beyond nutrition to the potential effects on the psychosocial and academic development" (Ozer, 2007, p. 861) back the claim that "few studies have focused on gardening being incorporated as a curriculum tool for success in academic endeavors" (Klemmer et al., 2005b, p. 448).

The successful use of school gardens in different settings is well documented (Braun, Kotar, & Irick, 1989; Canaris, 1995; Cavaliers, 1987; Dobbs & McDaniel, 1996; Dwight, 1992; Gwynn, 1988; Neer, 1990; Peyser & Weingarten, 1998; Pivnick, 1994; Salisbury, 1989; Sarver,

1985; Stetson, 1991; Thibault, 1994). Garden programs have been very successful with populations of children with special needs such as those who are developmentally disabled, autistic, and emotionally disturbed (Foster & Powell, 1991; Kaiser, 1976; Poroshina, 1985; Royal Horticultural Society, 2010; Sarver, 1985). The use of gardening as therapy with alienated youth and substance abusers has been documented by Cornville, Rohrer, Phillips, & Mosier, (1987), McQuinn and Reff (2001), Sandel (2004), and Richards and Kefami (1999).

Much of the research into the effects and impacts of school gardens and garden-based learning has revolved around the social and psychological effects such as: building self-esteem, developing interpersonal relationships, and improving attitudes toward school (Skelly, 2000; Walizcek, 1997); building a sense of responsibility and attitudes toward the environment (Ratcliffe, 2007; Skelly & Bradley, 2007; Walizcek, 1997); teamwork and self-understanding (Robinson & Zajicek, 2005). In this context, school gardens are sites for cooperative and collaborative activities in a forgiving, natural setting. Relationships in the garden are not the same as those in the traditional classroom. Students who may be struggling with traditional classroom-based education and pen and paper tasks may shine as weeders, soil turners, composters, and horticulturalists (Thorp, 2001).

Klemmer et al. (2005b) conducted a study in Texas Elementary Schools to "assess the effectiveness of school gardens for enhancing science achievement of elementary students in third, fourth and fifth grades" (p. 448). The State of Texas has a science TEKS (Texas Essential Knowledge and Skills) content that defines science achievement at each level. The researchers used a youth gardening curriculum that was developed based on the science TEKS and a similar adult gardening curriculum conducted by state extension agencies throughout the U.S. This curriculum is intended to educate youth about horticulture, health, nutrition, environmental

science, and leadership (p. 449). The researchers concluded after their study that "the garden curriculum was more effective as a teaching method in raising science achievement scores in boys in third and fifth grades, and for girls in the fifth grade compared to traditional classroom-based methods alone" (p. 449).

A study by Sheffield (1992) on *The Affective and Cognitive Effects of an Interdisciplinary Garden-Based Curriculum on Underachieving Elementary Students* was conducted during a third and fourth grade summer school Heritage Garden project at a South Carolina school. Sheffield hypothesized that underachieving students will achieve better academically and emotionally with an interdisciplinary curriculum set in a school garden. Results of formal pre- and post-tests of achievement (Peabody Individual Achievement Test), self-esteem (Coopersmith Self-Esteem Inventory), and attitudes toward school (School Attitude Measure) indicated greater gains in all three areas as compared to control classes. The most significant gains were in self-esteem, achievement in reading, reading comprehension, spelling, and written expression (Sheffield, 1992).

In her dissertation, Ratcliffe (2007) proposed a Model for Garden-Based Education in school settings (MGBE). The model posited that:

> a garden-based education program directly affects a school's learning environments in ways that may *directly* and *indirectly* affect students' personal characteristics and improve their academic achievement and health-promoting and environmentally responsible behaviors. It may also, affect broader community level factors, such as public health and environmental quality. These relationships between schools' learning environments, individuals' personal characteristics and behaviors, and community level factors are hypothesized to form positive feedback loops. (p. 95)

In Hawai'i with the school garden movement still relatively new, there has been almost no formal school garden research conducted. I found no academic or scholarly articles using the keywords school, garden, education, and Hawai'i. However, research into the effectiveness of school garden-based education to teach subjects such as science and math and to teach skills such as complex thinking and self-directed learning is important to the administrators in Hawai'i (Garcia, D., & Watterson, R., personal communication, October 2010, March 2011).

The Hawai'i Content and Performance Standards (HCPS II) sets the foundation for Hawai'i's public school curriculum, instruction, assessment, professional development, and accountability systems. HCPS II includes 10 content areas: Career and Life Skills, Educational Technology, Fine Arts, Health, Language Arts, Mathematics, Physical Education, Science, Social Studies, and World Languages. Content Standards define what students should know, be able to do, and care about. Performance Standards clearly describe quality products or performance with examples of student work and commentary on how that work demonstrates student attainment of the standard. HCPS II lists six General Learner Outcomes (GLOs) that are the goals of standard-based learning in all content areas, for all Hawai'i public schools grades pre-Kindergarten through twelfth (State of Hawai'i, 2007, 2010):

1. Self-Directed Learner: The ability to be responsible for one's own learning;
2. Community Contributor: The understanding that it is essential for human beings to work together;
3. Complex Thinker: The ability to be involved in complex thinking and problem solving;
4. Quality Producer: The ability to recognize and produce quality performance and quality products;

5. Effective Communicator: the ability to communicate effectively; and
6. Effective and Ethical User of Technology: the ability to use a variety of technology effectively and ethically.

The GLOs are the essential overarching goals for all grade levels and all of the academic disciplines. Every content and performance standard should support the learner's progress toward these outcomes because they enable learners to lead full and productive lives. High school graduation is dependent on the student's proficient demonstration of the HCPS II standards and the GLOs (Hawai'i State Department of Education, n.d.a.).

With all the publicity school gardens are receiving, it is all the more pertinent that research into the effects of school gardens and garden-based education on student learning and academic achievement is conducted. Such research will contribute to this growing movement and may aid in the justification of such programs in schools with reluctant administration and staff. Research into the efficacy of school garden programs as a pedagogical path may also provide schools with garden programs information that can be used to sustain the program and integrate gardening more fully into everyday core classes (Desmond et al., 2004; Ozer, 2007; Parajuli et al., 2008).

In the context of Hawai'i, no formal research has been conducted into the effects of school garden-based education in meeting the six GLOs goals of the Hawai'i Content and Performance Standards (HCPS II). Thus, this study fills a necessary need in the research.

Purpose

The goals of this project were to create a contextually and developmentally appropriate interdisciplinary standards-based school garden curriculum for students in the third, fourth, and fifth grades at the Kohala Elementary School; to implement and teach this curriculum twice a

week for one hour each lesson to an experimental group of 20 children; to evaluate the effectiveness of the program on the students related to the six Hawai'i GLOs; to make necessary revisions on interdisciplinary standards-based school garden curriculum and evaluative tools; and to refine my pedagogical practice and understanding.

The objective of this project was to assess and evaluate the extent to which the 20 students who participated in the interdisciplinary standards-based school garden curriculum showed any learning, comprehension, and understanding related to the six Hawai'i GLOs. These are gauged through their demonstration and application of the skills identified in the six GLOs in the school garden, regular school classroom, and at home.

Research Question

How does the experience of an interdisciplinary standards-based school garden education affect the learning and application of the six General learner Outcomes in elementary students?

The Curriculum

The six General learner Outcomes are the meta-message of the curriculum, while the content focuses on topics in several disciplines such as science, technology, engineering and math (STEM), history, and geography. The context of the school garden supports the learning of the content and the six GLOs through many of the tasks necessary for a thriving garden, such as: observation, composting, soil fertility care, plant propagation, irrigation, and weeding (Parajuli et al., 2008; Sheffield, 1992; Williams & Brown, 2012).

Methodology

In this research study context is critical and must be dealt with on its own terms (Lincoln & Guba, 1985). The context was a small public school in rural Hawai'i, the most isolated landmass on this planet. This study was a qualitative research process with quantitative research

elements employed as triangulation. Student learning as described by the six State of Hawai'i standards-based GLOs was measured quantitatively through the GLOs rubric created specifically for school garden-based education. The learning was also measured qualitatively through observations of students; interviews of students, teachers, and parents; and through other methods such as student presentations, photographs, and short videos. Data collected were used to track changes in student learning outcomes that occur as the students spent time learning, working, and discovering in the garden, and on garden-related activities.

The GLOs rubric was modified and contextualized from existing tools developed by garden educators specifically for measuring school garden-based learning effects, such as those developed at the Learning Gardens Project in Portland, Oregon (Parajuli et al., 2008), and the 4-point Likert scale GLOs evaluation rubrics provided by the State of Hawai'i Department of Education. Using a familiar format is recommended to aid in the children's understanding of what was expected of them (Mahon et al., 1996, p. 149) as well as the adults involved in the project.

Qualitative data were collected in order to better understand the experience of student learning in the context of school garden-based education and to determine the relevance of school gardens as a site for learning making. Data collection activities included formal interviews and *talk story* (informal chats) with homeroom teachers, the school counselor, the school principal, the participating students and their parents. Talk story is a practice in Hawai'i that may build and nurture relationships (Taosaka, 2002), which involves the telling of short stories of daily life, and past occurrences likely to shed light or provide details to the topic of conversation. The researcher also collected field notes during the garden classes and garden-based activities.

All the products created by the GT students in the school garden-based education program were analyzed for GLO demonstrations of skill. These were interpreted for indications of meeting the GLOs.

Limitations

This study is limited to the students in the Kohala Elementary School Gifted and Talented (GT) program, and therefore lacks randomization. This group of students was chosen based on the principles of naturalistic convenience sampling (Lincoln & Guba, 1985, pp. 200 - 202), and recommendations from the work of Parajuli et al. (2008), and Williams and Brown (2012) at the Learning Gardens at Portland Public Schools.

Convenience sampling is based on "informational, not statistical, considerations. Its purpose is to maximize information, not facilitate generalization" (Lincoln & Guba, 1985, p. 202). The procedures "depend on the particular ebb and flow of information as the study is carried out rather than on priori consideration" (Lincoln & Guba, 1985, p. 202). Williams and Dixon (manuscript in review) used strict criteria to filter through 152 articles written between 1990 and 2010 about school gardens to find the most rigorously researched school garden programs. One of the criteria is that the "intervention [school garden program] consisted of a minimum of an hour at least every two weeks" (p. 1). The research of Parajuli et al. (2008) indicated that two hours per week is the minimum amount of time that must be spent in the garden or involved in garden-related activities for measurable effects (p. 6). The GT class is the only class at the Kohala Elementary School that is in the school garden for 2 hours or more each week.

Another limitation is that there was only one researcher during the whole project. This same researcher also designed and implemented the interdisciplinary standards-based school

garden curriculum. Thus, there may be personal bias in the reporting of the findings. The third limitation is that the curriculum was taught only in the school garden context, and not observed within another setting.

Glossary of Terms

Discovery Garden. The Discovery Garden of Kohala Elementary School in Hawai'i is an actual school garden where gardening and related activities are conducted. When I refer to the Discovery Garden, I mean the actual physical school garden.

Kohala Elementary School garden program or *KES garden program*, refers to the school-wide garden program where students from pre-K through fifth grade participate in gardening and related activities.

Garden class is the class for the participating 20 students, where the interdisciplinary standards-based school garden curriculum was implemented and evaluated.

Interdisciplinary standards-based school garden curriculum refers to the curriculum in which several disciplines and the six GLOs are taught through garden-related activities. Science is taught through observation and the recording of plant germination and growth, and through composting as students experiment with building the compost with different ratios of carbon to nitrogen. Technology is taught through safe and proper use of garden tools and equipment and through the design and creation of an irrigation system. Engineering is taught and practiced as the students build garden furniture, a chicken tractor, and fencing. Math is integrated as the students solve real challenges such as carbon to nitrogen ratio for the compost piles, measuring and determining garden bed and path sizes, fractions of seeds germinating, and graphing the germination rates. Students were facilitated to notice which GLOs they used in the garden through questioning and discussions.

Pedagogy of food or *the pedagogy* is the practice, philosophy and psychology of how I taught the curriculum based on my experience, knowledge accumulation, and wisdom development.

The Plan

The rest of this study is organized as follows: Chapter 2 is a review of literature on the purpose of education for the context of this study, the connection between children and nature, child development and learning theories, school garden programs and their effects, interdisciplinarity, curriculum and evaluation, and the six GLOs. Chapter 3 is an in-depth description of the interdisciplinary standards-based school garden curriculum and pedagogy. Chapter 4 discusses the research design, sample selection, and instruments used in this research study. Chapter 5 offers an analysis and interpretation of the research data. Chapter 6 concludes the study with a summation of the findings and recommendations for further research, recommendations for curriculum and research instrument revision, and a description of how the findings and their interpretation supported my pedagogical refinement.

CHAPTER II

LITERATURE REVIEW

This literature review focuses on the relationships between the purpose of education for a sustainable future and the school garden movement, and on the theoretical framework that informs the pedagogy and design of the interdisciplinary standards-based school garden curriculum that I created, implemented, and evaluated.

In this review, I briefly discuss the purpose of education**,** within the scope of this project, so that the readers may understand my strong inclination toward the use of school gardens as a vehicle to teach through place, subjects, processes, and skills, and as a haven to nurture attachments to nature. This is the kind of education that I hope will lead us to a sustainable future.

Next, I review the literature about the relationship between children and nature. Following that, I present child development theories of Rudolf Steiner, Jean Piaget, and advocates of place-based learning such as David Sobel, Stephen Kellert, Peter Kahn, and David Orr. I then situate what I have reviewed about the relationship between children and nature and child development within the framework of structural-developmental learning theory.

In a central position in this chapter, I review how school gardens are used to teach content, social and intellectual process and skills, and as a place to develop and nurture relationships with nature and community. I include a brief review of some of the pertinent literature on curriculum development and evaluation. Then, I transition my thinking and write about the development of an interdisciplinary curriculum. In this section I very briefly discuss interdisciplinarity, what it is, and why I think it is a methodological match for school garden-

based education. Also in this section and in relationship with the argument for an interdisciplinary curriculum, I explain why and how I think STEM education may work well in the interdisciplinary framework and in school garden settings. I elaborate further on the discussion of interdisciplinarity, STEM, and curriculum design and implementation in chapter 3.

Finally, I review the literature explaining and interpreting the six Hawai'i GLOs from different perspectives. In some other states, the GLOs are called performance goals. The GLOs and similar performance goals were created in response to the No Child Left Behind Act of 2001 and to the call to better prepare students with twenty-first century skills for twenty-first century jobs (U.S. Department of Commerce, U.S. Department of Education, U.S. Department of Labor, National Institute of Literacy, and the Small Business Administration, 1999). This section is a result of findings from the pilot study of this project conducted in school year 2010 - 2011 at the Discovery Garden of Kohala Elementary School, which revealed that there were differing and even contradicting interpretations of the GLOs by the teachers, administrations, and parents, and a lack of understanding of these GLOs by the students themselves. I look at the philosophical underpinnings of the GLOs and discuss how I rationalized the fit of the GLOs to the educational philosophes and strategies I described in the beginning of this chapter, coming full circle with my discussion.

What is the Purpose of Education?

I contrast two philosophical positions prevalent throughout modern education. The first position is based on the belief that our education system is necessary to prepare future members of the workforce, ensuring that they will keep our economic system stable and growing. This has been particularly true since the Industrial Revolution. "…for one hundred and fifty years

institutional education has seen fit to offer as its main purpose the preparation for economic success. Good education = good job, good money, good *things*" (Gatto, 1992, p. 66).

Public education, in its current manifestation, was built on the need to produce workers for the factories and production arenas of the Industrial Revolution. Schools were looked upon in the early twentieth century as a "branch of industry and a tool of governance" (Gatto, 2006, p. 38). Woodrow Wilson, before the First World War disclosed: "We want one class to have liberal education. We want another class, a very much larger class of necessity, to forgo the privilege of a liberal education and fit themselves to perform specific difficult manual tasks" (p. 38).

According to several prominent educators and philosophers, including Gatto (1992), New York Teacher of the Year 1991, J. C. Holt (1967), Orr (1992, 1994), and Sterling (2001), the emphasis of education during this period moved from process to product. In the industrialized schooling paradigm, scoring well on a multiple choice test seems to be the aim of all formal schooling, which alienates many students resulting in dropping out of school and underachievement (Wise, 2008, pp. 6-7). Children are rushed from one subject to the next with little time for reflection and discourse to gain understanding of the lessons (Gatto, 1992, p. 6). Memorization of facts and figures is given priority over understanding of procedures and their application (J. C. Holt, 1967, pp. 28-29). The purpose of education has

> shifted from *educational* values to do with process, and developing potential and autonomy, and *social* values relating to equality of opportunity, community and social cohesion, toward *economic* values such as efficiency, quality control and production, which education is supposed to serve in an unprecedented way. (Sterling, 2001, p. 39)

Personally, I have watched many teachers, especially public school teachers, become information transmitters instead of educators – those who draw out the potential in each and

every student. The current education system is a transmissive system instead of a transformative one (O'Sullivan, 1999; Sterling, 2001). In this transmissive system, students are viewed as empty vessels waiting to be filled. This mentality leads to the homogenization of curriculum, weakening social and ecological systems and privileging the marketplace (Illich, 1996, p. 25; Williams & Brown, 2012, p. 7). This forces the continuation of the status quo. I quote Sterling (2001) again,

> At present, an extreme instrumentalism dominates educational policy and practice. In Britain and other Western countries such as the USA, Canada, Australia and New Zealand at least, a very managerialist view of education has come to dominate our schools, modeled on economic change and perceived 'demands' of a globalized economy and an increasingly globalized culture. (p. 27)

The global corporate leaders are increasingly influential on the education system as it is clearly in their best interest to manage the workforce and, in Elie Wiesel's words, as cited in Orr, this system: "emphasize[s] theories instead of values, concepts rather than human beings, abstraction rather than consciousness, answers instead of questions, ideology and efficiency rather than conscience" (Orr, 1994, p. 8).

In the industrialized world-view, nature is viewed as a resource to be mined, clear-cut, drilled, exploited and extracted; to be worked against instead of with, to be conquered instead of cooperated (Berry, 1977; Ehrenfeld, 1997). Similarly, an education system in a nature dominating paradigm strives to teach us how to "manage planet earth" (W. C. Clark, 1989, p. 46), instead of learning to "reestablish a harmonious relationship with nature" (Ehrenfeld, 1997, p. 63). In this view, the aim of education is to perpetuate economic growth.

A being and becoming view of education is not limited to the single-minded purpose of job preparation, economic success, or the dominance of nature. What this means, in my own words, is that the aim of education embodies the notion of *being* and *becoming*, not only for the students and for the educators, but also for their community. This more organic view of education emphasizes the journey more than the destination, and thus the *process* of learning more than the product. In this view, education supports the development of capacities to meet all the needs of society, including the ecological, social and spiritual needs, and not just the economical (Orr, 1992, 1994; Williams & Brown, 2012, p. 14).

Dewey (1934), who advocated educative experiences and experiential learning, believed there is an intimate connection between education and social action in a democracy. He held this view:

> The purpose of education has always been to everyone, in essence, the same–to give the young, the things they need in order to develop if an orderly, sequential way into members of society. This was the purpose of the education given to a little aboriginal in the Australian bush before the coming of the white man. It was the purpose of the education of youth in the golden age of Athens. It is the purpose of education today, whether this education goes on in a one-room school in the mountains of Tennessee or in the most advanced progressive school in a radical community. But to develop into a member of society in the Australian bush had nothing in common with developing into a member of society in ancient Greece, and still less with what is needed today. Any education is, in its forms and methods, an outgrowth of the needs of the society in which it exists. (p. 1)

In this being and becoming view of education, education is collaboratively constructed by the student, teacher and the community in which the learning and teaching are taking place. Thus, education must be for the common good of the community (Dewey, 1934, p. 5).

Education for the common good was also one of the main themes of the work of Phenix (1961). He proposed that schools teach respect for all forms of life, in order to build conscience, and would shun all social stratification–racial, economical, and intellectual. There would be no grades given which segregate the students, instead schools would be structured to encourage and develop cooperation, collaboration and the true sense of community. He wrote:

> The most important product of education is a constructive, consistent and compelling system of values around which personal and social life may be organized. Unless teaching and learning provide such a focus, all the particular knowledge and skills acquired are worse than useless. An 'educated' person whose information and ability are directed to no personally appropriated worthy ends is a menace to himself and to society. A highly sophisticated society educated to no coherent way of life is likewise by its very learning made the more prone to disease and degeneration. (Phenix, 1961, p. 21)

Schumacher, a pioneer of sustainable development, has viewed education as the most vital resource of humanity. His quest for patterns of sustainability has provided him the experience to question traditional structures, especially that which prioritized only the economic structures. Schumacher (1977) stated that we need to “look at the world and see it whole” (p. 15) and by doing that we could develop to be better, nobler selves. Schumacher (1973) wrote that: “The task of education would be, first and foremost, the transmission of ideas of value, of what to do with our lives…to understand the present world, the world in which we live and make our choices” (p. 86).

The purpose of education for a meaningful life is not just a Western construct. Tsunesaburo Makiguchi, a Japanese educator in the early 1900s, also took up the idea of value as a purpose in education. This was the era when Japan entered the industrialization race, and Makiguchi was deeply troubled by the inadequacies he perceived in the Japanese educational system. As an antidote to industrialization, Makiguchi advocated the support of the creative nature of human beings. Makiguchi (cited in Bethel, 1989) wrote, "Helping us learn to live as creators of value is the purpose of education" (p. 54). He contended that education should enable "each individual to perceive life in the context of its nurturing community, human beings will choose to use their creative capabilities both to enhance their own lives to the fullest and to create maximum benefit for their community" (p. 6).

This idea of creating value is also found in the State of Hawai'i Department of Education GLOs. Students and teachers in Hawai'i are asked become *quality producers*. The state definition for quality producer is as follows, *the ability to recognize and produce quality performance and quality products*. The word quality denotes that there is some kind of value attached to the product and/or performance.

Gatto (1992) collected his thoughts and critiques of compulsory school in *Dumbing us Down: The Hidden Curriculum of Compulsory Schooling*. In his 26 years of teaching, Gatto (1992, 1993, 2001, 2006) found that in order to help children break the thrall of industrialized school or compulsory school, students need independent study, community service, large doses of solitude, and variety of apprenticeships with adults of all walks of life. Thus education is not passive, but an active involvement of discovery. In his writings, Gatto (1992) offered the following: "Education will help you figure out *what really matters*? *Discovering meaning for yourself*, and discovering satisfying *purpose* for yourself, is a big part of what education is"

(p. 68). An educated person can discover the truth for oneself. Gatto (2001, p. 226) has shown that he has an intense awareness of the profound significance of *being*, and the profound significance of being *here*.

Donning yet another lens to look at the purpose of education, I approach this topic from the environmental education perspective. Orr (1994) is among the leading environmental educators of today. His work with ecological literacy has been used to shift the emphasis of education from economics to ecology. He posited that more of the same kind of education that led to the industrialization of planet earth can only make things worse. However, he clearly pointed out that the subject is only the tool with which we can change the direction we are heading, the guide or the one holding the reins is us, human beings. In his essay "What is education for?" he paraphrased the Greek concept of Paideia and wrote, "The goal of education is not mastery of subject matter but mastery of one's person" (p. 13).

Steiner (1997), the founder of Waldorf Education, saw education as a force for social change. He put it succinctly, "The purpose of education is to develop free human beings who are able, of themselves, to impart purpose and direction to their lives" (Steiner, 1928, p. 27).

The ideas on the purpose of education from a being and becoming stance form the first assumption my readers should know as they enter this discourse. These philosophers/educators and their texts inform my belief and action as an educator, and yes, even as a human being. In summary, I agree with these thought leaders and in my words state my first assumption: the purpose of education is to *help us create value in our actions, develop love in our thinking, and foster equality and righteousness in our emotions.*

Children and Nature

I like garden class.
Why?

'Cuz we are outside. I like outside.
Why do you like outside?
'Cuz it is nice and friendly. From a conversation with a first grader.

Maybe it is weird but I really like being with plants.
Why?
I feel comfortable around them and some of them smell really nice. And even if they don't smell nice, I still like them. From a conversation with a third grader.

The old Lakota was wise. He knew that man's heart away from nature becomes hard; he knew that lack of respect for growing, living things soon led to lack of respect for humans too.
Chief Luther Standing Bear

According to Kahn (2002), Kellert (2002), Louv (2005), and Nabhan and Trimble (1994), in our contemporary twenty-first century, with more than 50% of the world's population living in urban areas, there are fewer opportunities for children to have direct experience with wild or semi-wild places than in the past century. Concerns about the ability of children to function safely without adult supervision and the increasing dependence on motorized transportation add further obstacles to spontaneous and familiar interactions with proximate nature.

In the industrialized school paradigm, children are cut off from nature (Gatto, 1992; Nabhan & Trimble, 1994; Orr, 1994). This route has brought us to climate change, devastating pollution, desertification, and other environmental calamities. Correspondingly, in the words of Berry (1977), "the ecological crisis is a crisis of character" (p. 17). Not only are we in ecological crisis, when we look around we still witness major social injustice, social stratification, racism, and the loss of culture. As those in the developing nations strive towards economic growth, there is homogenization of cultures and loss of language and indigenous wisdom (Berkes, 1999; Woodbridge, 2004).

In the being and becoming educational paradigm that I presented, the purpose of education is to help us create value in our actions, develop love in our thinking, and foster equality and righteousness in our emotions. This educational paradigm can reconnect children

(and adults) back to their environment – ecological and social. I believe that reconnecting with nature may be crucial to shift the emphasis from economical growth to environmental and cultural sustainability, and ultimately to the survival of this planet.

Chawla (2002) found a striking pattern when she reviewed studies of the lives of environmentalists. Most of them ascribed their strong ecological values to "a combination of many hours spent outdoors in a keenly remembered wild or semi-wild place in childhood or adolescence, and …an adult who taught respect for nature" (pp. 204 & 213). Lots of time rambling in the neighborhood woods and fields and a parent or teacher who cared about nature were frequently cited as causal forces in their development of their own environmental ethics (Sobel, 2008, p. 9).

Rachel Carson (1956) wrote: " If a child is to keep alive his inborn sense of wonder, he needs the companionship of at least one adult who can share it, rediscovering with him the joy, excitement and mystery of the world we live in" (p. 10). This thought is congruent with the ideas shared by Louise Chawla and David Sobel that children benefit more with the guidance of an adult from experiences in nature.

E. O. Wilson (1984), preeminent biologist, suggested that within all human beings there exists a deep source of attachment to nature. He posited that we are bound to living organisms well beyond the particularities of habitat. He described the innate urge to affiliate with nature, which begins in early childhood and flows into social and cultural patterns. *Biophilia*, as E. O. Wilson termed it, is "inscribed in the brain, expressing tens of thousands of years of evolutionary experience" (Thorp, 2001, p. 11).

Steiner (1982) posited that young children, before the age of 9 or 10, do not distinguish themselves from their environment.

> Therefore it is important to speak of everything that is around the child, plants, animals and even stones, in such a way that all these things talk to each other, that they act among themselves like human beings, that they tell each other things, that they love and hate each other. You must learn to use anthropomorphism in the most inventive ways. (p. 48)

After 9 or 10 years of age, Steiner (1998) has suggested, children can understand that they are separate from their surroundings and yet *in* it. Thus it is crucial to teach and show the child genuine relationships of nature, and that nature has "living meaning only in its context" (p. 194). He advocated using plants to teach children of the middle childhood ages about these relationships. However, he cautioned,

> when working with children we should never consider plants in any way other than in their connection with the Earth and the Sun…you should never awaken any idea other than the living idea that the Earth and the root belong together…that the flower is brought forth from the plant by the Sun and its rays. In this way, you place the children in the universe with life. (p. 194)

Sobel (2008), a leader in the creation of place-based pedagogy, developed this hypothesis: "One transcendent experience in nature is worth a thousand nature facts" (p. 13). He posited that children perceive nature differently from adults. He wrote, "their experiences [in nature] were transcendent in that the [child] often felt connected to or merge with the natural world in some highly compelling fashion" (p. 13). This view is in congruence with that of Rudolf Steiner's.

Kellert (2002) described a conceptual framework to consider the potential impact of contact with nature in child development. He suggested three distinctions among the kinds of experience children have with nature and its systems and process (pp. 118-121).

1. *Direct experience* involves actual physical contact with natural settings and nonhuman species. This experience is largely unplanned, and the natural setting includes creatures and habitats that function largely independently of human intervention and control.
2. *Indirect experience* of nature involves actual physical contact but in far more restricted, programmed, and managed contexts. Nature in these contexts is usually the product of deliberate and extensive human mastery.
3. *Vicarious* or *symbolic experience* occurs in the absence of actual physical contact with the natural world. The child encounters depictions and representations of nature that sometimes are realistic but that also, depending on the circumstance, can be highly symbolic, metaphorical, or stylized characterizations.

Direct encounters with nature provide children the opportunity to observe phenomena, such as trees growing in certain conditions but not in others; the rate of growth of plants during the rainy and dry seasons; the journey of insects on the ground or in the air; and such. In nature the child meets an inexhaustible supply of opportunities to develop and practice the act of comprehension (Kellert, 2002, p. 124). These experiences provide the child with opportunities to distinguish, identify and classify, engaging in conceptual tasks based on concrete observations. For example, insects have six legs, while spiders have eight. On the Big Island of Hawai'i, the wind blows in from the ocean during the day, and blows back out from the land to the ocean at night.

While the direct experiences in nature are the most vital and crucial for a child to develop a relationship with nature, both Kellert (2002, p. 134) and Sobel (2003, p. 159) asserted that direct experiences in an indirect nature setting are just as important and relevant. The experience

of playing and working in a garden, nature center, or zoos, while not a substitute for wild and semi-wild places, can still lead the child to appreciate, care for and love the earth. For example, children tending plants in a garden learn to care and learn to be responsible for them.

Wells (2000) after reviewing studies on the restorative effects of nature surmised, "A pattern seems to emerge from the literature. The pattern suggests that a child living in a place with more nature, with more restorative resources is likely to benefit with respect to his or her cognitive functioning or attentional capacity" (p. 782).

Kaplan's (1995) research with Attention Restoration Theory provided strong evidence that natural environments can assist attentional functioning in adults. Kaplan posits that there are four components in a restorative experience. They are fascination, being away, the environment must have extent, and there must be compatibility between the environment and one's purposes and inclinations (1995, pp. 172 – 173). Natural settings have all four components and "is likely to be supportive of the inclinations of those who seek a respite there" (p. 174). Taylor, Kuo, and Sullivan (2001) extended that research to children with Attention Deficit Disorder (ADD). Their results provided evidence that the Attention Restoration theory may be applied to children. In this day and age, children are bombarded from every angle by electronic images, synthesized sounds, and engineered chemicals. They have to extend energy to filter out the excess stimuli, an undertaking which can lead to attention fatigue. Taylor et al. wrote:

> Children's schoolwork requires extended periods of deliberate, effortful attention. And like adults, children often must carry out these tasks in a context filled with powerful distractions that constantly demand attention, making it extremely difficult to concentrate on the task at hand. In addition, because children's attention is not fully developed, they may be fighting off distractions with less attentional control than adults. Thus, children

> may need supportive environments where they can go to restore their ability to attend to stimuli. It seems plausible that natural environments might support attention in children, including children with ADD. (p. 58)

Sebba (1991) offered a different understanding of the impact of nature on attention. She suggested that the dynamic feature of nature constantly confronts all the child's senses. Nature signifies life which no technology, no matter how sophisticated, can truly simulate. Life is a riot of activity, growth, metamorphosis, and transformation. These stimuli increase the likelihood of the child's development of awareness, recognition, adaptive and problem-solving responses, and attention. Sebba, as cited in Kellert, stated that nature-based development is a critical and irreplaceable dimension of healthy maturation (Kellert, 2002, pp. 140-141).

To end this section, I bring back the first idea of biophilia. I suggest again that a crucial reason for children to be in nature is for them to love and be loved by her. Gould (cited in Orr, 1994) said, "We cannot win this battle to save species and environment without forging an emotional bond between ourselves and nature as well – for we will not fight to save what we do not love" (p. 43).

We value what we love. If our children are to be creators of value and save our planet, then they must be given the opportunity to love the earth.

> It is through close and intimate contact with a particular patch of ground that we learn to respond to the earth…We need to recognize the humble places where this alchemy occurs….Everybody has a ditch, or ought to. For only the ditches--and the fields, the woods, the ravines--can teach us to care enough. (Pyle, 1993, pp. xv, xix)

The second assumption I have for this study emerges from the research cited above: *Being in nature and developing a sense of place is an essential core of children's lives.*

Child Consciousness Development and Learning Theories

What is important for the art of education is a knowledge of the members of the human being and of their various developments. We must know what part of the human being especially needs to be worked on at a certain age and how to work on it in the proper way. Rudolf Steiner

How children learn is a direct function of how they think and grow intellectually. Mitchell Sakofs

For the scope of this study, the focus of child consciousness development will mainly be on the middle childhood period or elementary school age, 6 to 12 years old. This is the period of childhood for which the interdisciplinary standards-based school garden curriculum was written. Children younger or older than 6 to 12 have different developmental needs.

Rudolf Steiner provided indications for consciousness appropriate education in the early twentieth century. His philosophy, pedagogical ideas, and curricular thoughts were first put into practice in 1919 at a school located in the Waldorf-Astoria Cigarette Company in Stuttgart, Germany. This led to the naming of all schools that followed Steiner's educational philosophy as Waldorf Schools.

Steiner (1926, 1996a, 1996b, 1997, 1998) presented a view of three stages of child consciousness development. Early childhood, from birth to change of teeth (about 7 years old); middle childhood (ages 7 to 14); and late childhood (14 to about 21). The willing (doing) realm is developed the most strongly in the first stage, as infants navigate their way through the world of physical senses, movement, taste/smell, nature, and touch, to reach middle childhood. Children at this early childhood stage "think" by doing. The learning that happens during this phase is unconscious (Steiner, 1996b, p. 87). During this phase of life, children have a certain character that they express by being imitative. They try to imitate everything they see and hear. He wrote:

> Children, however, do not learn by instruction or admonition, but through imitation. The physical organs shape themselves through the influence of the physical environment. Good sight will be developed in children if their environment has the proper conditions of lights and color, while in the brain and blood circulation the physical foundations will be laid for a healthy moral sense of children see moral actions in their environment…As the muscles of the hand grow firm and strong through doing the work for which they are suited, so the brain and other organs of the physical body of human beings are guided into the correct course of development if they receive the proper impressions from their environment. (Steiner, 1997, p. 19)

By imitating what adults around him/her are doing, the child is learning actively, and is involved in everyday life tasks and activities, in familiar contexts and settings. Steiner posited that "everything done to and with a child at this stage has a direct effect on the formative of the child's being" (1926, pp. 15-16). What adults do around, to, and with young children form their physical bodies.

The emotional realm or feeling capacity is the most intensely developed during middle childhood (elementary school age). Steiner (1982, p. 19, 1996a, p. 109) postulated that artistic and imaginative endeavors are the most optimal form to guide the development of the emotional realm. He cautions educators against locking children's minds and thoughts to finished concepts, but instead to provide them examples and ideas that can grow and expand further.

> We must give them living concepts that can be transformed. But this can be achieved only through an imaginative approach in every subject…[I] will encourage you to use language creatively, to draw helpful drawings on the blackboard or to take up a paintbrush to make colorful illustrations of what you want to communicate…They have

> an eye for what is mobile. They can apprehend ideas that are flexible, and they can perceive what comes in the form of pictures or music. (Steiner, 1996a, p. 109)

As the middle childhood is a time for connection to the rhythmic processes of nature, Steiner encouraged intimate experiences with cycles of nature that can guide the child to perceive the world as an order-creating, patterned universe. This experience may facilitate the understanding of systems thinking as the child matures (Capra, 2005; Steiner, 1998, pp. 193-204).

Piaget (1954) identified various stages of cognitive development in children. The stages identified were:

1. Sensory motor (ages 0-2),
2. Preoperational (ages 2-7),
3. Concrete operational (ages 7-11), and
4. Formal operational (ages 11-14).

Children operating within the sensory motor, preoperational, and concrete operational stages are dependent upon concrete interactions with the world in order to promote intellectual growth and true learning. Piaget concluded that the child's "development of an accurate representation of physical reality depends on the gradual coordination of schemes of looking, listening, and touching" (Bransford et al., 2000, p. 80). It is only after the ages of 11 or 12 that a child is ready and capable to operate at a more formal manner and grapple with abstractions (Piaget, 1954; Sakofs, 1995, pp. 149-151).

Sobel (1993, 1996) studied the stages of child consciousness development through children's mapmaking. He found clear patterns of development through analyzing the maps, and interacting with the mapmakers. He found that early childhood (between 4 and 7) is characterized "by a lack of differentiation between self and the other" (Sobel, 1996, p. 13). From

ages 7 to about 11, children have a strong desire to explore and to wander beyond that which is familiar (Sobel, 1996, p. 19). Only after the ages of 11 or 12, do children want to engage in solving community issues and understand the implications of global issues (Sobel, 1996, p. 27). Thorp (2001) presented Sobel's schema beautifully in her dissertation:

1. *Empathy*, between the child and the natural world should be the objective for children ages 3-7. This connectedness to the natural world is the foundation to the understanding that everything is interrelated. Stories, songs, close encounters with plants and animals, and seasonal celebrations are suggested.
2. *Exploration*, marks the phase from age 7-11. This is the time to immerse children in the stuff of the physical and natural world. Constructing forts, creating small imaginary worlds, hunting and gathering, following streams and pathways, making maps, gardening, and shaping the earth are perfect activities during this stage.
3. *Social Action*, appropriately begins around age eleven and extends beyond age fourteen. Sobel strongly stated, "No tragedies before fourth grade." While woods, parks and playgrounds are the landscapes of middle childhood, adolescents want to engage with the larger community. Curricula that focus on environmental problems will be most successful when it starts in fifth and sixth grade, however Sobel warns it should be grounded in local context. (p. 29)

Kellert (1996, 2002) pulled the thoughts of Steiner and Sobel into a nature-based approach of looking at child consciousness development. He suggested that there are nine values of nature, which differentially emerge at varying ages or stages of development. The nine values are:

1. Aesthetic – physical attraction and appeal of nature;

2. Dominionistic – mastery and control of nature;
3. Humanistic – emotional bonding with nature;
4. Moralistic – ethical and spiritual relation to nature;
5. Naturalistic – exploration and discovery of nature;
6. Negavistic – fear and aversion of nature;
7. Scientific – knowledge and understanding of nature;
8. Symbolic – nature as source of language and imagination; and
9. Utilitarian – nature as a source of material and physical reward.

The developmental progression has four characteristics. First the formation of values of nature moves from relatively concrete and direct perceptions and responses to the more abstract levels of experience and thinking. Next the values generally shift from highly personal, egocentric, and self-centered concerns to the interests of others and to social interests. The geographic focus of the values leans from local and parochial settings to more regional and then global outlooks. Finally, emotional and affective values of nature emerge earlier than the more abstract, rational and logic-deduced perceptions (Kellert, 2002, pp. 131-132).

Kellert (2002) posited that between 3 and 6 years of age, the child develops the utilitarian, dominionistic, and negativistic values of nature. The child at this stage, becomes a little more independent and this stage "involves a primary emphasis on satisfying the child's material and physical needs, avoiding threat and danger, and achieve feelings of control, comfort and security" (p. 132). The child has an affinity towards that which is familiar, such as domesticated animals and recognizable nature settings, and also to that which meets personal needs and desires.

The second developmental stage is middle childhood, between the ages of 6 and 12 approximately. "Middle childhood is a time when the humanistic, symbolic, aesthetic, and

knowledge components of the scientific value develop most rapidly," while the values of the first stage diminish in significance (Kellert, 2002, p. 132).

Kellert (2002) also emphasized the middle childhood years as the most critical period in the development of the individual relationship with the natural world, just as Steiner and Sobel did before him. During this time, children are more likely to explore and venture beyond what is absolutely familiar. They develop cognizance of the rights of other living beings, and can begin, independent of adult imposition, to develop feelings of responsibility for care of nature. Most important, Kellert asserted:

> This is a time of greatly expanded interest, curiosity, and capacity for assimilating knowledge and understanding the natural world. Rapid cognitive and intellectual growth occurs including many critical thinking and problem-solving skills achieved through interaction and coping in the non-human environment. (p. 133)

Steiner, Piaget, Kellert, and Sobel concurred that children in elementary school can best learn from concrete, connective, nature-based, and imaginatively presented experiences. These educators also strongly stated that it is only after ages 11-12 that a child can begin to reason and conceptualize, only then can a child grasp abstract ideas and lessons. The ability to reason abstractly is based on the development of the nature values of humanistic, symbolic, aesthetic, and knowledge during the middle childhood phase.

Having presented child development theory, I now discuss the learning theory that best supports my understanding of learning from nature-based experiences. Williams and Brown (2012) included many student reflections in their book *Learning Gardens and Sustainability Education*, such as:

> We started collecting dirt inside a wheelbarrow then we dumped it in flower beds. We started digging rows but we could not dig the rows too deep or else the plants might drown. It was fun working with the wet soil. It was not mud but it was still wet; it stuck to our hands. (p. 126)

Williams and Brown (2012) posited that reflection is about meaning-making. They wrote:

> Because an experience is an interaction between a student and the environment, there is change in the self and also in the environment. The change encompasses both the learner and the social and environmental milieu each impacting the other in profound ways. (p. 126).

Williams and Brown (2012) conveyed the gist of structural-developmental theory, sometimes also known as constructivist theory, social cognitive theory, or structural interactional theory (Bandura, 1986; Damon, 1977; DeVires & Zan, 1994; Kahn, 2002; Kohlberg, 1969; Piaget, 1983). This theory posits that "behavioral, personal and environmental influences interact continuously in a reciprocal manner" (Ratcliffe, 2007, p. 107), and that "through interaction with a physical and social environment children construct conceptual understandings and values" (Kahn, 2002, p. 94).

In layperson's terms, this theory can be called by many names. Learning by doing, hands-on education, project based education, experiential education, discovery learning, participative learning, problem-based learning. Whatever it is called, learning by interaction with the physical and social world demands active involvement, taking time to practice, meaningful activities, and restructuring prior knowledge (Vosniadou, 2001). Active involvement requires that students interact with the world by exploring objects, manipulating tools, grappling with questions and controversies, performing experiments, and/or working. When doing, students engage multiple

abilities. Building a trellis for the pole beans in the school garden, requires motor skills, spatial skills, mathematical and thinking skills. As a result of the interactions and in engaging multiple abilities, students may be more likely to remember concepts and knowledge discovered on their own, as opposed to the transmissive model (Hammer, 1997). This approach builds upon children's natural motivation to explore, succeed and understand (Piaget, 1954), and "secures the active cooperation of the pupil in construction of the purposes involved in his studying" (Dewey, 1938, p. 67).

Through structural development "early forms of knowledge do not disappear but are transformed into more comprehensive and adequate ways of understanding the world and acting on it" (Kahn, 2002, p. 94). In the student reflection cited above, the student knew "we could not dig the rows too deep or else the plants might drown" (p. 94) after the experience of working in the garden. The student's knowledge is now "hierarchically integrated into a larger conceptual organization" (p. 94).

Scaffolding is yet another approach that describes this theory in action. Scaffolding can be described as learning by doing, in place, over time. Williams and Brown (2012) wrote,

> …it is not necessary to learn everything anew from personal experience alone; the combination of firsthand familiarity with collective cultural or community knowledge is foundational…Stories, songs, knowledge, practices, and customs contribute to meaningful engagement and communicate experience intergenerationally. (p. 127)

Another important aspect of the structural-developmental theory is that of learning through and in relationships.

Mercogliano (2001) wrote the following about educational relationships:

> Call it what you will, the learning that goes on within relationships and the learning that goes on about relationships are a fundamental part of the educational process. Anyone who has observed children in a setting that is based on cooperation and mutuality knows this to be so. If there are to be schools at all—and the arguments against them grow more compelling every day—then certainly their justification has to begin with their serving as safe, caring environments where kids can learn from and about each other, where they can establish enduring relationships with teachers and mentor figures, and where they can experience the interconnectedness of all life on a daily basis. (p. 1)

Profound learning can happen when the relationships between the student and teacher, between the student and student, and between student and learning are safe, valuable, successful, involving, caring, and enabling (Bransford, Brown, & Cocking, 2000, Rogers & Renard, 1999). Relationships form a structure for development and thus learning.

In the classic book, *Teacher*, Ashton-Warner (1963) provided this insight:

> From long sitting, watching and pondering (all so unprofessional), I have found out the worst enemies to what we call teaching. The first is the children's interest in each other. It plays the very devil with the orthodox method. If only they'd stop talking with each other, fighting each other and loving each other. This unseemly and unlawful communication! In self-defense I've got to use the damn thing. So I harness the communication, since I can't control it, and base my method on it. They read in pairs, sentence and sentence about. There's no time for either to get bored. Each checks the other's mistakes and hurries him up if he's too slow, since after all, his own turn depends on it. They teach each other all their work, sitting cross-legged knee to knee on the mat or on their tables, arguing with, correcting, abusing or smiling at each other. And between them all the time

> is this togetherness, so that learning is so mixed up with relationship that it becomes a part of it. What an unsung creative medium is relationship! (pp. 103-104)

Resnick (1987) reported that one major contrast between everyday settings and school environments is that the latter place much more emphasis on individual work than most other environments. In his article, "Collaborative Learning Enhances Critical Thinking" Gokhale (1995, p. 1) drew upon work of others:

> Proponents of collaborative learning claim that the active exchange of ideas within small groups not only increases interest among the participants but also promotes critical thinking. According to Johnson and Johnson (1986), there is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than students who work quietly as individuals. The shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers. (Totten, Sills, Digby, & Russ, 1991)

Sobel (1996, p. 10) has made significant contributions to supporting the need for adult-mediated or structured environments in healthy childhood development. The teacher's task is to prepare environments that are developmentally appropriate to accommodate a child's inner strivings to connection and autonomy (Piaget, 1954; Thorp, 2001). Sobel argued in *Beyond Ecophobia* that elementary curriculum often is not aligned with child development, nor do they provide proper scaffolding to learning. Sobel said, "authentic …commitment emerges out of firsthand experiences with real places on a small, manageable scale" (p. 34)

Sobel (1996) stated:

> The crux of the issue is the developmental appropriateness of…education curricula. Our problem is premature abstraction. We teach too abstractly, too early…If we prematurely

> ask children to deal with problems beyond their understanding and control, prematurely recruit them to solve the mammoth problems of an adult world, then I think we cut them off from the possible sources of their strength…children's biological tendency to bond with the natural world. (pp. 5-6)

These developmentally appropriate experiences may be described as educative experiences. Educative experiences are those that scaffold learning instead of stunting learning, which can be linked cumulatively to each other, and which can expand the learner's horizons.

Dewey (1938) wrote:

> The belief that all genuine education comes about through experience does not mean that all experiences are genuinely or equally educative. Experience and education cannot be directly equated to each other. For some experiences are mis-educative. Any experience is mis-educative that has the effect of arresting or distorting the growth of further experience. An experience may be such as to engender callousness; it may produce lack of sensitivity and of responsiveness. Then the possibilities of having richer experience in the future are restricted. (pp. 25-26)

Structural-developmental theory is an interactional theory. Children construct knowledge and values through active involvement with the physical and social world. They do not yet have the capacity to understand or conceive the abstract world. The experiences that are thoughtfully mediated by a caring adult or educator can be more educative, and create more structures or scaffolds of learning than the experiences that arrest or distort growth. Positive social interactions with adults or peers can help children build relationships with humans, nonhumans and nature.

This theory of learning understands that the process is more important than the product. DeMarco (1997) succinctly wrote:

> Taking risks in learning is promoted, and errors are used as a strategy to further learning. Learning is also directly related to the learner's prior knowledge and individual context, and it is made relevant when it is related to the real life of the learner. (p. 10)

The review of child development and structural-developmental/constructivist learning above shapes my third assumption for this study, that *learning is as diverse as the learners - everyone can learn, but not always in the same capacity or context or rate*. This theory also formed my fourth assumption, which is *learning causes change, and thus learning is change*.

School Gardens

Learning gardens on school grounds provide poetic and critical texts for nurturing students' connection with the more-than-human world. Dilafruz Williams & Jonathan Brown

A Brief History and Rationale for School Gardens as Outdoor Learning Spaces

The school garden movement is not new. Notable educators and philosophers including Rousseau, Dewey, Montessori, Pestalozzi, and Gandhi promoted school gardens (Subramaniam, 2002). Montessori (1912) outlined five specific benefits of gardening to children:

1. Learning to care for living creatures and for life;
2. Executing independent work, without the help of the teacher;
3. Developing patience by waiting for plants to grow;
4. Developing and appreciation for nature; and
5. Developing interpersonal skills.

Prior to World War I, in the United States, educators used the school garden with individual plots to train children "in the basics of civic responsibility and the industrial work

process" (Bassett, 1981, p. 3). At these gardens, children were taught the efficiency of every move through working in well-defined, neat rectangular plots, and how the energy conservation could lead to increases in productivity and economic wealth (p. 3).

World War I and World War II brought about the "liberty gardens" and "victory gardens" movements, respectively, as a means for citizens to show patriotism and to support the military effort. Children were mobilized with the formation of the U.S. School Garden Army, and this "army" produced food for the school lunch programs and learned about production. Hayden-Smith (2007, p. 22) quoted the federal Bureau of Education (BOE), "Every boy and every girl . . . should be a producer. . . Production is the first principle in education. The growing of plants and animals should therefore become an integral part of the school program. Such is the aim of the U.S. School Garden Army." The school garden movement waned in the 1950s due to the focus on technology and to winning the Cold War (Subramanian, 2002). However, this movement is on a comeback with contributions from prominent players such as Michelle Obama, Alice Waters, and environmental and place-based educators.

According to the U.S. Department of Agriculture Economic Research Services (2006), more than 83% of the population of the United States lives in urban areas. This limits children's accessibility to natural habitats and interactions with nonhuman life cycles (Blair 2009; Moore, 1995). Urbanization coupled with parental fears of unsupervised activities has lead to a context in which the childhood experience exploring woods, rivers, and fields on one's own is mostly a thing of the past (Kahn, 2002; Kellert, 2002, Pyle, 2002).

One place still stands out in parents' minds however, as a relatively safe and supervised space – schools. Thus, well-designed school grounds, play yards and gardens can readily

improve on the diversity of many children's natural experiences and provide the repetitive access, meanings, and associations needed to create a bond with a place (Blair, 2009, p. 17).

School gardens provide a real world context for learning that is distinguishable from typical hand-on learning activities in the classroom, which tend to be simulations of real world experiences (Ratcliffe, 2007, p. 101). A garden can be a microcosmic reflection of the natural environment, and the gardener must work *with* not against nature. School gardens can provide children with direct experiences with nonhuman life cycles and systems such as growth and decay, living soil systems, plant-insect relations, water cycles, waste and fertility, and such. In school gardens, children can witness and observe the simple and the complex simultaneously.

School gardens can also teach place-making, localization and that "small is beautiful" (Schumacher, 1973). Blair (2009) wrote:

> Everything except possibly the purchased plants and seeds are part of the natural local environment. The clouds, rain, and sun, the seasonal cycle, the soil and its myriad organisms, the insects, arachnids, birds, reptiles, and mammals that visit the garden teach about place. Even if some of the weeds, insects, and birds are not native to a place, these immigrant flora and fauna are as locally adapted as the children themselves. (p. 17)

Conceptual Framework for Garden-Based Education

I presented four assumptions in preceding sections that shaped my thinking about education. These four are:

1. The purpose of education is to help us create value in our actions, develop love in our thinking, and foster equality and righteousness in our emotions.

2. Being in nature and developing a sense of place is an essential core of children's lives.
3. Learning is as diverse as the learners - everyone can learn, but not always in the same capacity or context or rate.
4. Learning causes change, and thus learning is change.

Several researchers working in this area of school gardens have suggested that it is important for the sustainability of school garden programs to develop a contextually appropriate, place-based model (or design) of garden-based education (Blair, 2009, p. 35; Ozer, 2007, pp. 851-853; Phibbs & Relf, 2005, p. 427; Van Dexter, 2008; Williams & Brown, 2012, p. 58). In the next few pages I will focus on two garden-based exemplars, which fit with my views and assumptions presented in the beginning of this chapter. These are Williams and Brown's (2010, 2012) learning gardens principles linking pedagogy and pedology, and Ratcliffe's (2007) Model for Garden-Based Education (MGBE).

Williams and Brown: Learning Gardens principles linking pedagogy and pedology

Williams and Brown (2010, 2012) used living soil as metaphorical construct for education. Upon a deep and delicious look at living soil, Williams and Brown dug up and developed seven guiding principles.

Principle 1: Cultivating a sense of place.

This principle is congruent with the research on the connection between children and nature. Children are fascinated with soil and have no qualms digging in it to discover living creatures, fungi, and roots. By beginning with observing and working with soil in the school

garden, we can learn that it is the soil that makes up the land, and it is the land which shapes us (Meyer, 2003, p. 157). Williams and Brown (2012) stated:

> Living soil is inherently local…Since globalization is impacting actual local places, for us, gardens provide one fruitful and practical location to grow and cultivate a "sense of place." Individual gardens are finely tuned local expressions of phenomena such as sun, rain, wind, air, and more, all of which are common globally. Just as in each location different species of plants will flourish in response to these common environmental factors, like wise school gardens can focus attention on locally relevant aspects of common global social and ecological factors. (pp. 47 & 59)

The sense of place which can be cultivated through learning and working in a school garden is both physical as well as cultural. We can learn and understand more about local geography as we study the local climate, and what plants grow best in that climate. We can learn about local culture by tracing the history of a plant that grows well, to discover how it came to the local setting. For example; sugarcane was introduced to Hawai'i in the 1800s as a cash crop. Many different ethnic groups from all over the world came to Hawai'i to work the cane fields. Villages, schools, and stores developed in the large areas cultivated in sugarcane (Juvik & Juvik, 1998, pp. 246 – 247). Planting sugarcane in school gardens in Hawai'i provides the opportunity to learn about place through history, culture, and the sweet taste of the juice.

Principle 2: Fostering curiosity and wonder

Living soil invites endless queries. How did those roots get down there? What will happen to the worms if the garden floods? The transmissive, industrial form of education

presented earlier in this chapter stifles curiosity and wonder. Williams and Brown (2012) postulated that curiosity and wonder are foundational to learning (p. 75). They believe that "Learning gardens provide a landscape of inquiry directly on the school grounds that transcend the search for quantifiable answers" (p. 77). A student curious about worms may begin a worm bin. This may lead to vermi-composting as a means to recycle cafeteria green waste. This may lead to more studies on soil fertility using worm castings as fertilizers. There is no end to the wonder and the "what ifs."

Principle 3: Discovering rhythm and scale

Williams and Brown (2012) wrote, "through engagement with soil, we can tune into the natural rhythms and cycles of earth, moon, sun. Living soil also teaches us something about appropriate and functional scale" (p. 47). This idea of rhythm will be explored further in Chapter Three where I describe the concept of time in the garden, and as I describe the seasonal curriculum I developed for this project.

Principle 4: Valuing biocultural diversity

This principle provides a framework for my assumption that learning is as diverse as the learners - everyone can learn, but not always in the same capacity or context or rate. Williams and Brown (2012) wrote,

> Living soil supports both biological diversity an cultural diversity, and in turn biological and cultural diversity tend to support soil…In countering the trend towards homogocene, valuing biocultural diversity brings life to the center of the educational enterprise, and resists the simplification of the world to which children are introduced. (pp. 48 & 110)

Just as every species of plant, insect, or micro-organism in the school garden has a range of biological, chemical, and physical needs, so does every child in every school. While we may not be able to meet all these needs, we can celebrate them and learn about and from them.

Principle 5: Embracing practical experience

This principle is directly connected to several of the General Learner Outcomes, which will be explained in detail later in this chapter, especially *community contributor* and *quality producer*. This principle is also supported by child development and learning theories claiming that we learn best by doing. "Gardens encourage children to go outside of the classroom and put knowledge into practice…Experience deepens learning through creating a back and froth movement between the old and new ways of knowing" (Williams & Brown, 2012, p. 48).

Principle 6: Nurturing interconnectedness

All my prior thoughts and descriptions of learning through relationships and in relationships are beautifully distilled in this principle of nurturing interconnectedness. Williams and Brown (2010, 2012) described interconnectedness as relationships. Through working with soil and in the garden, children learn about systems, ecosystems, planting systems, irrigation systems, and such, and can broaden their ways of knowing and thinking.

Principle 7: Awakening the senses

I wrote earlier in this chapter that we cannot save what we do not love, and that the task of education is to foster love and value especially of the earth. This may be done through getting to know the earth. Using all the five senses to know something or someone will increase the amount of data we can collect. The school garden provides a diversity of ways to awake the senses through sight, smell, touch, taste and sound. Williams and Brown (2012) offered these reasons to awake and nurture the senses:

> Sensory awareness invites us the present moment and thus encourages engagement with life. Through sharpening the role of the senses in learning, meaning-making can be deepened. Engaging the full range of our sensory capacity helps to center awareness, and ground abstract concepts within physical reality. Sharpening the senses reinforces in a bodily way the themes of interconnection that is characteristic of all living things. (pp. 48, 147, 148)

The use of these principles guided my work in the creation of the interdisciplinary standards-based school garden curriculum which will be discussed in more detail in the following chapter. Next I will discuss another conceptual framework for school gardens, Ratcliffe's Model for Garden-Based Education (MGBE).

Ratcliffe's Model for Garden-Based Education

Ratcliffe (2007) developed a Model for Garden-Based Education (MGBE) with a combination of Social-Cognitive Theory (SCT) and Resilience Model (RM) as the conceptual framework. Please note, as reviewed in the section before, the Social-Cognitive Theory (SCT) is another term for the structural-developmental learning theory. MGBE predicts that a school garden program may improve or enhance the curricular, physical, and /or social learning environments. She wrote that "a school garden may shape the *curricular learning environment"* (p. 96) through hands-on, project-based, and placed-based education, as well as engaging youth and adults in genuine, ongoing processes. The curricular learning environment may also be enhanced through integrating multi disciplines and ages, and by providing experiential learning opportunities to reinforce concepts and abstract ideas. Garden based education also can engage multiple intelligences.

Ratcliffe continued her discussion by pointing out that a school garden may "alter the *physical learning environment"* (p. 96) by improving the quality of the school environment through enriching the visual and sensory aesthetics, and by diversifying the environments in which students play and learn. School gardens provide a perception of safe places in the school and/or community to learn and play. School gardens also provide increased opportunities for "visual reinforcement of learning, consuming vegetables, performing environmentally responsible behaviors, finding refuge, connecting with nature, and nurturing living things" (pp. 96- 97).

In the MGBE, Ratcliffe provided a third way in which school gardens may shape the learning environment in a school. She indicated that a school garden "may influence the *social learning environment"* (p. 97) by positively altering the school culture and identity through increasing opportunities for fostering relationships between the students and adults, and among the students themselves. School gardens can promote and foster cultural exchange, and increased parental and community involvement, which provides more opportunities for intergenerational mentoring. When more parents, caregivers, and community members are involved in school activities and programs, there is increased modeling of behaviors by the adults, which can be emulated by the students. Having a diverse community on a school campus may provide more opportunities to practice democracy and meaningful participation in school and community for both youth and adults.

Ratcliffe continued, the "MGBE predicts that changes in the learning environment described above will directly and indirectly affect participants' personal characteristics" (p. 97). Ratcliffe used the terminology "development of the whole child" in the MGBE to describe the wide variety of characteristics affected by garden-based learning experiences.

As a result, Ratcliffe predicted that:

> the changed learning environments and resulting effects on the development of the child will result in improvements in the following outcomes: (1) academic achievement including science and math test scores, grade point average (GPA), discipline, and absenteeism; (2) health related behaviors including fruit and vegetable consumption, willingness to try vegetables, snacking behaviors, and physical activity patterns; and (3) environmentally responsible behaviors including composting and recycling (pp. 97-98).

I used Ratcliffe's MGBE framework to guide the organization of the discussion for rest of this section on school gardens.

School Gardens Shaping the Curricular Learning Environment

Gardening need not be taught either for the sake of preparing future gardeners, or as an agreeable way of passing time. It affords an avenue of approach to [the] knowledge of the place farming and horticulture have had in the history of the human race and which they occupy in present social organization. Carried on in an environment educationally controlled, they [gardens] are a means for making a study of the facts of growth, the chemistry of soil, the role of light, air, moisture, injurious and helpful animal life, etc. There is nothing in the elementary study of botany, which cannot be introduced in a vital way in connection with caring for the growth of seeds. Instead of a subject belonging to a peculiar study called 'botany,' it will then belong to life, and will find, moreover, its natural correlation with the facts of soil, animal life, and human relations...It is pertinent to note that in the history of man, the sciences grew gradually out of useful social occupations. John Dewey

In a study by Graham et al. (2005) of 4,194 California school principals, the researchers found that,

> the most frequent reason for having a garden was for enhancement of academic instruction (89%)…and that the most frequently taught subjects using the garden were science (85% of the schools surveyed), environmental studies (70%), nutrition (66%), language arts (60%), and math (59%). (p. 149)

In a survey of 13 school-garden researchers, Phibbs and Relf (2005) found that the learning outcomes of school garden educational programs most often studied were health and nutrition (69%), environmental education (EE; 30%), and self-esteem or self-concept (30%). The age groups studied were predominantly elementary (85%) or middle school (38%). The present research also shows that among published quantitative studies, science achievement, nutrition knowledge, and change in food behavior have been most frequently measured, preceding environmental attitude change, self-esteem, and life skills (Blair, 2009, p. 20).

I searched for *quantitative* assessments of school gardens using EBSCOHost, ERIC and ProQuest databases. I found five studies about quantitative assessment of science achievement in conjunction with school garden (Dirks & Orvis, 2005; Klemmer et al., 2005a, 2005b; Mabie & Baker, 1996; Smith & Motsenbocker, 2005), and one dissertation on the affective and cognitive effects of an interdisciplinary curriculum on underachieving students (Sheffield, 1992). All five studies showed higher Science Achievement (SA) for gardening students.

Klemmer et al. (2005a) developed a science achievement evaluation instrument which was used in two studies, Klemmer et al. (2005b), and Smith and Motsenbocker (2005). Both studies used the same Junior Master Gardener (JMG) Level 1 curriculum developed by the Texas Agricultural Extension Service (1999a, 1999b). However, class teachers who had been trained in using the JMG curriculum taught the students in Klemmer's study, and the teachers in Smith and Motsenbocker's study were primarily young and inexperienced undergraduate students (p. 442).

Klemmer et al. (2005a) studied the science achievement of 647 third, fourth and fifth graders from seven elementary schools in Temple, Texas; while Smith and Motsenbocker (2005) studied 62 fifth graders in three schools in East Baton Rogue, Louisiana. Klemmer et al. (2005a) found that the garden-based curriculum was "more effective as a teaching method in raising

science achievement scores for boys in third and fifth grades, and for girls in the fifth grade compared to traditional classroom-based methods alone" (p. 448). Smith and Mostenbocker (2005) concluded: "This study shows that even with instructors who had little background in teaching methods and a once a week gardening session for students, some improvement in science achievement test scores can be attained" (p. 442).

Dirks and Orvis (2005) also used the JMG curriculum with third graders in 14 classrooms in 11 schools in Indiana. These researchers used a modified Likert scale to measure students' short-term knowledge gain and short-term changes in *attitudes* concerning gardening, science and the environment (p. 444). Their results indicate that gardening can successfully be used in the classroom and has the capacity to influence students positively in their learning, especially for science and agriculture related topics (pp. 446-447).

Sheffield (1992) taught an interdisciplinary garden-based curriculum, *Heritage Garden,* to an experimental group for four hours a day during a 5-week long summer school session. The National Gardening Association developed this curriculum. The children in the experimental and control groups consisted of *underachieving* third and fourth graders who were one or more grade levels behind in reading and math, and who had been retained a grade at least once. Sheffield used the American Guidance Peabody Individual Achievement Test (PIAT) to pre- and post-test the students in both groups (p. 41). At the end of the session, Sheffield found a significant difference in the achievement tests of reading comprehension, total reading, spelling and written language in the experimental group (pp. 116-117). The next aspect to be discussed is the influence of school gardens on the physical learning environment.

School Gardens Altering the Physical Learning Environment

For every school there should be a garden attached where students may feast their eyes on trees, flowers, and plants…where they always hope to hear and see something new. Since the senses

are the most trusty servants of the memory, this method [gardens] of sensuous perception will lead to the permanent retention of knowledge. J. A. Comenius

Ratcliffe (2007) stated that school garden may alter the physical learning environment in several ways including enhancing or increasing "quality of the environment where children play and learn…opportunities for visual reinforcement of learning, consuming vegetables, performing environmentally responsible behaviors, finding refuge, connecting with nature, and nurturing living things" (p. 97). Based on that reasoning, I have included studies about the impact of school garden programs on nutrition-based outcomes in this section.

Using EBSCOHost, ERIC and ProQuest databases, I found 11 studies on the impact of garden food and nutrition programs, of which 5 were conducted in–school (Cason, 1999; Lineberger & Zajicek, 2000; McAleese & Rankin, 2007; Morris et al., 2001; Morris & Zidenberg-Cherr, 2002), and the rest were after-school and/or community programs. All studies provided "promising evidence" that "garden-based nutrition-education programs may have the potential to lead to improvements in fruit and vegetable intake, willingness to taste fruits and vegetables, and increased preferences among youth whose current preferences for fruits and vegetables are low" (Robinson-O'Brien et al., 2009, p. 279).

School gardens are an important element of the movement to increase foliage and plants on school grounds (Dyment & Bell, 2008), a movement in response to the sustainability revolution (Edwards, 2005), and the No Child Left Inside (Louv, 2005) movement. Parents, educators, and health experts are advocating more time outside for children to engage in physical activity, nature immersion, and social skills development (Dyment & Bell, 2008; Dyment & Reid, 2005). Schools around the world have embraced the notion of school ground greening and are transforming hard, barren expanses of turf and asphalt into places that include a diversity of

natural and built elements, such as shelters, rock amphitheaters, trees, shrubs, wild-flower meadows, ponds, grassy berms and food gardens (Dyment & Bell, 2008, p. 958).

The greening of school grounds is not only for curricular and health purposes, it is also for the ecological sustainability of our planet. Capra (1997) said:

> As we move toward the 21st century, the great challenge of our time is to create ecologically sustainable communities, communities in which we can satisfy our needs and aspirations without diminishing the chances of future generations. For this task, we can learn valuable lessons from the study of ecosystems, which are sustainable communities of plants, animal, and microorganisms. To understand these lessons, we need to learn the basic principles of ecology. We need to become ecologically literate, and the best place to acquire ecological literacy is the school garden. (pp. 45-46)

School gardens can provide a place for children to learn environmentally responsible behaviors and to connect different areas and school systems together. Capra (1997) again:

> Learning in the school garden is learning in the real world at its very best. It is beneficial for the development of the individual student and the school community, and it is one of the best ways for children to become ecologically literate and thus able to contribute to building a sustainable future. (p. 50)

School Gardens Influencing the Social Learning Environment

All human experience is ultimately social; that it involves contact and communication.
John Dewey

Structural-developmental (or constructivist or social cognitive) theory is an interactional theory; children construct knowledge and values through continuous interaction with a physical and social world. I discussed briefly in the previous section how children can develop through interaction with the natural or physical world of the school garden; this part will briefly explore

how school gardens can be a place to foster relationships, build community, foster cultural heritage, and practice life skills.

Robinson and Zajicek (2005) conducted a study to assess changes in the life skill development of 190 third, fourth and fifth grade students participating in a 1-year school garden program in Texas. The researchers developed a Youth Life Skills Inventory (YLSI) that used a three-point Likert-type scale. This was an adaptation of Townsend and Carter's (1983) Leadership Skills Inventory and the 4-H National Youth Assessment Survey (Peterson et al., 2001). The curriculum used in this program is the very same Junior Master Gardener (JMG) curriculum used in the Klemmer et al. (2005a) and Smith and Motsenbocker (2005) studies. Robinson and Zajicek (2005) looked at these six life skill constructs: working with groups, self-understanding, leadership, decision-making, communication, and volunteerism (2005, pp. 454-456).

Robinson and Zajicek (2005) concluded that:

> The youth that participated in the year-long garden program increased their overall life skills as well as improved teamwork skills and self-understanding. These skills are extremely important to ensure socially responsible and productive students. Gardens are a place where students can work together, make decisions, manage problems, and gain a sense of responsibility. The middle childhood period marks a strong growth in social relations and may be the right time to introduce youth to gardening and its benefits. (p. 456)

Mayer-Smith et al. (2007) created the Intergenerational Landed Learning Project, which brings together community elders, elementary students, and their teachers on an urban farm to explore how farming practices can be integrated with school curriculum to foster environmental

knowing and care. Their study showed that the children gained a new experience of a world outside of their classrooms by working side-by-side with experienced farmers and gardeners who are community elders. This experience was social and contributed to the physical and curricular learning of the students.

> These elder farm friends are mentors, friends, and role models for the children. They provide wisdom, direction, and guidance that assist their young apprentices in gaining access to the practice of farming and membership in a community farm. The intergenerational community context provides the social setting and relationships that support the growth of environmental consciousness. Farm friends share with the children the common goal of growing food crops and not only model but also articulate concern for the environment. (p. 83)

In Australia, Cutter-Mackenzie (2009), studied Multicultural Schools Gardens which were created in low-income schools to implement "a culturally focused environmental education program" (p. 122). This program had a strong social focus and used the school garden to bring communities together to design the garden, create curriculum topics, and to work. At the end of her research Cutter-Mackenzie found evidence that:

> The multicultural school gardens program went beyond a sole (and typical) focus on gardening, incorporating the students' cultural heritage. The program led to the development of a "space" that facilitated a strong sense of belonging among students who were formerly dislodged from their birthplaces, coupled with enhanced opportunities in learning English language (an essential skill in living in any Western culture) and forming connections to the local environment. This paper has provided food for thought with respect to the potential for children's gardening to transcend language and cultural

differences, therein providing authentic learning opportunities that extend well beyond previous expectations of school gardening programs. (p. 133)

Parajuli et al. (2008) found that by creating a strong social component of the Learning Gardens at Portland, Oregon, through inviting parents and families to create gardens according to their own agro-ecological and culinary traditions, the following were enhanced:

1. parents and extended families participation in schools and learning gardens;
2. positive impact on the learning home-environment for students; and
3. recognition and validation of parents knowledge and skills. (pp. 45-47)

The studies reviewed above demonstrate that school gardens may be used to influence the social learning environment positively, benefiting not only the students and their families, but also the faculty, staff, and the community at large. In the following section, is a brief discussion on curriculum development and the evaluation of the curriculum.

Curriculum and Evaluation

Tyler's (1949) book, *Basic principles of curriculum and instruction,* has been a foundational reference for educators since its publication. The principles presented are universal and timeless. Tyler's rationale for viewing, analyzing and interpreting the curriculum and instructional program begins with the following four questions:

1. What educational purposes should the program seek to attain?
2. What educational experiences can be provided that are likely to attain these purposes?
3. How can these educational experiences be effectively organized?
4. How can we determine whether these purposes are being attained? (p. 1)

My belief that the meta-purpose of education is to: *help us create value in our actions, develop love in our thinking, and foster equality and righteousness in our emotions.* However, in

the context of this study and of this school garden-based program, the purpose of the program is to teach the six Hawai'i GLOs through the content and context of the program. These six GLOs are reviewed later in this chapter.

From my experience, direct observations, and research, I believe that in order for the students to learn and apply the six GLOs, the learning experiences selected need to be interdisciplinary (Dewey, 2009), contextually and developmentally appropriate (Steiner, 1996a; Orr, 1992, 1994; Tyler, 1949, pp. 63-66; Williams & Brown, 2012), and steeped in the understanding of how six GLOs work structural-developmentally together. These ideas are presented briefly below, and explored deeply in the chapter on curriculum and pedagogy.

Also by virtue of being a school garden-based program, these learning experiences can be designed using nature's patterns (Benyus, 1997), organized seasonally (Parajuli et al., 2008; Sobel, 1996, 2004, 2008; Williams & Brown, 2012), structured on botanical growth rhythms (Steiner, 1990), and in relationship with living soils–*pedology* (Williams & Brown, 2012). These elements are described in further detail in the curriculum and pedagogy chapter.

I advocate that the evaluation of these experiences, and thus the program, be authentic and culturally appropriate. This school garden-based program is a task- and activity-oriented program. The students were evaluated on their performance on the tasks and demonstrations of the six GLOs as they worked, played and learned in the garden, and not on some abstraction such as how they performed in a multiple choice test. In Hawai'i, a very culturally appropriate evaluation is an event called *Ho'oike* which literally means *to show*. This show and tell event supports the students' recreation of the task or activity as a means to share knowledge and wisdom gained, as well as a way to share how much the individual has changed in the course of

the learning experience (Kahakalau, 2003; Meyer, 2003). The philosophy and methodology of the evaluation will be discussed in greater detail in the fourth chapter of this dissertation.

Interdisciplinarity and STEM

Knowledge is interconnected and interdependent (Sheffield, 1992, p. 10). According to Dewey (2009) in his *Waste in Education* lecture,

> All [educational] waste is due to isolation. Organization is nothing but getting things into connection with one another, so that they work easily, flexibly, and fully…the fundamental organization is that of the school itself as a community of individuals in its relations to other forms of social life. (p. 45)

Dewey proposed to unify education through making connections among subjects and also between school and home. While he may not have used the term interdisciplinary he describes the character of such a curriculum and education.

> All studies grow out of relations in the one great common world…Experience has its geographical aspect, its artistic and its literary, its scientific and historical sides. All studies arise from aspects of the one earth and the one life lived upon it… When the child lives in varied but concrete and active relationship to the common world, his studies are naturally unified. It will no longer be a problem to correlate studies. The teacher will not have to resort to all sorts of devices to weave a little arithmetic into the history lesson, and the like. Relate the school to life, and all studies are of necessity correlated. (pp. 56-57)

A comprehensive research study on *How People Learn* (2000) led by Bransford et al. (2000) for the National Research Council posited that children depend on certain strategies to "acquire knowledge and develop effective activities to use their minds well" (p. 96). Bransford

et al. provided this insight "…the most pervasive strategy used to improve memory performance is clustering: organizing disparate pieces of information into meaningful units. Clustering is a strategy that depends on organizing knowledge" (p. 96).

Gatto (1992) first described unrelatedness in his attempt to advocate for the necessity of interdisciplinarity and relationship building,

> The logic of the school-mind is that it is better to leave school with a tool kit of superficial jargon derived from economics, sociology, natural sciences, and so on, than with one genuine enthusiasm… Confusion is thrust upon kids by too many strange adults, each working alone with only the thinnest relationship with each other, pretending for the most part, to an expertise they do not possess. (p. 3)

For Gatto, this is what education should be, "Meaning, not disconnected facts, is what sane human beings seek, and education is a set of codes for processing raw data into meaning" (p.3).

From my experience, and from the wisdom of the educators before me, I could see how having a curriculum that connects subjects makes so much sense and is economical. The school garden by virtue of being a microcosmic representation of the earth is a context conducive for practicing interconnectedness and interdisplinarity. Activities and tasks in the school garden lend themselves very methodologically to teaching and using STEM, especially with a focus on the S - science. Understanding and improving soil fertility could bring in scientific inquiry, use of probes to discover the pH of the soil, calculations of volume of amendments needed to support healthy soil, and the actual engineering of adding and mixing in the amendments to the garden soil. Other interdisciplinary activities included harvesting produce, weighing of the harvest, and then bringing the produce home to cook with parents. This simple task tied in mathematical skills, chemistry skills, social skills, and as well as nurturing the physical body. When I look

back at when my teaching was effective, I could see that those were the times when I taught interdisciplinarily, weaving subjects and making connections with and for my students. This kind of teaching and learning supported the scaffolding of learning, creates opportunities for learning for a diversity of learners, and is matched with the structural-developmental theory of learning.

I end this section with borrowing again from other school garden educators. Sheffield (1992) described her school garden-based interdisciplinary curriculum beautifully,

> Knowledge is interconnected and interdependent. With an interdisciplinary curriculum, the curriculum is centered on core activities and coordinating fields of knowledge. Subjects are not presented as separate and distinct from one another but rather in a holistic manner.

Phenix (1964) notes that "the ideal curriculum is one in which maximum coherence is achieved, and segmentation is minimized." (pp. 10-11)

The Six General Learner Outcomes (GLOs)

The review of the GLOs in this section is from a cultural and a global stance. I provide a contextual rationale for my choice to use these GLOs as measurable values in chapter four on methods. In this section, the reader will be introduced to several Hawaiian words and phrases that provide another tone to the discussion.

The State of Hawai'i Department of Education General Learner Outcomes are the overarching goals of standards-based learning for all students in all grade levels. Observable behaviors, which are demonstrated in daily classroom activities, are evidence of GLOs. Student effort, work habits, and behavior are important and *they must be evaluated separately* from academic performance in the content areas (in accordance with Board of Education Policy 4501:

Assessing/Grading Student Performance). The GLOs should be an integral part of the school culture as the GLOs do not exist in isolation. The six GLOs are:

1. Self-directed Learner (The ability to be responsible for one's own learning);
2. Community Contributor (The understanding that it is essential for human beings to work together);
3. Complex Thinker (The ability to demonstrate critical thinking and problem solving);
4. Quality Producer (The ability to recognize and produce quality performance and quality products);
5. Effective Communicator (The ability to communicate effectively);
6. Effective and Ethical User of Technology (The ability to use a variety of technologies effectively and ethically).

The GLOs in Hawai'i and similar performance goals in other States were created in response to the No Child Left Behind Act of 2001 and the need to better prepare students with "21st century skills for 21st century jobs" (U.S. Department of Commerce et al., 1999). The opening paragraph of this 1999 report state:

> Global competition, the Internet, and widespread use of technology all suggest that the economy of the 21st century will create new challenges for employers and workers. While it is possible to compete in this new global economy by creating low-wage, low-skilled jobs, America has chosen to take full advantage of its labor force and to create high-performance workplaces. If economic success is to ensure a high quality of life for all Americans, it will require adopting organizational work systems that allow worker teams to operate with greater autonomy and accountability. These new forms of organization and management cannot succeed without additional investments in the skills

> of U.S. workers. In the workplace of the 21st century, the Nation's workers will need to be better educated to fill new jobs and more flexible to respond to the changing knowledge and skill requirements of existing jobs. Meeting the challenge of employment and training will call not only for the best efforts of employers, educators and trainers, unions, and individual Americans, but also for new forms of cooperation and collaboration among these groups. Lifelong skills development must become one of the central pillars of the new economy. (p. 4)

The impetus for the kind of education as stated above is an echo of the purpose of education for economics sake as presented earlier in this chapter. However, in a closer look at the outcomes from a structural-developmental theory lens, several other reasons for this kind of education surfaced.

The Partnership for 21st Century Skills (P21) is a national organization that advocates for twenty-first century readiness for every student. In *P21 Framework Definitions* (2009), this organization advocates the weaving of twenty-first century interdisciplinary themes into core subjects. They list the following themes, and several processes with each theme:

1. Global Awareness
    - Using twenty-first century skills to understand and address global issues,
    - Learning from and working collaboratively with individuals representing diverse cultures, religions and lifestyles in a spirit of mutual respect and open dialogue in personal, work and community contexts,
    - Understanding other nations and cultures, including the use of non-English languages.
2. Financial, Economic, Business and Entrepreneurial Literacy

- Knowing how to make appropriate personal economic choices,
- Understanding the role of the economy in society,
- Using entrepreneurial skills to enhance workplace productivity and career options.

3. Civic Literacy
    - Participating effectively in civic life through knowing how to stay informed and understanding governmental processes,
    - Exercising the rights and obligations of citizenship at local, state, national and global levels,
    - Understanding the local and global implications of civic decisions.
4. Health Literacy
    - Obtaining, interpreting and understanding basic health information and services and using such information and services in ways that enhance health,
    - Understanding preventive physical and mental health measures, including proper diet, nutrition, exercise, risk avoidance and stress reduction,
    - Using available information to make appropriate health-related decisions,
    - Establishing and monitoring personal and family health goals,
    - Understanding national and international public health and safety issues.
5. Environmental Literacy
    - Demonstrate knowledge and understanding of the environment and the circumstances and conditions affecting it, particularly as relates to air, climate, land, food, energy, water and ecosystems,

- Demonstrate knowledge and understanding of society's impact on the natural world (e.g., population growth, population development, resource consumption rate, etc.),
- Investigate and analyze environmental issues, and make accurate conclusions about effective solutions,
- Take individual and collective action towards addressing environmental challenges (e.g., participating in global actions, designing solutions that inspire action on environmental issues).

I am very encouraged about the inclusion of these themes, in particular the Environmental Literacy theme. This is because the weaving of the above themes into core curriculum seems to suggest a more encompassing purpose of education which may include, helping to create value in our actions, develop love in our thinking, and foster equality and righteousness in our emotions. I began to understand that the six GLOs are *processes* or skills, which can be applied to teach, understand, and apply content effectively (Bransford et al., 2000, pp. 77-78). I looked for other expressions of these six GLOs.

'Ōlelo No'eau are Hawaiian proverbs and poetical sayings. Many of these were collected and translated by Mary Kawena Pukui between 1910 and 1960. These sayings "reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawai'i and its people but of all humanity" (Pukui, 1983, p. vii). Many public schools in Hawai'i, including Kohala Elementary School have 'Ōlelo No'eau printed on the walls, posters, and letterhead. The most famous 'Ōlelo No'eau is the Hawai'i State motto – *Ua mau ke ea o ka 'āina i ka pono* – The life of the land is perpetuated in righteousness, which can be found inscripted on the Hawai'i United States quarter.

Kamehameha Schools, a private Native Hawaiian educational institution describes the six GLOs from a cultural perspective, incorporating several ʻŌlelo No'eau into the description. The following description was taken from a poster series on the GLOs published by Kamehameha Schools.

Table 1

The General Learner Outcome as presented by Kamehameha Schools Hawai'i

GLO in English and Hawaiian	Hawaiian ʻŌlelo Noeau	Explanation
Self-Directed Learner–*Kuleana Ihola*	Nānā ka maka, hana ka lima. *The eyes watch and the hands perform.*	In the days of old, questioning the instructor was rude. The student paid close attention to what was taught. Students learned quickly and were able to perform the task and in turn, teach others.
Community Contributor–*Mālama Kaiāulu*	Kōkua aku, kōkua mai. *As we help others, we find help for ourselves.*	The Hawai'ian lived in two distinct areas of the islands; those who lived near the shoreline and those who lived in the uplands. Groups traded with one another those goods only available in their own area. This system created a mutually beneficial relationship that supported subsistence living.
Complex Thinker–*Ho'okuano'o*	Mai pono hana, hana pono. *Don't be busy with frivolous work; do what you need to do.*	When the going gets tough, the tough gets going, it's been said. In life we are faced with challenges that must be overcome. The first step is to stop and think. At first glance, a problem might seem too difficult. However, if we think on it long enough, we will find the answer. Never give up!
Quality Producer–*Hana*	Mai maka'u i ka hana,	Ka hana no'eau or the well crafted products

No'eau	maka'u i ka moloā. *Don't fear work, fear laziness.*	Hawai'ians made are still today great examples of exquisite craftsmanship. They took their time and were very critical; anything they made needed to be of fine quality.
Effective Communicators–*Kākā'ōlelo*	I ka'olelo nō ke ola, I ka'ōlelo no ka make. *In the word is life, in the word is death*.	The power of the word is easily demonstrated. When we have a poor outlook, we "see" everything in a negative way, and even the activities we enjoy are not the same. When we can reframe our situation, we "see" things in a "new light." Being able to communicate is an important task of a member of a community. Understanding and being understood will help in any situation.
Effective/Ethical user of technology–*Kūpono Hana'ike*	Hele nō ka 'alā, hele nō ka lima. *Where the adz goes, the hand goes.*	As an aboriginal society, the Hawai'ians made use of the resources around them to produce quality products. Today technology is almost limitless. Users of technology must understand how it works to be effective. More importantly the user must appreciate how to use it to benefit others.

I also consulted a cultural teacher (*kumu)* who is highly respected in the community, for his interpretation of the GLOs from a Hawai'ian perspective (K. Ching, personal communication, 02/01/11). Kumu Keala Ching founded the *Nā Wai Iwi Ola* (NWIO) Foundation to perpetuate the Hawaiian culture and practices through hula protocol and ceremonies, the use and study of the Hawaiian language and by embracing the stories of our *kūpuna* (elders) past, present and future. Kumu Ching is particularly interested in education as he has his degree in early childhood education from the University of Hawai'i at Manoa. He felt that he could expand

further on what was presented by Kamehameha Schools and had several more suggestions, including different translations for several for the GLOs. The following is a recapitulation of our conversation held 02/01/11.

Kumu Ching described Self-Directed Learner as *Kuleana Ihola*–self responsibility. He provided this ʻŌlelo Noeau: *Ua mau ke ea o ka 'āina i ka pono* - The life of the land is perpetuated in righteousness. The verbatim explanation is as follows:

> Kau'ikeaouli (King Kamehameha III) voiced this wise saying, giving each individual "Hawai'ian" the opportunity to do right to the land, to themselves and to the community. It is the responsibility one has within "kuleana ihola". In old Hawaii, instructors model the righteousness of learning so that learners understand the outcome of learning without questioning the instructors. Righteousness is the best model of verse (ʻŌlelo Noeau) teaching.

Kumu Ching described GLO 2 Community Contributor as *Mālama Kaiāulu*–community care. The ʻŌlelo Noeau he chose to match was *'A'ohe hana nui i 'alu like kakou* - No work is large if we work together. He explained:

> In old Hawai'i, work was shared throughout the community to nurture all members from the elders to the next generation. A successful model of a community was shared from within the immediate family as the first learning community.

For GLO 3 Complex Thinker, Kumu Ching chose the word *Ho'okauno'o*, which can be translated as learning center. He felt that this could be phrased as *No ka luna ko luna, No ka lalo ko lalo*, meaning, what is up belongs up, what is down belongs down. He went further to say:

> Understanding that everything has a purpose in life, the study of ʻahupuaʻa and complex thinking allows the comprehension learning that upland provides a nurturing source for

> gardening; where as, lowland provided sources from the ocean. Through ‘opelu fishing, a blend of upland plants like pumpkin, taro, and sweet potatoes provide the chum used for fishing ‘opelu. Understanding the resources of place – *Ho’okauno’o.*

Kumu Ching described Quality Producer as *Hana No’eau*, meaning special work. He said: *Ua hala ē ka Pu’ulena, Aia i Hilo* - The Pu’ulena winds of Hamakua, ends up in Hilo! Seize the moment to learn.

> In old Hawai'i, a family tradition was handed down though generations, skilled artisans like lauhala weavers, eel catchers, bird catchers, feather makers, and tapa makers, etc. It is told that when you are given the opportunity to learn seize the moment, for the moment might never come again – do not let the Pu’ulena winds blow by and end up in Hilo. Take all the opportunities to learn, and learn with the greatest intention to perpetuate the art and enjoy your learning process!

For GLO 5, Effective Communicator, Kumu Ching agreed with the interpretation from the Kamehameha Schools’ literature, and did not have any additional words to add.

The last GLO Effective/Ethical user of technology, Kumu Ching chose to describe it as *Kūpono Hana'ike,* being rightful & knowledgeable. The ‘Ōlelo Noeau he offered was, *Kuhikuhi ho'i na lima, hele wale na* maka, which can be translated as, where the hands are pointed, the eyes follow. He explained:

> Focus upon the work at hand, as the hands do the work the eyes observe. Technology involves the hands with the eyes focused on the accomplishments needed. Hawaiians worked with all tools like technology that supports the perfection of the work.

The interpretation from Kumu Keala and Kamehameha Schools presented the GLOs as processes to prepare our students not only to enter the workforce, but also to perpetuate the

Hawai'ian culture, belief system, and contribute to society. The following are a few more ideas and thoughts culled from literature to understand more about the six GLOs.

GLO 1: Self-Directed Learner

Self-directed learning has been one of the education field's high-interest topics for more than a decade, perhaps because the concept is so central to what adult education is all about (Knowles, 1975; Mezirow, 1985). An estimated 70% of adult learning is self-directed learning (Cross, 1981). Self-directed learning has been described as "a process in which individuals take the initiative, with or without the help of others" (Knowles, 1975, p. 18) to diagnose their learning needs, formulate learning goals, identify resources for learning, select and implement learning strategies, and evaluate learning outcomes.

There is interest in developing self-directed learning capacity in children, though there are not many research studies in this area (Rivero, 2003; Md Nor & Saeedina, 2009). In their study, *Exploring self-directed learning among children* Md Nor and Saeedina (2009), found that children have the capacity to be self-directed learners. Children love to learn, they feel capable of learning anything they may need to know, they like to think about the future, and they are able to evaluate their own learning. However, the inefficiency of current educational system does not support the actualization of these capabilities in children (Md Nor & Saeedina, 2009, pp. 660-661).

In the school garden, self-directed learning can be demonstrated in the curricular learning environment when students use the garden to conduct experiments based on personal interest, such as waste management experiments, soil tests, photosynthesis experiments and so on (Stone, 2009). Self-directed learning in the physical learning environment may be demonstrated through the students taking on the responsibility to create a biologically diverse, aesthetically pleasing

school garden (Sobel, 2004, pp. 40-42), and through understanding the connection between the eating of fresh fruits and vegetables and overall health (Ratcliffe, 2007). To quote Kumu Keala Ching's words above, in the context of the social learning environment of the school garden, "In old Hawaii, instructors model the righteousness of learning so that learners understand the outcome of learning without questioning the instructors. Righteousness is the best model of verse (ʻŌlelo Noeau) teaching."

GLO 2: Community Contributor

This GLO is often described as *cooperation* or *collaboration* by the teachers and staff at Kohala Elementary School (field notes, August 2010 through March 2011; A. Carlson, J. Baptista, & A. Nickl, personal communication 03/30/11). The word *kōkua* (cooperation, assistance) is a regular choice made by the staff and faculty (field notes, August 2010 through March, 2011). Resnick (1987) reported that one major contrast between everyday settings and school environments is that the latter place much more emphasis on individual work than most other environments. Bransford et al. (2000) provided several examples:

> A study of navigation on U. S. ships found that no individual can pilot the ship alone; people must work collaboratively and share their expertise. More recent studies of collaboration confirm its importance. For example, many scientific discoveries in several genetics laboratories involve in-depth collaboration (Dunbar, 1996). Similarly, decision making in hospital emergency rooms is distributed among many different members of the medical team (Patel et al., 1996). (p. 74)

The school garden provides many tasks and intergenerational opportunities on which to cooperate and collaborate, from building compost piles, to weeding, to sharing of harvests, and learning from the elders (Robinson & Zajicek, 2005; Sobel, 2004, 2008; Stone, 2009;

Subramaniam, 2003; Waters, 2005). In this way, the school garden is more of a real-life setting than most school contexts.

GLO 3: Complex Thinker

Often this GLO is also called *Critical Thinker* among the staff, teachers, parents, and community (field notes, August 2010 through March, 2011). This skill is no stranger in all fields. Many articles and books have been written about critical thinkers, of which the work of Brookfield (1987) may be most familiar. He offered seven critical thinking themes that informed this study (pp. 5-9):

1. Critical thinking is a productive and positive activity.
2. Critical thinking is a process, not an outcome.
3. Manifestations of critical thinking vary according to the contexts in which it occurs.
4. Critical thinking is triggered by positive as well as negative events.
5. Critical thinking is emotive as well as rational.
6. Identifying and challenging assumption is central to critical thinking.
7. Critical thinkers try to imagine and explore alternatives.

School gardens can provide many opportunities for critical thinking and problem solving in a concrete context, where the feedback is immediate and garden-based (Stone, 2009, pp. 32-36, 96-101).

GLO 4: Quality Producer

The GLO may seem the one that is most geared towards economics, jobs and the workforce, however, the Hawai'ian culture-based interpretation uses the word *craftsmanship*. This word denotes quality, and to produce something of quality, time is a factor. Something of

quality usually lasts; it is permanent. Schumacher (1973) tackled the difficult concept of the economics of permanence in several chapters of *Small is Beautiful*. He wrote,

> Nothing makes economic sense unless its continuance for a long time can be projected without running into absurdities. The economics of permanence implies a profound reorientation of science and technology, which have to open their doors to wisdom and, in fact, have to incorporate wisdom into their very structure… To give [a] preliminary example; in agriculture and horticulture, we can interest ourselves in the perfection of production methods which are biologically sound, build up soil fertility, and produce health, beauty and permanence. Productivity will then look after itself (pp. 21-22, 34).

The school garden is a place where high quality foods can be produced and eaten. Students can learn to discern healthy plants form unhealthy ones and to support their growth through practices such as soil fertility, proper tilling, and crop rotation. Students at The Garden Project of Troy Howard Middle School in Belfast, Maine are exemplary quality producers, growing more than 8,000 pounds of vegetables a year, and winning prizes for heirloom vegetables at the country's largest organic fair, and they are doing it at weather conditions below 10 degrees (Stone, 2009, pp. 32-36).

A quality producer does not necessarily mean someone who serves only the economic realm, but also one who adds to the improvement of society and care of the environment.

GLO 5: Effective Communicator

In the school year 2009 – 2010, only 63% of Hawai'i fourth graders and 64% of the fifth graders were reading proficiently at grade level (State of Hawaii Department of Education, 2010, p. 4). Being able to read and write is fundamental to effective communication, as is verbal

communication. The DOE has in their plan to increase those numbers to 75% by then end of the 2011-2012 school year.

More and more children are spending a lot of time in front of the television set or playing video games. According to the National Survey on Children's Health 2007 (U.S. Department of Health and Human Services, Health Resources and Services Administration, 2009), 54.4% of children aged 1-5 watched more than one hour of TV or video during a weekday nationwide. Research conducted by Sage (2003), of the University of Leicester School of Education, on the thinking, speaking, reading and writing skills of children over 20 years provided evidence that children in Leicester, UK, were growing up with poor communication skills, because they were spending too much time watching television. They were learning to process messages visually rather than verbally. Dr. Sage found that having poor conversational skills is a major obstacle to making progress at school. She noted that, families used to gather together every evening and recount what they had done during the day. Children learned in that context how to put verbal ideas together in their minds. Today, children come home from school and sit in front of the TV processing largely picture information, which does not engage children in thinking, speaking and reflecting.

Children who work and learn in the school garden have the opportunity to interface directly with other children, adults and nonhumans. There is no screen between them. The virtue of garden-based work is that it "rewards cooperation," and in order to cooperate there must be effective communication between the cooperators.

GLO 6: Effective/Ethical use of Technology

The twenty-first century idea of technology almost always includes computerized technology, and renewable energy technology. While that is important, researchers from the

Center of Ecoliteracy who have studied schooling for sustainability, including the use of school gardens to teach multidisciplinary programs, have found evidence that it is more developmentally appropriate and supportive to teach younger students the basics of technology, such as the use and maintenance of simple garden tools, carpentry tools, and measuring tools (Brown, 2010; Stone, 2009, pp. 32-36, 84 – 89, & 90 – 95). In his article, *Little machines in their gardens: A History of school gardens in America, 1891 to 1920*, Brian Trelstad (1997), features several photographs of children using gardening and farming tools. Children are using full size rakes, shovels, hoes, and even a plow (pp. 164 – 168). The basic skills learned in this setting will scaffold the learning of more sophisticated technology such as power tools, and hand-held electrical probes.

Continuing the idea of beauty and permanence in this context of technology, I again defer to Schumacher (1973), who provided two examples of wise or ethical technology:

> In industry, we can interest ourselves in the evolution of small scale technology, relatively non-violent technology, "technology with a human face," so that people have a chance to enjoy themselves while they are working, instead of working solely for their pay packet and hoping, usually forlornly, for enjoyment solely during their leisure time. In Industry, again – and surely, industry is the pace-setter of modern life – we can interest ourselves in new forms of partnership between management and men, even forms of common ownership. (p. 22)

The literature above along with the Hawaiian cultural interpretations informed my understanding that the GLOs are not static, easily quantifiable products, but rather they are dynamic, developing processes. The development of the GLOs does not happen in a linear pattern but concurrently with each GLO supporting and promoting the development of the other

five. The visual of this relationship is like gears turning each other as one gear turns (Figure 1). The being and becoming a general learner who is self-directed, contributes to community, thinks complexly, produces quality works, communicates effectively, and who uses technology ethically is a life-long practice. The process of learning is inextricable from the product, which is the learner. The process shapes learner, that the learner in turn deepens and re-defines the process. Thus the learning and application of the six GLOs is also the learning and application of self.

Figure 1. GLOs relationship to each other.

Summary

This review presented a representative sample of the literature in the areas of the purpose of education, child development and learning theory, the relationship of children and nature, the use of school gardens, and a philosophical overview of the six GLOs. Education that helps us to

be creators of value, and to be free human being able to impart purpose and direction to our lives emphasizes the process of learning and not so much the product. This paradigm of education focuses on supporting and building on the potentiality of students. As children grow and learn, their knowledge can be scaffolded with educative experiences built upon more educative experiences.

School gardens have been around for more than a hundred years, and are acceptable by parents and educators as places conducive for experiences *with* and *in* nature. Children's experiences in nature support their development cognitively, effectively, and physically. School gardens designed with these three areas in mind will have nature-based elements and principles to create interdisciplinary, child centered, and experiential curriculum; to develop safe, biologically diverse, and healthy physical environments; and to foster relationships both human to human and human to nonhuman.

The school garden is a dynamic setting offering multiple contexts for teaching and learning. Gick and Holyoak (1983) posited that when a subject is taught in multiple contexts, and includes examples that demonstrate wide application of what is being taught, people are more likely to abstract the relevant features of concepts and to develop a flexible representation of knowledge (Bransford et al., 2000, p. 63). The school garden has tremendous potential to be used as a safe, accessible and nurturing avenue to teach, learn, and practice the processes that will lead to consistent demonstration of the six GLOs by all the students involved in the program.

In the next chapter, I discuss the pedagogy used to develop the interdisciplinary standards-based school garden curriculum and the context in which the curriculum was taught and evaluated.

CHAPTER III

CONTEXT, PEDAGOGY, AND CURRICULUM

The research question guiding this study is: How does the experience of an interdisciplinary standards-based school garden education affect the learning and application of the six GLOs in elementary students?

The curriculum and pedagogy, thus, are central to this question. I begin by situating this discussion, literally, through a brief description of the context in which and for which the curriculum was designed, created, and implemented. Next, I present how the curriculum and pedagogy of the interdisciplinary school garden-based education is based on the theoretical framework and philosophical underpinnings previously discussed in the review of literature. Finally, I describe how the curriculum was implemented on a day-to-day basis.

Context

..meaning is contextually grounded… Elliot G. Mishler

The Community of North Kohala

Ua mau ke ea o ka ʻāina i ka pono.
The life of the land is perpetuated in righteousness. Hawai'i State motto

This is the land of King Kamehameha, the determined lonely one who did not give up and who approached challenge sure in this knowledge that he would always win. The Hawaiians planted kō and hala in their land named Kohala. While hala provided leaves for mats and sails, kō, sugar cane gave sweetness. Sophia Schweitzer

The Discovery Garden located in the Kohala Elementary School campus in Kapaau, North Kohala, Hawai'i, is open to all students of the Kohala School Complex, and North Kohala community. This garden is a manifestation of a dream for reviving agriculture in North Kohala

voiced by the principal of the Kohala Elementary School, Danny Garcia, and shared by many members of the community including a senior administrator of the school. Kohala farmers once grew enough produce to feed all the area residents, but now, like most of Hawai'i, the residents are dependent on food imports (Schweitzer, 2003).

The following is taken from the 2008 North Kohala Community Development Plan (NKCDP):

> Kohala has a long agricultural history, from the days of Kamehameha I in the 18th Century, to the more recent sugar plantation days, which ended in the 1970s. The Kohala community was largely food self-sufficient until recent decades. They have been producing their own food by growing crops, ranching, fishing, and sharing with one another. Although it is more difficult to continue this tradition today, many residents are doing so, and would like to support and encourage such activities…In the long-run, the Kohala community would like to work towards producing at least 50% of the food it consumes. (p. 34)

To meet the goal stated above, the community has adopted several strategies in the NKCDP including, Strategy 1.5: Establish Agricultural Education Programs. Thus, the community of North Kohala is very invested in the Discovery Garden project. Their support is manifested in several ways including sending a community representative to Discovery Garden Talk Story (discussion) meetings, promoting and attending garden volunteer workdays, helping to solicit and procure resources such as fencing and garden tools for the project, donating supplies and tools, and providing promotional space in the local newspaper (field notes, 2010 – 2011).

The School

He aupuni palapala ko'u; o ke kanaka pono 'oia ko'u kanaka.
Mine is the kingdom of education; the righteous man is my man.
Uttered by King Kamehameha III

Kohala Elementary School serves children in pre-Kindergarten (ages 3-4) through Grade 5. During the 2010-2011 school year, there were 387 students enrolled. There are 19 regular education homerooms, and 6 special education (SPED) classes. The population of SPED students makes up 16.7% of the student body. North Kohala is a rural area, and the State is currently facing an economic downturn. The number of students on the free and reduced lunch program made up 67% of the total population in 2010-2011, up from 54% from the 2009-2010 school year.

This school has instituitionalized *pono* (uprighteousness) as a behavioral norm. A powerful value found in Native Hawaiian culture, *pono* may be the highest compliment a child can receive at Kohala Elementary School (D. Garcia, personal communication, September 2010). All over the state, Pono in School Campaigns are being launched as an antidote to bullying, school violence, and racism (R. Golden, personal communication, February 18, 2011; Growing Pono Schools, 2011). All over Kohala Elementary School, in classrooms, walkways, bathrooms, the cafeteria, and the school office are posters and signs promoting *pono* behavior and listing ways to demonstrate such behavior. The principal, Danny Garcia (personal communication, September 2010), truly believes that by having *pono* as a consistent behavior expectation, the students (and teachers) will develop to be productive and healthy citizens, and that the occurrences of disruptive, violent, disrespectful and dishonest behavior will decrease. *Pono* is also a commonly shared value by most of the North Kohala community (R. Watterson, personal communication, December 2010).

Schools that fail to make *adequate yearly progress* (AYP) for five consecutive years under No Child Left Behind (NCLB) must be *restructured* (Hawai'i State Department of Education, 2010, p. 5). In Hawai'i, restructuring is an attempt to apply focus, data, and expertise in a challenging state environment by encouraging the use of diverse providers (F. M. Hess & Petrilli, 2006; F. M. Hess & Squire, 2009).

Kohala Elementary School began the restructuring process in the Fall of 2010. The State of Hawai'i Department of Education contracted with an external independent diverse provider, Edison Learning, to drive the restructuring effort at Kohala Elementary School. The organization conducted monthly testing in mathematics and language arts in all the Grades One through Five. Using the data collected from these tests, the Edison Learning consultants worked with the leadership and faculty of the school to modify and create teaching and learning strategies that would enable higher academic achievement of students, so that the school would meet Hawai'i State mandated progress goals (Edison Learning, 2011).

The leadership of the Kohala Elementary School and the Edison Learning consultants was very interested in the development of the Discovery Garden-based pedagogy as a teaching strategy to help meet academic achievement and student learning goals. The principal and Edison consultants, namely the lead consultant Jane Colson, provided me with data from the monthly Edison tests and quarterly Hawai'i State Assessment (HSA) tests, which I used to help determine the school garden curriculum for all the classes and for the interdisciplinary, STEM-focused Gifted and Talented program.

The principal of Kohala Elementary School, Danny Garcia, was also particularly interested in understanding the effect and impact of the Discovery Garden program on his students meeting the six Hawai'i GLOs.

The State of Hawai'i Department of Education (n.d.c.) had three strategic goals for the years 2008-2011:

1. Improve student achievement through standards-based education,
2. Provide comprehensive support for all students, and
3. Continuously improve our performance and quality. (p. 11)

Objective 1.3 of Goal One is to "Increase the percent/number of elementary school students receiving a "usually" or "consistently" rating on all GLOs at the end of the school year" (p. 14). According to the State of Hawai'i Department of Education 2009 Superintendent's 20th Annual Report, 56% of elementary students received the desired ratings (p. 14). The faculty and school counselor at Kohala Elementary School use a grade appropriate rubric based on recommendations by the State of Hawai'i Department of Education to evaluate how their students are meeting the GLOs. For the school year 2009-2010, the school did not meet the annual benchmarks for the GLOs set by the DOE.

The faculty members at Kohala Elementary School are mostly experienced educators. More than 80% have been teaching for than 10 years, and four of the faculty members have been at the school since the early 1970s. Only one Kohala Elementary School teacher in 2010-2011 was a first year teacher. Only two of the full time faculty members, and one administrator live someplace other than North Kohala. The faculty and staff were integrated fully into the North Kohala community, serving on community committees, attending sport events, and volunteering at various local events and campaigns (D. Winters & H. Fernandez, personal communication, January 4, 2011). At least three faculty and/or staff members showed up for the Discovery Garden volunteer workdays. For the principal, Danny Garcia, all the above was a strong

indication of the commitment of his faculty and staff to the school and to the school garden program (personal communication, February 26, 2011).

The Discovery Garden of Kohala Elementary School

Ne huli ka lima in luna, pololei ka opu; Ne huli ka lima i lalo, piha ka opu.
When your hands are turned up, your belly will be empty; When your hands are turned down (to the soil), your belly will be full. ʻŌlelo Noʼeau

It's good to work with the plants.
Weeding.
Sunny.
Itchy.
Carrots.
Work is good for plants.
Fun.
A gazillion times fun.
Awesome.
Taro.
Fun.
Mud.
Weeding.
Digging.
Teamwork.

A poem by First Graders, collectively created January 27, 2011.

In September 2010, the Discovery Garden at Kohala Elementary School Talk Story group which included the principal of Kohala Elementary School (KES), a KES faculty member, a Kohala Middle School representative, one Kohala High School faculty member, a school parent, at least one community member, and myself collaboratively created this working vision of the Discovery Garden of Kohala Elementary School:

The Discovery Garden will produce healthy produce and healthy, contributing citizens.

The mission of the Discovery Garden is: To teach in an exploratory manner, sustainable agricultural practices, the STEM subjects, wellness and nutrition, and pono (uprighteousness) behavior in the setting of a school garden.

The objectives of the 4.0-acre Discovery Garden were:

1. To support academic achievement;
2. To be an avenue to teach *pono* (uprighteous behavior), wellness and nourishment, mind/body engagement, food eating and making;
3. To be involved in place making by interacting with nature and in the garden;
4. To build community; and
5. To meet the GLOs of State of Hawai'i Education Department, for students to become:
    a. Self-directed learners,
    b. Community contributors,
    c. Complex thinkers,
    d. Quality producers,
    e. Effective communicators, and
    f. Effective and ethical users of technology.

Using the principal's vision, borrowing from best practices of other successful garden programs, and including the calculation of continued community support, I created a draft of a 5 year plan for the Discovery Garden. This plan supports the development of the school garden as curricular, physical and social learning environments, and enabled us to prioritize and effectively manage the projects.

The school year 2010-2011 of the Discovery Garden program was the pilot year. It was dedicated to learning how to garden, to develop fully each grade's garden plot, and to build up the infrastructure systems such as irrigation, composting, tool use and storage, and a protected outdoor meeting space. At my first introduction to the faculty, I asked the faculty to think about their vision or ideas of the function of the school garden, and which academic benchmarks I could help to meet through garden activities and lessons. Some homeroom teams asked to meet

with me, but most teams met and discussed their vision about the school garden without me. After their meetings, they emailed me their thoughts and benchmark ideas. Their data and information helped me to design the following for the 2010-2011 school year:

Grade One: Senses garden to teach scientific inquiry and observation;

Grade Two: Butterfly/insect garden to teach biodiversity and unity;

Grade Three: Vegetable garden to teach life cycles and interdependence;

Grade Four: Hawai'ian subsistence plants – taro and sweet potatoes to teach science, technology, and society; and

Grade Five: Pizza Gardens to teach circular geometry and heredity.

Once we had these ideas agreed upon by the team and the principal, garden classes began.

Pedagogy of Food

Are soil, food, gardens, and water the most effective gateways to the next phase of social and pedagogical engagement the result of which will not only be deep but also delicious?

Pramod Parajuli

Sustainability contains the word *'āina* (land or that which feeds), which contains the root word *'āi* (food).

What would happen, for example, if we were to start thinking about food as less of a thing and more of a relationship?

Michael Pollan

In this section, I will synthesize the conceptual framework concepts, learning garden principles, and the four assumptions I have about education presented in the previous chapter into a pedagogical philosophy, I call the *Pedagogy of Food*. This pedagogy was used to develop the interdisciplinary standards-based school garden curriculum. There are four pedagogical principles that guided my creation of the curriculum:

1. The curriculum is consciousness appropriate – humans eat from liquids to solids.

2. The curriculum is situated in the structural-development theory framework – you are what you eat.
3. The curriculum is food, place, and relationship based – you eat what you are.
4. The curriculum provides for the realization of the dimension of time – slow food, slow school.

Figure 2. Pedagogy of food principles.

Curriculum is consciousness appropriate and curriculum is situated in the structural-development theory framework

The child development and learning theories were reviewed in the preceding Literature Review chapter. In brief, children in elementary school can best learn from concrete, connective, nature-based, and imaginatively presented experiences. Elementary school children, ages approximately 6-11 years old, construct knowledge and values through active involvement with

the physical and social world. They do not yet have the capacity to understand or conceive the abstract world. Only around ages 11-12 a child can begin to reason and conceptualize, and grasp abstract ideas and lessons. The ability to reason abstractly is based on the development of the natural values of humanistic, symbolic, aesthetic, and knowledge which happens during the ages of 6 to about 11 years old (Piaget, 1954; Steiner, 1982, 1996b)

I designed a curriculum that contained projects, activities, and experiments to be conducted by the students with the understanding of the stages of development and consciousness of the third, fourth, and fifth grade students. The curriculum is experiential-, place-, and project-based with concrete, relatable activities in which the children could be wholly involved. An example of an activity/lesson that is developmentally appropriate and structural-developmentally based, as captured in my field notes follows:

> The study of living soils is the first theme of the curriculum. The students observed closely the soil in the school garden. They used all their senses in their observation. They looked at the soil, shook it and listened, smelled and felt the soil, and they even tasted it, behind my back when they thought I was not looking. Then they ran simple soil analysis tests. They measured the pH of the soil, and soil moisture content, and they used simple soil test kits to determine nutrients in the soil. We sent soil samples to be tested in the University of Hawaii at Manoa labs, and the students *Skyped* with the graduate assistant who conducted the tests. They watched him conduct soil tests and asked many clarifying questions. Based on their observations, the soil analysis results, and input from soil health research they conducted, the students added soil amendments to an area of the garden, leaving area another untreated. The students planted the same seeds in each section on the same day and at the same time, and observed the plants' germination, growth, and health.

They compared and contrasted the plants in the two sections and drew conclusions about the health of the plants based on what they had actually experienced and done.

The curriculum I created also addressed two assumptions: that being in nature and developing a sense of place is an essential core of children's lives, and that learning is as diverse as the learners - everyone can learn, but not always in the same capacity or context or rate. The students were encouraged to engage their five senses, thinking processes, communication skills, and to manipulate technological devices. The many different learning situations ensured that all the students could participate in some way or form during the activity/lesson. The students learned to nurture the soil and provide for the soil through soil chemistry and adding amendments. The enthusiasm at which they tackled the task spoke to feeling that they enjoyed and loved being in the space of the school garden. The curriculum designed around the two pedagogical principles stated above also incorporated two Learning Garden principles from Williams and Brown (2012), that of cultivating a sense of place and awakening the senses.

Curriculum is food, place, and relationship based

Kirschenmann (2008), in his article *Food as Relationship,* urged readers to understand that "food is not an isolated thing—a mere commodity comprised of a list of ingredients or the numbers on a nutrition facts panel. Food always becomes part of the ecology from which it is produced" (p. 108). It has been found that food-based learning within a school garden program supports the development of the students' relationship with food and ecology. A study conducted at Texas A&M University demonstrated that students involved in a school garden program had more positive attitudes toward fruit and vegetable snacks and an improvement in vegetable preference scores (Lineberger & Zajicek, 2000). Similarly, a study conducted by Ratcliffe (2007) at two sites in the San Francisco Unified School District indicated that:

> gardening influenced factors that may predict or affect children's vegetable consumption, including improved recognition of, attitudes toward, preferences for, and willingness to taste vegetables. Gardening also influenced factors associated with vegetable consumption, including increased variety eaten as measured by self-reported monthly consumption, and consumption of different vegetable varieties at school. (p. v)

School garden programs such as *The Edible Schoolyard* at Martin Luther King Middle School, Berkeley, California, and *The Garden of Wonders* program at Abernethy Elementary School, Portland, Oregon, that focus on food as the core component of their curriculum, also report school-wide success in affecting healthy food choices, including choosing fruits and vegetables to eat during school lunch (Parajuli et al., 2008; Rauzon et al., 2010; Williams & Brown, 2012).

The work of the school garden educators mentioned above complement my personal belief and experience that it was logical and natural to have a school garden curriculum be themed around food, and then to tie that theme into ecology, science, mathematics, and culture. For example: taro or kalo is a staple food of Hawai'i, and is central to the Native Hawai'ian creation story. The following is adapted from the traditional Hawaiian mo'olelo (story) retold by the Hawaiian Studies kumu (teacher) at Kohala Elementary School:

> They say that Papa Honomaku, the Earth Mother and Wakea, the Sky Father came together and gave birth to a beautiful girl named Ho'ohokukalani, the stars. Ho'ohokukalai and Wakea came together to create a child who was born premature and alu`alu, watery or deformed. They named the child Haloa Naka Lau Kapalili, and buried it into the ground, and after Ho'ohokukalani wept upon the grave the kalo plant sprung forth. Wakea and Ho'ohokukalani came together again and created their second child, the

> strong baby boy also named Haloa. The kalo in the earth became the sustenance for the younger brother Haloa the Man, and the genealogy of the Hawai'ian people was forever linked to the sacred kalo.

To launch our study of the *botany of food*, a unit designed to be taught for 3-4 weeks, the students asked several elders of the Kohala Elementary School community how to plant taro. The following is taken from my field notes (spring 2011).

> There were two different ways suggested. Several elders suggested planting the taro in trenches, so that the plant could grow out and up. Other elders said that since taro is primarily a root crop, it should be planted in mounds, so that the root could grow down into the hump. So, the students created two different taro patches of the same size. In the first patch, the taro was planted in trenches, and in the other patch, the taro was planted in small mounds. Both patches were planted from the same stock four days apart, and treated with the same soil amendments, and provided equal volume of water. When students harvested and weighed the taro, they found very little difference in size, shape or weight of the taro corm (root). Several homeroom teachers and I speculated that the students treated the plants in each patch so carefully and fed the plants so much organic compost that the plants just responded positively to the attention regardless of the type of planting system. Two parents and one grandparent prepared the taro for the classes to eat for lunch four days following the harvest. There was enough to feed more than 60 students and five adults. This activity exemplifies how the curriculum was place-based, depended on relationships, and resulted in delicious food.

What I realized from my observations is eloquently described by Charlton (1977) who wrote:

> Any curriculum which is devised as a result of theorizing must include a component which helps sensitize as person first of all to his own past, and then to the past of others…he includes the factor of time in his model [of curriculum] – he builds change into it…[his] theory is relevant to a particular kind of social situation…in which change is considered to be a good thing. (pp. 84-85)

The activity described above can exemplify what Charlton so eloquently stated. The food, place, and relationship based pedagogy of food incorporates the Learning Garden principles of cultivating a sense of place, nurturing interconnectedness, and valuing biocultural diversity. This pedagogy also honors that learning causes change and that "change is considered to be a good thing" (Charlton, 1997, p. 85).

Curriculum provides for the realization of the dimension of time

The structural-developmental theory of learning supports the assumption that children do not all learn at the same pace. The time dimension is an important principle of the pedagogy. The following is a short depiction by Gatto (1992) of a context where time is mechanized and individual learning pace and abilities are not honored. The setting is an industrialized school system run by bells that denote small chunks of time in which all learning is supposed to take place. Gatto described a carefully and thoughtfully planned lesson, and his students enthusiastically receiving his instruction:

> But when the bell rings, I insist they drop whatever it is we have been doing and proceed quickly to the next workstation. They must turn on and off like a light switch. Nothing important is ever finished in my class nor in any class I know of…Indeed, the lesson of bells is that no work is worth finishing, so why care deeply about anything? Years of

> bells will condition all but the strongest to a world that can no longer offer important work to do. (p. 6)

The pedagogy of food model posits that we all need time to observe, to reflect, to compare and contrast, to engage deeply, to slow down. M. Holt (2005) in his essay *The Slow School*, and Payne and Wattchow (2008*), Slow Pedagogy and Placing Education in Post-Traditional Outdoor Education* both discuss *slow pedagogy.* Payne and Wattchow wrote, "slow pedagogy [acts] as a primacy of experience and the 'growth' required in fostering a secondary, deep reflection about the organism-environment interaction, and human nature of experience" (p. 36).

M. Holt's (2005) *The Slow School*, "attends to philosophy, to tradition, to community, to moral choices…the students have time to understand not just memorize...the school must be contextualized – it must understand its community, socially and politically, and work with it…and less [coverage] is definitely more" (pp. 59-61).

> Learners, especially in school settings, are often faced with tasks that do not have apparent meaning or logic. It can be difficult for them to learn with understanding at the start; they may need to take time to explore the underlying concepts and to generate connections to other information they possess…Providing students with time to learn also includes providing enough time for them to process information (Bransford et al., 2000, p. 58).

Time must be factored into the curricular, physical and social environment of school gardens based education. The plants in the school garden cannot be rushed into germinating and growing, and neither can the fruit such as cucumbers, pumpkins, or corn be hastened into ripening. So it is with the children. They too cannot be rushed into learning concepts no matter

how appropriate the teacher deems it to be. Time must be given to foster curiosity and wonder, to embrace practical experience, and to discover rhythm and scale (Williams and Brown, 2012). The pedagogy of food employs time in the garden for the children to discover, explore, play, reflect, and work.

The Curriculum

E kuhikuhi pono i na au iki a me na au nui o ka ʻike.
Instruct well in the little and the large currents of life. ʻŌlelo No'eau

In teaching, do it well; the small details are as important as the large ones (Pukui, 2004, p. 40).

An ideal curriculum is one in which maximum coherence is achieved, and segmentation is minimized. Phillip Phenix

The design and framework of curriculum development for the Kohala Elementary School Gifted and Talented Program for third, fourth, and fifth graders was based and built on what I understand and know about how children learn, my current experience with Hawaiian epistemology, my experience teaching in school gardens, the Pedagogy of Food, Williams and Brown's Learning Gardens principles, Ratcliffe's Model of Garden-Based Education, interdisciplinarity, and current understanding of the six GLOs. Elements of the project were also taken and adapted from the work of the Learning Gardens of Portland Public Schools in Oregon (Parajuli et al., 2008), The Edible School Yard program (Murphy, 2003; Waters, 2005), and the Center for Ecoliteracy (Stone, 2009). I also drew from Williams and Dixon (in review), who synthesized research between 1990 and 2010 on the impact of garden-based learning on academic outcomes. They used the following as criteria for rigorous garden programs:

- there was structured garden-based curriculum;
- academic outcomes were measured and linked with subjects;
- intervention consisted of a minimum of an hour at least every two weeks;

- there was intentional connection with subject standards; and
- assessment tests were specific to the age-group being studied.

It was very important to the administration of Kohala Elementary School that the school garden curriculum include a strong STEM emphasis. This was in response to recent research that has brought the need for comprehensive STEM education into clear focus for educators at all levels. President Barack Obama launched *Educate to Innovate*, a campaign to improve the participation and performance of America's students in STEM, on November 23, 2009. As part of this national imperative, teachers *must* engage elementary and middle school children in becoming problem solvers, innovators, inventors and logical thinkers eager to master STEM subjects now and as they move into high school, college and careers. According to the Bayer Report on Science Education (2004), 38% of teachers in elementary classrooms lack full confidence in their qualifications to teach science. Almost as many say that they rely more on what they learned in high school science than on what they learned in their teacher preparation courses in college.

In the September 2010 publication, *Report to the President: Prepare and Inspire K-12 education in Science, Technology, Engineering, and Math (STEM) for America's Future*, the Presidents' Council of advisors on science and technology stated that:

> It is important to note that the problem is not just a lack of *proficiency* among American students; there is also a lack of *interest* in STEM fields among many students. Recent evidence suggests that many of the most proficient students, including minority students and women, have been gravitating away from science and engineering toward other professions. Even as the United States focuses on low-performing students, we must

> devote considerable attention and resources to all of our most high-achieving students from across all groups. (p. vi)

The council continued by admitting that they are troubled by the pervasive lack of interest in STEM subjects as well as the mediocre test scores. They noted that even schools that are generally successful often fall short in STEM fields. Thus the problem must be addressed with systemic solutions. A huge part of the problematic system which must be addressed is teacher development. The council concluded that schools often lack teachers who know how to teach science and mathematics effectively, and who know and love their subject well enough to inspire their students. These teachers lack adequate support, including appropriate professional development as well as interesting and intriguing curricula. Schools also lack tools for assessing progress and rewarding success.

The council also addressed the point that the United States lacks clear, shared standards for science and math that would help all players in the system set and achieve goals. As a result, too many American students conclude early in their education that STEM subjects are boring, too difficult, or unwelcoming, leaving them ill-prepared to meet the challenges that will face their generation, their country, and the world (Presidents' Council of Advisors on Science and Technology, 2010, p. vii).

STEM education is most successful when students develop personal connections with the ideas and excitement of STEM fields. This can occur not only in the classroom but also through individualized and group experiences outside the classroom and through advanced courses. The school garden-based education program seemed to be a perfect fit for the GT program as the garden can provide curricular, physical and social learning environments conducive to learning STEM topics and subjects in an experiential, multidisciplinary way.

I used the above literature and experience to develop and create the interdisciplinary standards-based school garden curriculum which included STEM topics, was experiential, place-, relationship-, and project-based, and linked to specific subjects and their standards. It was written mainly for fourth and fifth graders, and is adaptable for students younger (Kindergarten through third grade) and slightly older (sixth and seventh grade). This interdisciplinary standards-based school garden curriculum will also integrate topics and subjects from agriculture, language arts, fine arts, Hawai'ian culture and history, and geography, and is linked to several specific standards of those subjects.

The objectives of the interdisciplinary standards-based school garden curriculum are to:

1. Teach the six GLOs.
2. Provide opportunities and settings for the learning of the six GLOs.
3. Support the students' continued development and demonstration of the six GLOs.
4. Reinforce lessons, skills, and knowledge of STEM subjects.
5. Reinforce and integrate standards-based knowledge and skills of science, mathematics, social studies and language arts disciplines.

To meet the above objectives, the curriculum design integrated several components such as:

1. The six Hawai'i GLOs, which include the progressive personal and social development of the student.
2. Science, Math, Social Studies, and Language Arts content of each grade.
3. The gardening skills and knowledge appropriate for each grade.
4. The seasonal cycles of the garden and the natural environment.
5. The cyclical nature of community activities of the school and neighborhood.

The daily lessons in the garden will have five major components, framed on the understanding of how children learn:

1. Observation using senses and capacities.
2. STEM in the garden – a topic related to what is being taught in the third, fourth, and fifth grade homeroom classes.
3. Garden jobs – time spent using the STEM skills discussed to execute garden tasks, such as building compost heaps, creating garden beds, weeding, fertilizing, seed saving, harvesting, etc. This component also supports the development of personal and social skills such as cooperation, problem solving, systems thinking, leadership, communication, and quality production.
4. Language Arts in the garden – garden journals, letter writing, speeches, descriptive writing, poetry, drama, based on the topic presented, garden observations, and/or garden jobs.
5. Culture in the garden – a story or activity that will invite a deeper connection and relationship to the context, such as a Hawai'ian myth, art and drawing, and/or cooking.

The content and activities of the school garden lessons are based on homeroom teacher requests and suggestions, Hawai'i state benchmarks, and community connections. The third, fourth, and fifth grade homeroom teachers at the Kohala Elementary School were surveyed in late December 2010 and early January 2011 to gather information on benchmarks and class topics/themes. They were asked to provide information about the following:

1. Science, Math, Social Studies, and Language Arts benchmarks they know students have had challenges meeting and understanding;
2. Topics/themes that they planned to teach each quarter of the school year; and

3. Personal and social skills their students could benefit from learning.

From the survey, the following topics within STEM subjects and skills became clear:

1. Science: Foundations of Life – soil, water cycle, solar energy;
2. Science: Relationships – plant-insects, plant-human, ecology;
3. Botany: Parts of plants;
4. Science Vocabulary;
5. Math: Graphing, application of measurement formulas (eg. how to find area and volume);
6. Life skills:
    a. Cooperation,
    b. Leadership,
    c. Follow-through,
    d. Responsibility, and
    e. Creative problem solving.

There were also important systems that needed to be placed in the Discovery Garden for the sustainability of the garden program. These were based on observations of the garden teacher, local expert gardeners and farmers, engineers, the faculty and staff of the Kohala Elementary School, parents and community of the Kohala Elementary School. These systems included an irrigation/water catchment system using water off the school roof; a self-containing renewable solar electrical system for the garden to run water pumps, and electrical equipment such as laptops, digi-probes and microscopes in the garden; soil fertility – a composting area; plant nursery for starts and transplants; and an animal husbandry system for the raising of fowl, pigs, and goats.

The lessons were developed using the information from the homeroom teachers, and incorporated the creation and installation of the systems necessary for the sustainability of the garden. The curriculum was divided into broad themes, based on seasonality, on benchmark sequencing as developed by the State of Hawai'i Department of Education, and on homeroom teachers curricular sequencing.

Sometimes the lesson planned is thrown out when a student draws the class' attention to something interesting and exciting in the garden previously unnoticed. Being a structural-developmental/constructivist based educator allows me to use what seems pertinent to the children and class for that moment.

A crucial element of a thoughtful garden program is that there is something for everyone to do. From the detailed oriented to the action motivated. A. Rieux (personal communication, April 2011), Garden Teacher at a neighboring district, said, "Helping students find their place in the garden may help them find their place in whatever that is they choose to do in life." There are six basic tasks in the garden, with many variations within them:

1. Composting and soil fertility,
2. Garden bed preparation and maintenance,
3. Planting,
4. Weeding,
5. Organizing and cleaning the outdoor classroom, tool shed and nursery, and
6. Harvesting.

Each task has specific tools associated with them for efficiency and optimal results. The children rotated through all the tasks, learning proper use of tools, and the skills to do the work.

The closing moving poem was a crucial reflective and evaluative component of the program. After all the tools are put away neatly, the children gather in a circle in the outdoor classroom. They think of a word or phrase that will describe either or a combination of what they did in the garden, how they felt, and/or what they learned. A sample is included at the beginning of this section. I paid close attention to not only what is said, but also who said it. These poems were recorded in the field notes for the day.

Table 2 is a sample of the curriculum.

Table 2

Discovery Garden Program Curriculum for Gifted and Talented Class

<table>
<tr><td colspan="4">Fall 2011–seasonal and evolving. Goal: Prepare the new intergenerational heritage garden for use by Kohala Community tutus and kapuna, and for Ethnic Gardens</td></tr>
<tr><td colspan="4">August/Sept. Organizing Theme: Living Soils</td></tr>
<tr><td>Grade</td><td>Specific focus</td><td>Science and Math Standards
Social Studies</td><td>GLOs</td></tr>
<tr><td>3</td><td>Using the five senses, develop a hypothesis based on observations</td><td rowspan="3">Standard 1: The Scientific Process: SCIENTIFIC INVESTIGATION: Discover, invent and investigate using the skills necessary to engage in the scientific process.

Standard 4: Measurement: FLUENCY WITH MEASUREMENT: Understand attributes, units, and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring.

Standard 6: Cultural Anthropology: SYSTEMS, DYNAMICS, AND INQUIRY-Understand culture as a system of beliefs, knowledge, and practices shared by a</td><td rowspan="3">#1: Self-directed learner

#3: Complex thinker

#6: Ethical and effective use of technology</td></tr>
<tr><td>4</td><td>Using the five senses, develop an experiment to test hypothesis based on observation</td></tr>
<tr><td>5</td><td>Using the five senses, identify variables within the experiment</td></tr>
</table>

		group and understand how cultural systems change over time. Culture: Who am I – What is race? What is nationality? What is ethnicity?	

Observations	**Lessons**	**Tasks**
Touch, smell, look, listen closely at soil. What lives ON the soil? IN the soil? Dry soil/wet soil – compare & contrast Hard soil/soft soil What is culture? How is that revealed in what we do in Kohala?	What makes up soil? Living and nonliving content. How to care for soil? Simple soil test. Complex soil test. Soil water content analysis. How to use tools such as soil probes, microscope, pH meter. Exploring own ethnicity and culture.	Soil amendments. Compost pile building. Collect soils for soil test. Start seeds, planting. Soil tests – content and water. Mulching paths. Microscope use to look at soil. Interviews of kapuna/tutu from different ethnicities. Video making.

Sept/Oct: Organizing Theme: *Sun, wind and weather.*

Grade	Specific focus	Science and Math Standards Social Studies	GLOs
3	Sun movement. Wind movement. Develop a hypothesis based on observations.	Standard 8: Physical, Earth, and Space Sciences: EARTH AND SPACE SCIENCE: Understand the Earth and its processes, the solar system, and the universe and its contents. Standard 4: Measurement: FLUENCY WITH MEASUREMENT: Understand attributes, units,	#3: Complex Thinker #2: Community Contributor #5: Effective
4	Sun and earth relationship – daily rotation, annual revolution. How does climate affect geography?		

	Develop an experiment to test hypothesis based on observation.	and systems of units in measurement; and develop and use techniques, tools, and formulas for measuring. Standard 7: Geography: WORLD IN SPATIAL TERMS-Use geographic representations to organize, analyze, and present information on people, places, and environments and understand the nature and interaction of geographic regions and societies around the world.	communicator
5	As above Grade 4 include Earth orbiting the Sun. Identify variables within the experiment.		

Observations	**Lessons**	**Tasks**
Where does the sun rise/set? How fast does the wind blow and which direction? How has the weather been recently? Compare/contrast shady part of garden with sunny part. How does climate affect geography? And vice versa?	Nature runs on sunlight. All our food comes from the sun, as does our energy. Plants depend on sun – how? The four directions – North, south, east and west. Sun orbit patterns. Geography – mapping of place GPS Google Earth	Mapping – 2D and 3D GPS mapping Google Earth Use maps to design ethnic gardens Begin collecting seeds and plants for those gardens Start seeds Continue to prep the Intergenerational Heritage garden Slide show. Video.

Oct/Nov: Organizing Theme: *Water and structure.*

Grade	Specific focus	Science and Math Standards Social Studies standard	GLOs

3	How do these structures keep living things alive?	Standard 4: Life and Environmental Sciences: STRUCTURE AND FUNCTION IN ORGANISMS: Understand the structures and functions of living organisms and how organisms can be compared scientifically. Standard 9: Patterns, Functions, and Algebra: PATTERNS AND FUNCTIONAL RELATIONSHIPS: Understand various types of patterns and functional relationships. Standard 2: Historical Understanding: INQUIRY, EMPATHY AND PERSPECTIVE– Use the tools and methods of inquiry, perspective, and empathy to explain historical events with multiple interpretations and judge the past on its own terms.	#2: Community Contributor #5: Effective communicator #6: Ethical user of technology
4	Plant and animal structures.		
5	Human structures.		

Observations	**Lessons**	**Tasks**
Which plants feel wet/dry? Where do plants store water? How does water travel in a plant? What is the difference a rock and plant? How does water flow? How does water affect/change the geography and culture of a place	No Water, No Life. Why and how we need water. How water travels in a plant, animal, humans. Irrigation system – how it works Plant cell/Animal cell – compare & contrast. Water and culture.	Design and install irrigation system of Heritage garden. Continue creating beds and gardens. Composting. Mulching.

such as Kohala?	Ahu pua'a. Wai/a'ina.	Reports on water.

Nov/Dec: Organizing Theme: *Botany.*

Grade	Specific focus	Science and Math Standards Social Studies	GLOs
3	How do animals depend on plants? And vice versa.	Standard 3: Life and Environmental Sciences: ORGANISMS AND THE ENVIRONMENT: Understand the unity, diversity, and interrelationships of organisms, including their relationship to cycles of matter and energy in the environment. Standard 11: Data Analysis, Statistics, and Probability: FLUENCY WITH DATA: Pose questions and collect, organize, and represent data to answer those questions. Standard 1: Historical Understanding: CHANGE, CONTINUITY, AND CAUSALITY-Understand change and/or continuity and cause and/or effect in history.	#3: Complex Thinker #2: Community Contributor #4: Quality Producer
4	Explain how simple food chains and food webs can be traced back to plants.		
5	Describe the cycle of energy among producers, consumers, and decomposers.		

Observations	**Lessons**	**Tasks**
Parts of plants – start with roots and move up every week or two. Look for flowers, seeds, fruit.	Root structures and function. Leaf – veins. Photosynthesis.	Planting into heritage garden. Garden maintenance. Reports on tasks.

Fungi. Plants and culture. You eat who you are.	Plant life cycle. Seeds – covered or gymnosperm (naked). How do seeds travel? Flowers – simple/complex. Decomposers – fungi are fun guys ;-) Energy cycle.	Mini-STEM Fair

Implementing the Curriculum in the School Garden-Based Program

The protocol of the Gifted and Talented school garden-based program is as follows:

1. Chant *Oli* (Hawaiian chant) to ask permission to enter.
2. Enter the garden in a pono manner.
3. Gather at a designated area.
4. Garden teacher provide a theme/idea for observation, e.g., look for insects, how are leaves arranged, sounds you hear, soil texture, etc.
5. 2 minutes of silent observation, students should be 10 feet away from each other in the garden.
6. Gather back for discussion of observation.
7. Lesson of the day.
8. The garden teacher will explain garden jobs and other projects– digging, weeding, composting, planting, seed collecting, plant labeling, garden art projects, design projects, etc.
9. Jobs and projects.
10. Provide 5 minute warning to end time.
11. Put tools and materials away neatly.

12. Gather for closing circle – recapitulate the mini-lesson and open sharing.
13. Moving poem – say a word of phrase that will express your feelings about the garden, or what you did or learned.
14. Exit in a pono manner.

The thematic, subject and standards linked lesson of the day followed the curriculum as presented in Table 2. After the first month of class, pairs of students chose garden-related topics or areas in which to be an expert. Students borrowed books from the school and public libraries, looked up topics on the Internet, and asked local experts. Students applied their knowledge in a project and presented their experience at a *Ho'oike* mini-STEM fair, which was modeled after School Science Fairs, at the end of the semester (see Table 3).

Table 3

Several Student Expertise Projects

Student	Area(s) of interest	Project	Team
A–male, fifth grade B–male, fourth grade	Soil Science	Improving soils of the Discovery Garden through understanding soil needs, composting, crop rotation, and nitrogen fixing plants.	Pedology
C–male, fifth grade D–male fifth grade	Insects	Encouraging beneficial insects in the garden by planting the optimal plants	Entomology

E–female, fifth grade F–female, fifth grade	Medicinal Plants Useful plants Plant diseases Weeds	Create a chart for K – 3 grades to use to identify medicinal plants and weeds at the Discovery Garden Experiment with organic cures for plants diseases such as powdery mildew on squashes	Ethnobotany
G–female, third grade H–female, third grade	Student Run Farmer's Market Irrigation	Create a student-run farmer's market. Design and install irrigation system to the garden area.	Market
J – female, fifth grade K – female, fifth grade	Orchard Irrigation	Design and install irrigation system to the orchard area. Select trees for the school orchard based on interviews with local farmers, and research.	Water
L–female, fifth grade M – male, fifth grade	Native Hawai'ian plants	Create a chart of the Native Hawai'ian plants in the garden and their uses.	Hawai'i
P – female, fourth grade Q – male, third grade	Plants of European origin	Select culturally important plants. Design and create a Europe garden bed.	Ethnic studies
R – female, fourth grade S – male, third grade	Plants of Filipino origin	Select culturally important plants. Design and create a Philippines garden bed.	Ethnic studies

The six GLOs were implicitly taught in the school garden activities and content lessons. Meaning, I did not introduce the GLO as the lesson of the day. Instead, I created opportunities

for the students to engage in the process during the activity. At the end of class, I pointed out to the students how they demonstrated the GLOs while they were in the school garden.

Summary

This interdisciplinary standards-based school garden curriculum is grounded on localized knowledge, strives to be contextually and culturally appropriate, addresses stages of child development, integrates learning principles, weaves several subjects in at the same time, and is intentionally connected with standards. Students are supported to pursue individual interests when studying the school garden, thus providing a wider range of knowledge, and contributing energy, excitement and enthusiasm to the class and program. The pedagogy of food provides a foundation for teaching and learning in and around the school garden, and the curriculum teaches content and knowledge through the application of the six GLOs.

CHAPTER IV

METHODS

What we observe is not nature herself, but nature exposed to our method of questioning.
Werner Heisenberg

Research Design

I trust that by now the reader recognizes my assumption that the six GLOs are dynamic processes or skills, not just static ends or outcomes. Thus, this is a study of children learning to process their experiences in a school garden setting. Since I am working on the basis that every student learns differently, a one-size-fits-all method of inquiry will not be appropriate as the only method of inquiry for this study. The methods employed in the design of this study should reflect how I view the world, and should be an appropriate fit with the phenomenon of inquiry.

In the review of literature, I presented the structural-development learning theory, a theory that posits that conceptual understandings and values are constructed through interactions with the physical and social environment, and that in this environment behavioral, personal and environmental influences interact continuously in a reciprocal manner.

As Guba and Lincoln (1998) articulated, the interconnectedness of ontology, epistemology, and methodology create the paradigms in which the world must be addressed. With the above as an organizing system, here are my limitations:

1. Ontology. My position is that there is no single truth or reality; we are constrained by contextually, emotionally and sociality constructed realities, religious and spiritual truths, all intermingled and woven into an in-comprehendible universal reality. The myriad of realities are linked and connected through laws and patterns of nature, and thus realties must be understood in

relationships (Capra, 2005). Relationship of whole/part, of self/other, of gravity/levity, of learning/teaching and so on. Also, since reality is in dynamic flux, our knowledge of any reality or realities will always be imperfect.

2. Epistemology. In my reality, I love to learn and teach. I recognize others who love similarly, and recognize situations and settings where this love is passionately expressed. The school garden is such a space. The "knowing" then has the potential to heal and to create. To heal that which mis-educative experiences may have arrested or distorted (Dewey, 1938), and to create the acceptance of different pathways of knowing such as intuitive, narrative, kinesthetic, or spiritual. Just as the realities of knowing are in a dynamic flux, so are the relationships of knower and the known. Van Manen (1990) stated:

> We can only understand something or someone for whom we care. In this sense of how we come to know a human being, the words of Goethe are especially valid: "One learns to know only what one loves, and the deeper and fuller the knowledge is to be, the more powerful and vivid must be the love, indeed the passion." (p. 6)

3. Methodology. In this study, I did not have the objective distance I became part of the community I was studying. Learning is multifaceted and thus requires a multifaceted look and based in the realities of everyday life, children's world view, and cultural context (Van Manen, 1990, p. 11). "A dynamic participative reality can only be discovered with participative methods; in other words, knowledge is co-created" (Thorp, 2001, p. 36). The learners are just as diverse as the learning, and so the inquirer must attempt descriptions and interpretations of the experience of learning which are deep and delicious.

Having situated myself and established these three fundamental axioms of the structural-developmental paradigm, I hope that the reader can clearly see that the design of this research

study must be a design that is contextually appropriate, dynamic, and open to the unpredictable. Lincoln and Guba (1985) wrote,

> The design must be emergent rather than preordinate: because meaning is determined by context to such a great extent; because the existence of multiple realities constrains the development of a design based on only one (the investigator's) construction; because what will be learned at a site is always dependent on the *interaction* between the investigator and context, and the interaction is also not fully predictable; and because the nature of mutual shapings cannot be known until they are witnessed…the design must therefore be "played by ear"; it must unfold, cascade, roll, emerge. (pp. 208-209)

So how does a design emerge? What Lincoln and Guba (1985) wrote is congruent with the structural-developmental theory, "On site, the investigator must engage in *continuous* data analysis, so that every new act of investigation takes into account everything that has been learned so far" (p. 209). In the emergent design I shift from an orientation of product to an orientation of process, another congruency with my philosophy of education. The naturalistic research design thus is a best fit to the axioms and demands presented.

Interpretation of the Program: Methodology of Formative Evaluation

I am interested in *process*. I believe that the evaluation process must be authentic and can be used not only to evaluate what has been learned and how it has been learned, but also to review knowledge, support knowledge transference, and even to teach new knowledge (Bransford et al., 2000, pp. 63-77; Fiske, 1991, pp. 115-123).

This study was process research. The dynamic interactions between the students and the school garden and the students and the students interested me. Using the GLOs as values of measurement was also a dynamic choice. There is no end to self-directed learning or contributing

to community. It is a process. The study evaluated a situation and impact of curriculum on a certain group of students. I looked for individual changes in each student, how each student changed was measured through the value of the GLOs. The findings, which are presented in the next chapter, reflect an analytical description of the process. The evaluation is thus a formative one. A formative evaluation is an outcome evaluation of an intermediate stage of the teaching instrument (Stake, 1977, p. 388).

Students doing authentic tasks supply valid direction, intellectual coherence, and motivation for day-in and day-out work of knowledge and skill development (Wiggins, 1998, p. 21). An assessment task, project or problem is authentic if it:

1. is realistic,
2. requires judgment and innovation,
3. asks the student to "do" the subject – carry out exploration,
4. replicates or stimulates contexts in which adults are "tested,"
5. assesses the student's ability to efficiency and effectively use a repertoire of knowledge and skill to negotiate a complex task,
6. allows appropriate opportunities to rehearse, practice, consult resources, and get feedback on and refine performances and products. (p. 22)

Thus I studied authentic tasks as they were happening with the understanding that I was evaluating the impact of the curriculum in an exploratory and formative manner. The objective of this evaluation was to gauge the effects of the interdisciplinary standards-based school garden curriculum in this particular setting or case, in hopes to, in the future, implement the curriculum in a wider range of schools. The prospect of a statewide implementation of the curriculum for a summative evaluation will be discussed in the final chapter.

Participant Selection Criteria

Participants in this study were selected based on convenience sampling principles and time spent participating in the school garden-based education program. Convenience sampling is a from of naturalistic sampling based on "informational, not statistical, considerations. Its purpose is to maximize information, not facilitate generalization" (Lincoln & Guba, 1985, p. 202). A naturalistic sample shifts the emphasis from product to process, from breadth to depth, and from bland to delicious. What is important to the researcher in naturalistic sampling is the scope and range of information obtained from the sample, the sampling is "not representative but contingent and serial" (Lincoln & Guba, 1985, p. 224). Parajuli et al. (2008) indicated that 2 hours per week is the minimum amount of time that must be spent in the garden or involved in garden-related activities for measurable effects (p. 6). Students must be given time to experience all the aspects of the garden, and to reflect on the experiences. The GT class is the only class at the Kohala Elementary School that is in the school garden for 2 hours or more each week. Working with this group saved time, money and effort, three characteristics of convenience sampling (Lincoln & Guba, 1985, p. 201).

The Kohala Elementary School Leadership Team used assessment rubrics for Gifted and Talented (GT) programs created by the State of Hawai'i Department of Education (2007, pp. 32-46) to select the GT students. Members of this team include the school principal, school counselor, several teachers, and the Special Services Coordinator staff member. The Coordinator oversees all pullout programs at Kohala Elementary School, of which the GT class is one. Participation in this program was dependent on parental consent, which made it a Tier Three program (State of Hawa'I Department of Education, 2007, p. 22). The number of students identified as GT was 22, however only 20 students found the program to be educative match.

The two students who did not continue in the program did not want to miss their regular class work or be "away from their friends" (personal communication, September 2011). All the 20 students' parents provided consent for their children to participate in the program. Consent forms (Appendix A).

The adults who participated in this study were the nine third, fourth, and fifth grade homeroom teachers, the school principal, the school counselor, the student services coordinator, and four parents/care-givers of the GT students.

The Gifted and Talented Class

The sampling for this project was based on convenience and the length of time spent in the garden. The only class that fit those considerations was the GT class. While being gifted and talented was not a criterion to be in this study, as this was the group conveniently selected, it is important to briefly discuss the concept of being gifted and talented.

The GT program for specifically selected third, fourth and fifth graders used an interdisciplinary, especially STEM focused, standards-based school garden curriculum. The Leadership Team of the Kohala Elementary School selected the students using the following criteria taken from the State of Hawai'i Department of Education (2007) *Program Guide for Gifted and Talented*: standardized test scores, creativity, and leadership potential. The participants were selected without any input from me, and largely based on recommendations by their homeroom teachers, who chose students they felt would benefit from an academically challenging, socially engaging, and physically active program.

These students had scored above a certain point (300 points) on the Hawai'i State Assessment (HSA) exams and thus were eligible to participate in an academically accelerated pullout program. The students did not have to be responsible for the material they missed during

the garden class, as the work in the garden class was deemed a suitable replacement for homeroom class work. The Leadership Team requested that the garden-based curriculum be interdisciplinary with a strong emphasis on STEM. While these students scored *high* on the Hawai'i State Assessment standardized tests (more than 300 points), they did not necessary score *consistently* or *usually* on the GLOs. The GLOs are scored on a 4-point Likert type scale with consistently being 4, and rarely being 1. This class met two times a week, Wednesdays and Thursdays from 10:15 am to 11:15 am for the duration of the Fall 2011 semester at the Discovery Garden of the Kohala Elementary School.

Twenty students were selected:

- Nine fifth graders: 5 females, 4 males.
- Seven fourth graders: 4 females, 3 males.
- Four third graders: 2 females, 2 males.

There was at least one student from each of the nine homerooms. There were three homerooms per grade. There were 2 more females than males. According to the school records, for the 2011-2012 school year, the selected students represented all the major ethnic groups found in Hawai'i including Japanese, Chinese, Filipino, Caucasian, Portuguese, and Puerto Rican, and all students came from low to middle income families. According to a survey conducted by the Student Services Specialist at the Kohala Elementary School in May 2011, school parents were in high favor of programs such as the GT program and general school garden program.

The State of Hawai'i Department of Education (2007) *Program Guide for Gifted and Talented* explained:

The Jacob Javits Gifted and Talented Students Education Act (Javits) was originally passed by Congress in 1988 as part of the Elementary and Secondary Education Act to support the development of talent in U.S. schools. The definition for gifted and talented found in this act is:

> The term gifted and talented student means children and youths who give evidence of higher performance capability in such areas as intellectual, creative, artistic, or leadership capacity, or in specific academic fields, and who require services or activities not ordinarily provided by the schools in order to develop such capabilities fully. (p. 2)

Hawai'i State Definition of Gifted and Talented, Chapter 51:

> Gifted and talented are children and youth whose superior performance or potential indicates possible giftedness in intellectual, creative, or specific academic abilities, leadership capability, psychomotor ability, or talent in the performing and visual arts. (p. 2)

Three-Ring Concept of Giftedness of Joseph S. Renzulli:

> Giftedness consists of an interaction of three basic clusters of human traits: (1) above average ability, (2) high creativity ability, and (3) high task commitment. Gifted and talented children are those possessing or capable of developing this composite set of traits and applying them to any potentially valuable area of human performance. Children who manifest or are capable of developing an interaction among the three clusters require a wide variety of educational opportunities and services that are not ordinarily provided through regular instructional programs. (p. 2)

The Six GLOs as Measurable Objectives

In this section, I discuss the rationale of choosing the six GLOs as the measurable objectives of this study, as opposed to some other standards or benchmarks.

According to Williams and Dixon (manuscript in review), research on the educative impact of school gardens has shown positive results both for direct academic subjects, such as science, mathematics, and writing; and for indirect academic outcomes such as social development, problem solving, critical thinking, and life skills. In her study, Blair (2009) showed that school garden-based education has positive impact on science achievement, food and nutrition preferences, environmental attitude, and self-esteem. Williams and Dixon (manuscript in review) specifically analyzed 48 studies on school garden-based learning and found that,

> The results showed a preponderance of positive impacts on direct and indirect academic outcomes and other outcomes of garden-based learning included in the synthesis. These results were consistent over all program types, student samples, and school types, and were consistent within the disparate research methodologies used. (p. 1)

They conclude that the academic precursors or indirect academic outcomes are just as important as the direct academic outcomes. These skills are crucial for learning with understanding and for developing metacognition, the ability to self-direct and monitor one's own learning. Without these skills, students may only be rote learning, and may not be able to transfer or apply knowledge to different contexts or settings (Bransford et al., 2000; Dewey, 1938; Gatto 1992, 1993, 2001).

The State of Hawai'i Department of Education GLOs are the overarching goals of standards-based learning for all students in all grade levels, Kindergarten through twelfth grade. Observable behaviors, which are demonstrated in daily classroom activities, are evidence of

GLOs. Student effort, work habits, and behavior are important and they *must be evaluated separately from academic performance* in the content areas in accordance with Board of Education Policy 4501: Assessing/Grading Student Performance (Hawai'i State Department of Education, n.d.b.). The GLOs should be an integral part of the school culture as they do not exist in isolation. The six GLOs are:

1. Self-Directed Learner (The ability to be responsible for one's own learning);
2. Community Contributor (The understanding that it is essential for human beings to work together);
3. Complex Thinker (The ability to demonstrate critical thinking and problem solving);
4. Quality Producer (The ability to recognize and produce quality performance and quality products);
5. Effective Communicator (The ability to communicate effectively);
6. Effective and Ethical User of Technology (The ability to use a variety of technologies effectively and ethically).

The first rationale to use these overarching goals, the six GLOs as the measurements for this study, is that they are important enough to the leaders of the State of Hawai'i Department of Education to state that these GLOs "should be an integral part of the school culture" and that observable behaviors, which are demonstrated in daily classroom activities, such as student effort, work habits, and behavior are evidence of the GLOs. I chose to observe the behavior of students in the school garden as they learn through experience, apply what they learn, transfer their knowledge from the school garden experience into other settings and contexts, and communicate what they have learned and experienced. Using the six GLOs as measurable objectives in this context aligns my work with that of the State of Hawai'i Department of Education. Since these

GLOS are the only standards that are consistent in Hawai'i public schools from Kindergarten through twelfth grade, these are *the* standards by which to measure curricular influence. By aligning observable behavior to the GLOs, I could measure the students' discovery of new ways of learning, as well as new ways of being and becoming. The students' could comprehend their discovery of self through the lens of the six GLOs.

The GLO rubric, provided by the State of Hawai'i Department of Education, serves as a guideline for teachers and students (Appendix B). "Elementary teachers use this rubric and classroom-based evidence to determine a student's rating for each GLO, which is then communicated to parents via the elementary standards-based report card" (Hawai'i State Department of Education, n.d.b.). I took this rubric and adapted it for use in the school garden, as a pre- and post-survey tool (Appendix C).

The second rationale for this choice of the six GLOs is based on research on the science of learning. In the National Research Council (2000) report by Bransford et al., *How People Learn: Brain, Mind, Experience, and School*, the researchers present that "a major goal of schooling is to prepare students for flexible adaptation to new problems and settings" (p. 77). They highlight the importance of processes or skills such as the six GLOs in a person's ability to learn and to transfer the knowledge appropriately (pp. 77-78, 97, 102-104). Skills such as problem solving and critical thinking (GLO 3) are crucial in all areas of life and in all subjects (p. 23). They surmise that: "Children are problem solvers and, through curiosity, generate questions and problems: Children attempt to solve problems presented to them, and they seek novel challenges" (p. 234).

The National Research Council (2000) researchers also studied self-directed learning, on which they conclude that "young children exhibit a strong desire to apply themselves in

intentional learning situations" (p. 102) or to be self-directed learners. They recommended that schools build on children's motivation to explore, succeed, understand, and to harness this in the service of learning (p. 102). By focusing on the six GLOs as the objectives of the program, I was able to align the interdisciplinary standards-based school garden curriculum with the larger picture of education.

The rationale to choose the GLOs instead of particular content standards as measures had to do with the current educational and political trends in the State of Hawai'i Department of Education (2007, 2010, n.d.c.) and at the Kohala Elementary School.

> If an insufficient percentage of students in any of a school's subgroups (identified by race as well as by socioeconomic, special education, and English-language-learner status) score "proficient" on the state assessment in reading or math, the school is labeled as failing to make Adequate Yearly Progress (AYP). Schools must be "restructured" by the district if they fail to make AYP for five consecutive years (F. M. Hess & Petrilli, 2006, p. 53).

Since Kohala Elementary School failed to make AYP for the past 5 years, the school is being put through No Child Left Behind (NCLB) restructuring for at least two school years, 2010- 2012.

The option that Kohala Elementary School adopted for their restructuring was to "enter into a contract to have an outside organization with a record of effectiveness operate the school," which means that the faculty and the staff go through extensive and intensive retraining and coaching (Scott, 2008). I was very concerned that the intervention of external educational consultants may affect the students' acquisition of content knowledge. I believed that since the GLOs are not a focus of the NCLB restructuring intervention organization, I would be able to

more precisely and correctly establish correlation between the school garden curriculum and the student's behavior modification.

Data Collection

This study employed a qualitative methods approach using various data collection instruments including a quasi-experimental pre- and post-survey design, interviews, and observations in the field with a non-randomly assigned sample. Quantitative data was collected to validate the study and to ensure more reliability of data through triangulation. I will briefly discuss quantitative data and then qualitative data.

Quantitative Data

Triangulation of data is very important to naturalistic studies. Collecting quantitative data provided another method of data collection. I explain more about triangulation later in this chapter.

Quantitative survey instrument. I developed a rubric to explore the effects of participating in an interdisciplinary standards-based school garden-based education experience on the third, fourth, and fifth graders in the learning of the six GLOs (Appendix C). The students and their homeroom teachers filled out this rubric prior to starting the program, and at the end of the program. I developed the rubric by adapting the rubric provided by the State of Hawaii Department of Education with input from the Kohala Elementary School principal, counselor, and Special Services Coordinator staff member. The wording of the statements describing indications and demonstrations of the six GLO process were modified from existing GLO scoring literature to reflect school garden-based activities and experiences.

The rubric uses a four-point Likert type scale. This is the same format that is familiar with all DOE personnel and the students (field notes, observation and school records, 2010 –

2011). The four possible responses and the points associated with each response are: 4 = Consistently, 3 = Usually, 2 = Sometimes, and 1 = Rarely.

This rubric was pilot tested in the school year 2010 – 2011 on fourteen GT students who participated in the program, and their homeroom teachers, and was revised over the Summer of 2011 based on recommendations and feedback from the students and adults involved in the pilot testing. The rubric was presented at Hawai'i statewide School Garden Conference in July 2011 to collect more teacher feedback and to gauge the potential to use this rubric statewide at DOE schools. More than 25 teachers attended the session and provided feedback and suggestions, some of which were incorporated into the edition of rubric used for this study.

Based on the feedback from those listed above, and further literature review (Skinner et al., 2011), the revision of the rubric included additional questions targeted at gauging student motivation. For example, under GLO number 1, self-directed learner, the framing of learning is as follows: I learn because…: I want to, My teacher says I have to, Of my friends, My parents expect me to.

A limitation of this survey is that most of the GT students are already viewed as "consistently" or "usually" good learners (archival records, report cards 2009 – 2010, 2010 – 2011, 2011-2012 school year). Therefore the changes may not be dramatically significant. This limitation accentuated the necessity for other measurement instruments or tools such as written work, observations, and in-depth interviews. This survey however, did ask for garden-based education indicators that were not found in the GLO rubrics used by the school for regular reporting.

Quantitatve data analysis. To analyze the impact of the school garden-based educational program experience, independent sample *t* tests were used to detect any differences in the change (post-test minus pre-test) for all six GLOs and student motivation in each individual student.

Qualitative Data

My intention to collect qualitative data was to gather more descriptions and accounts of the lived experience of learning, teaching, playing, working, and such in a school garden, in order to better understand student learning of the GLO processes, and to determine the relevance of the school garden-based education program on student learning. These narratives may help to complete the picture in order to understand better how this interdisciplinary standards-based school garden curriculum may affect the learning of the six GLOs.

I listened and looked for recurring patterns and units of data related to the demonstration of the six GLOs in the interviews, field notes, photos, videos, student-produced documents and other media products, and other documents. The pilot study in 2010-2011, included in-depth interviews with students, teachers, school administration and parents provided several pointers from which to begin the construction of a network of related and connected themes.

Qualitative data collection.

Figure 3. Summarizing view of qualitative data collection instruments.

Interviews or talk story. I conducted formal interviews and *talk story* with the students, teachers, principal, school counselor, and parents. In Hawai'i, there is a culture of *talk story,* an informal chit-chat where life and daily events stories are told and shared. Many pertinent points and useful information surfaced during the talk story as it is a more relaxed conversation modality. As the Big Island is geographically small, and communities are close knit, I often met my students, their parents, teachers, and school administration at the beach, grocery store, bank, or post office. When we met we would talk story and, inevitably the conversation would turn to the school garden, and more information was collected. Information from these talk stories were included in my field notes.

I conducted formal interviews with all nine of the third, fourth, and fifth grade homeroom teachers at the Kohala Elementary School, the school principal, the school counselor, the special services provider, and four parents/care-givers for a total of 16 formal interviews.

Prompting questions used in the adult in-depth personal interviews included:

1. Please describe what you think the six GLOs mean.
2. How do you think children learn the GLOs best?
3. What do you think about school gardening?
4. What do you think the outcomes of the school garden program should be?
5. Does gardening with the kids work? What works? What doesn't work?
6. Do you think the students are learning in the garden? If yes, how and what? If not, why not?
7. Do you see any transference between what is learned in the garden to the classroom or home?

Student focus groups were conducted. Students were segregated by gender for a total of four focus groups, two all male, and two all female. The decision to segregate by gender was based on my understanding of children's social dominance as researched by Pellegrini et al. (2011), and Telsi et al. (2011). Separating by gender may enable me to collect data that is more individually reflective than group biased. Two other all-student focus group interviews were also held for a total of six sessions. Prompting questions used in these focus group interviews included:

1. Describe the six GLOs, what do you think they mean?
2. What do you think about the GT class in the school garden?
3. What did you like best? What didn't you like?
4. What did you learn in the garden about Science, Technology, Engineering and Math (STEM)?
5. How does working in the garden help you learn more about STEM?
6. What do you do in the garden that teaches you to be – list the six GLOs?
7. What do you think we should we do more of in the garden next year?
8. What do you think we should we do less of in the garden next year?

All the interviews and focus groups were digitally recorded.

Challenges of interviewing children. Parker (1984), posited that young children "tend toward high suggestibility, their responses will be readily influenced by any bias in the questions" (p. 20). For children in the middle childhood years, ages 9-12, in which all the 20 students fell, another challenge to the interviewer surfaces, that is their "peer identification builds and, with it the tendency to withhold personal information from adults" (p. 21). He continued to list two more challenges to interviewing with children–that of the situation of the interview, "an

environment or context that will unavoidably shape its content like a container shapes the liquid within it. The child's responses will be shaped by the situation" (p. 22), that of self-reporting, and also by their desire to please me as their teacher. He pointed out:

> The use of an interview assumes the respondents possess the necessary self-knowledge to answer the questions, and that such self-knowledge presupposes the self-diagnosis which yielded it. So, not only might a child, for a variety of developmental reasons, be unwilling to communicate about attitudes, values, feelings, and the like, he or she might simply be *unable* to do so. (p. 22)

Thus, it was very important to have other means of collecting qualitative data in this project, other than interviews or focus groups to validate the data.

Observations using GLO indicators. As a participatory observer, I am bound to the forces of context, discourse and meaning (Mishler, 1986, p. 27). On the subjective end of the continuum I have considered several observations that may speak of the indicators, and will stretch to the other end of objectivity and let the phenomenon speak for itself (Van Manen, 1990, pp. 8-13). I developed a detailed matrix as a guide for the observations using GLOs as indicators (Table 4).

Table 4

The GLO Universe Matrix

GLO to be evaluated	**Indicators**	**Observations**
Self-directed learner *The eyes watch and the hands perform.*	• Student-initiated decision making on garden tasks.	Note how many days or weeks into the program that the students start self-directing the garden tasks.
	• Peer instruction.	Note how many days or weeks into

		the program that the students start teaching about those tasks to other children.
	• Ability to follow a self-established direction of learning.	All the variations of time and decision making processes students will create to choose their field of expertise. Students do not need external prompting to learn.
	• Plan and manage time and resources to achieve goals.	Students work backwards from a learning goal or garden task. Students conduct research on their own to learn about their chosen topic or field.
Community contributors *As we help others, we find help for ourselves.*	• Cooperates with and helps and encourages others in group situations.	Group job participation.
	• Understands and follows rules of conduct.	Students follow the rules of conduct of the garden, and transfer the following of these rules to non-garden settings.
	• Analyzes conflict and applies methods of cooperative resolution.	Note student vocabulary during moments of conflict. Note their tone of voice.

	• Demonstrates responsible and ethical behavior in decision making.	Note the considerations of the students for ethics, greater good, personal benefit, and ecological benefit.
	• Responsibly implements a solution.	The solution does not create other problems.
	• Respects people's feelings, ideas, abilities and cultural diversity.	Use of respectful words and actions – *pono*.
Complex thinkers *Don't be busy with frivolous work; do what you need to do.*	• Applies prior learning experiences to new situations.	Methods and frequency of implementation of prior learning to the development of the intergenerational garden project.
	• Considers multiple perspectives in analyzing and solving a variety of problems.	Group opinion solicitation. Conducting research (internet, books, ask experts) prior to decision making.
	• Generates new and creative ideas and approaches to developing solutions.	Innovation and invention.
	• Evaluates the effectiveness and ethical considerations to a solution and make adjustments as needed.	Adaptations on the systems or methods or techniques that failed.

Quality producers *Don't fear work, fear laziness.*	• Recognizes and understands what quality performances and products are.	Public speaking. Essays. Presentation creation – PowerPoint, posters, etc. Student-run farmers market. Creating healthy soil. Growing food.
Effective communicators *In the word is life, in the word is death*.	• Listens to, interprets, and uses information effectively. • Communicates effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes. • Uses language to build up instead of hurting feelings. • Reads with understanding various types of written materials and literature and uses information for a variety of purposes.	Understanding and applying what garden experts present. Student run farmers market. Student-to-student communication. Student-to-teacher communication. Public speaking on expertise during STEM fair. Note student vocabulary during moments of conflict. Note their tone of voice. Research reading – articles, books, internet, etc.

	• Communicates effectively and clearly through writing, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes.	Reports and essays. Presentations.
	• Observes and makes sense of visual information.	Following visual directions to set up equipment etc.
Effective and ethical users of technology *Where the adz goes, the hand goes.*	• Effective garden tool use.	Appropriate use of garden tools – "right tool for the right job honey!"
	• Uses a variety of technologies in producing an idea or product.	Rube Goldberg garden machine project.
	• Uses a variety of technologies to access and manage information and to generate new information.	Research for expertise study and presentation for STEM fair.
	• Understands the impact of technologies on individuals, family, society and the environment.	Student-run farmer's market.
	• Uses appropriate technologies for communication, collaboration, research, creativity and problem	STEM fair, essays, reports, PowerPoint, posters, letters, and such.

	solving. • Understand and respects legal and ethical issues.	Appropriate use of the internet.

Here is an example of a lesson in the garden with 11 of the 20 GT students (I only had the third and fourth graders this particular day), with clearly indicated pedagogical and theoretical applications, interdisciplinary content, and GLO objectives (see Table 5).

The student feedback to the lesson is shown in Table 6.

Table 5

Sample Lesson, Taken from Field Notes 09/29/11

Field notes/observations	Standards integrated
The task for the day was to measure and clearly mark with bright string several new garden beds in a newly fenced area. These are going to be the heritage garden beds were students and community will grow heirloom food plants for seed and stock. The beds were representative of each major ethnic group in Hawai'i, eg. Japanese garden, Filipino, Caucasian, etc. I instructed the students to first measure with a measuring tape established garden beds at which they felt very comfortable working. I also asked them to measure walking path widths on which they felt comfortable getting around the garden. These students were involved in the creation of these garden beds and paths during the past semester. These students discovered that the garden beds which best suited their arm's reach and allowed for several students to work side-by-side had patterns of 4 feet and 8 feet. The beds were 4 feet wide by 8 feet long, or 8 feet wide by 16	Food and place-based education. Structural-development theory, prior knowledge and experience. Ethical and effective use of

feet long, with small working paths in the middle of them. Concurrently, the students found that walking paths which were 4 feet wide allowed for two students to push/pull a wheelbarrow (one at the back, and one in the front) without forcing them to step into the garden bed. I facilitated the discussion with the students about their experience measuring the beds and how this knowledge could help them decide the size of the new heritage beds. They all agreed very quickly that each bed should be 8 feet by 16 feet, with 4 feet wide paths between them. I then asked them to organize themselves into 2 groups, with each group working opposite ends of the newly fenced garden area. Immediately student T, female, fourth grade, selected her group, and student B, male, fourth grade selected his. The groups were well-mixed gender-wise and age wise. From what I could see, the two groups self-organized with roles of measurer, stringer, and staker easily accepted. The students checked in with me about where to find the tools they needed, note: they did not ask which tools, and took off to get the tools. In one group, the students took turns at each job. In the other group, they kept their job the whole duration. Each group completed one garden bed and path before it was time to put away tools, gather, and close. During closing, I asked each student to share what they did today, and which skills or GLO they used.	technology. Real-life context. Mathematics – area, length, width. Community contributor. Critical/Complex thinking. Problem solving. Leadership. Effective communication. Self-directed learning. Effective and ethical use of technology. Community contributor. Quality producer.

Table 6

Student Feedback to Lesson in Order in Which They Shared

Student	Statement	Standards
Student B, male, fourth grade	"Math, I used a hammer and tape."	Mathematics. Effective and ethical use of technology.
Student G, female, third grade	"Measured, it was fun."	Mathematics.
Student S, male, third grade,	"Community contributor – working together."	Community contributor.
Student W, male, fourth grade	"Patterns of life, 8, 4, 8, 4."	Mathematics. Complex thinker.
Student Q, male, third grade	"I thought about that too!"	Mathematics. Complex thinker.
Student U, female, fourth grade	"I like working in the garden to help others."	Community contributor.
Student P, female, fourth grade	"At first it was confusing, but then I saw how all we did fit together."	Complex thinker. Problem solving.
Student H, female, third grade	"You know, this pattern of life thingy – do you think we can see it elsewhere?"	Complex thinker. Self-directed learning.
Student R, female, fourth grade	"I can't wait until we get it all done and start planting."	Self-directed learning. Quality producer.

Student V, male, fourth grade	"We only got one bed done."	Self-directed learning.
Student T, female, fourth grade	"But don't worry we'll get the rest done next time, and it looks nice, that's what counts."	Problem solving. Quality producer. Community contributor.

Objective observations and field notes. Objective observation differs from observation focused on the GLOs as I did not have the GLO indicators as a screen to view the phenomena, but just allowed the phenomena to speak for itself and investigate the experience as it is lived (Van Manen, 1990, pp. 53-76). As a participatory observer, I made field notes of the experience of teaching and learning in the school garden every evening after school. I sought objective interpretation through group reflection of field notes through weekly reviews and discussions of the field notes with the homeroom teachers, the school principal, the school counselor, the special services provider of the school, other school garden educators and researchers. I called these weekly check-ins. These check-ins are referred to by Lincoln and Guba (1985) as peer reviews.

Student created products. Student generated reports, posters, essays, letters, PowerPoint presentations, videos, and journals (written and photographic) were used as documents to be researched. I noted demonstrations of skills and the six GLOs, and the settings in which they occurred.

Photographs and short videos. D. Harper (2000) described photo elicitation as an underutilized qualitative method, and noted that research can construct a visual narrative. "Visual

imagery adds a layer of complexity to our texts and representations pointing at specific moments of human interactions" (Thorp, 2001, p. 45). At least once a quarter, I gave the camera to the students and asked them to take three photographs each that best showed their work and learning in the garden. They then explained why they took these pictures, and turned them into slide shows. Student teams were also given a video camera to capture short clips of their activities and projects in the garden. The student created slide shows and videos were then analyzed (Heath et al., 2010) for demonstrations of the GLOs.

Other documents. I wrote a weekly newsletter about the Discovery Garden, which described what was going on in the garden. I included lessons taught, what was planted and growing and harvested, an anecdotal story or two, student and teacher quotes, pictures, and announcements. This newsletter was circulated between the staff and faculty of Kohala Elementary School, the families, the wider community of Kohala, and nationwide to other school garden teachers. All copies of the newsletter were also posted on the Hawai'i Island–School Garden Network blog found at (Koh, 2011) http://kohalacenter.org/schoolgardensblog/?cat=14. I received weekly responses to my newsletter from the teachers, staff, and parents of Kohala Elementary School, from North Kohala community members, and other school garden teachers around the State and country.

I also wrote grant proposals to generate funds for the Discovery Garden. These proposals and grant reports also served as archival documents for research.

Qualitative data analysis. I listened and looked for recurring patterns in the interviews, field notes, photos, videos, student-produced documents and other media products, and other documents.

Processing naturalistic obtained data. Naturalistic data analysis was used to develop codes, categories, and themes that reflect study participants' words and meanings (Guba & Lincoln, 1985; Smith, 1981). This form of analysis was conducted throughout the entire course of the study. The process was highly recursive and reflexive. It was a dynamic process. Questions were asked, data were gathered, more and possibly different questions were asked, and more and possibly different data were gathered, and so on. This process allowed me as the researcher to interact with the data, and thus scaffolded my understanding and interpretation of it, and I could then utilize diverse pathways of thinking and knowing simultaneously. This process has a built-in feedback mechanism for correction, adaptation and validation. In this manner, the data could be analyzed, synthesized, and then interpreted again and again for deeper and diverse insights.

Content Analysis

The content was analyzed using strategies adapted by Lincoln and Guba (1985, pp. 339-351), of Glaser and Straus' constant comparative methods. I summarized the strategies and the principles and processes associated with each:

1. *Unitization of data*. Each unit had two characteristics: it was heuristic, aimed at understanding something or some action; secondly, it was the smallest piece of information about something that could stand by itself, that is, it had to be interpretable in the absence of any additional information. These units were found within the observational and interview notes, documents and records, and the like. Each unit was entered on an index card and coded to indicate original data source.
2. *Comparing units for categorization*. The data units were sorted into categories or domains by constantly comparing them to each other. This constant comparison aided

me in devising rules that describe the category properties, which can be used to justify the inclusion of a particular unit to a category, as well as to provide basis for replicability. “Categorization can be accomplished most cleanly when the categories are defined in such a way that they are internally as homogenous as possible and externally as heterogeneous as possible” (p. 349).

3. *Memo ideas*. This strategy allowed me to step back and gain objectivity to the data, to make deeper and more coherent sense of what is happening. Writing memos and notes helped me make sense of the data, as well as capture insights or “aha!” moments as patterns emerge.
4. *Integrating categories and their properties*. The set of categories was examined for possible relationships. When the properties of categories became very clear and explicit and there was a convergence of categories. Some categories were too large and unwieldy and required further subdivision, and some categories were missing or did not fit into the GLO schema. This strategy provided a system to locate and include them in further analysis. At this point an explanatory construction of the situation began to emerge as the conceptual relatedness of the data was revealed. Here the structural-developmental theory created a framework to understand and interpret the relationships of the processes and processing.
5. *Delimiting the construction*. During this phase, the original list of categories was reduced because of the increasing clarity of construction, emerging patterns, and relationships. Tentative categories or themes became defined and stabilized, and some data was put “on the back burner” for future papers or studies. This stage then flowed recursively into the write-up of the study.

After collecting and coding data, I engaged in the reflection or comparison of the emerging themes and concepts with other relevant themes, theories, and related references. This process entailed returning to the data sources–subjects, writings, biographies, artwork, photographs, and such. During time of contemplation and deduction "delimited data" were collected to fill in the gaps which emerged during the comparative phase (Charmaz, 2000 p. 519; Wuest, 2009, pp. 55-56). This constant comparison was constructivist in nature, allowing for and expecting variations, dynamic changes, and the "unexpected" to surface within the research structure. The relationship of the researcher to the data must be reflexive and contextually situated. "We can only claim to have interpreted *a* reality, as we understood both our own experience and our subjects portrayal of theirs" (Charmaz, 2000, p. 523).

The coding of the data was an emergent and interactive process. Guided by the work of Charmaz (2000) and Wuest (2009), I allowed the data to "speak" to me and I listened. The data coding begins the theory development process. Line-by-line coding supports the tuning into the subject's views and life-world, and shapes the creation of sensitizing, multidimensional concepts. I had to sensitive to the world of children. I had to be aware of my own bias. The concepts then were grouped into processes. For example: Concepts such as "becoming an expert," "harnessing resources," and "taking on more" are part of the negotiation process (Wuest, 2009, pp. 57-59). The process then is formed into the theory. The process is emergent and interactive, which may result in the acclimatization of initial questions to develop a deeper relationship with the data. This approach "assumes that what we take as real, as objective knowledge and truth, is based upon *our* perspective." Researchers can use the constructivist framework to further "knowledge of subjective experience and to expand its representation while neither remaining external from it

nor accepting objectivist assumptions and procedures" (Charmaz, 2000, pp. 521-525). This framework acknowledges the interactive nature of data collection and analysis/comparison.

Validity and Reliability

The job of validation is not to support an interpretation, but to find out what might be wrong with it. A proposition deserves some degree of trust only when it has survived serious attempts to falsify it. Lee Cronbach

The validity of the rubric (survey instrument) used in this study was improved through the initial pilot testing. Pilot testing of the instrument was conducted with 14 GT fourth and fifth grade students from Kohala Elementary School of the 2010-2011 school year, their six homeroom teachers, the school principal, the school counselor and four parents/care-givers. An additional pilot testing of this instrument was conducted during the Fourth Annual Hawai'i School Garden Network Conference in July 2011. I presented this instrument during a workshop session and collected feedback about the instrument from garden and homeroom teachers, and administrators from across the state of Hawai'i.

Several quality criteria for this study that address validity and reliability from a phenomenological and structural-developmental perspective are:

Catalytic validity. Research is judged by the "degree to which the research process reorients, refocuses, and energizes the participants" (Lather, 1986, p. 67). Catalytic validity was evident in the ability and capacity of the research participants to know better and build upon their learning, termed by Freire as *conscientization,* or structural-developmental theory, that is "knowing" reality or "doing" reality in order to transform it better. While this may be unorthodox as it flies directly in the face of the essential positivist tenet of researcher neutrality, this argument is premised on a recognition of the reality-altering impact of the research process itself, and also on the need to channel consciously this impact so that respondents gain self-

understanding and, ideally, self-determination through research participation (Lather, 1986, pp. 67 - 68). I shared regularly with the participants my observations of the learning, working, and playing in the school garden. I solicited their reflections on my reflections. I asked them to let me know when there were activities and tasks we did in the garden that taught several lessons at once, and to share, if they could, what those lessons were.

Triangulation. Triangulation of data is crucially important to naturalistic studies. Validity and reliability were reinforced by seeking multiple data sources, methods of data collection, and theoretical schemes (Lather, 1986, p. 67; Lincoln & Guba, 1985, p. 283). Triangulation functions to seek "counterparts as well as convergences" (Lather, 1986, p. 67). The multiple data sources have been identified as the students, teachers, parents, school principal and school counselor; documents, student projects and photographs/videos. I created a rubric instrument for quantitative data collection and interviewed, observed, and dialogued to gather qualitative data.

Reflexivity. Reflexivity refers to "the process of personally and academically reflecting on lived experiences in ways that reveal the deep connections between the writer and her subject" (Goodall, 2000, p. 137). This practice can help to situate one's writing in other parts of one's life such as "disciplinary constraints, social movements, familial ties, and personal history and longings" (Thorp, 2001, p. 58). In so doing truths, biases, assumptions, prejudices, and fears may be exposed, so that I can practice to be an objective observer, while still being engrained in the project and program. "Persistent reflexivity indicates how our 'working theories' have changed by the logic of the data collected along the way" (Thorp, 2001, p. 59). I practiced this in the weekly newsletters I wrote about the Discovery Garden. I compared and contrasted the work in the garden with my farm work at home, I described the social interactions in the garden in

relation to the interactions elsewhere, and I shared what I have learned in and through the community of North Kohala. Some lessons were joyous, others were painful, but all were valid.

Face validity or *member checks*. Lincoln and Guba (1985) referred to member checks as "the most crucial technique for establishing credibility" (p. 314). In this practice, data, analytic categories, interpretations and conclusions are tested with at least a subsample of the participants. "Good research at the non-alienating end of the spectrum...goes back to the subject with the tentative results, and refines them in the light of the subjects' reactions" (Reason and Rowan, 1981, p. 248). I conducted weekly check-ins with the homeroom teachers, school principal, school counselor, special services provider, and quarterly check-ins with the parents of the students.

Summary

This chapter described the research design and the methodology of formative evaluation, including the procedure that will be used to determine the effects of the experience of a school garden-based education on learning and demonstrating the six GLOs (or processes). I presented the rubric specially created for this project as well as how the participants were selected. I also discussed the methodology of validating the study as well as ensuring the reliability of the data collection.

CHAPTER V

FINDINGS

This chapter begins with a brief analysis of lessons learned from the pilot study. The data from the pilot study informed and modified the methodology for the research project. Next I discuss the results of the quantitative data, and then discuss the qualitative findings. Following the presentation of the findings, I will provide an analysis and interpretation of the findings.

Lessons from the Pilot Study

I grouped the lessons into three themes using the Learning Garden principles provided by Williams and Brown (2012). The first is discovering rhythm and scale; the second is cultivating a sense of place; and the third is awakening the senses.

Discovering Rhythm and Scale

This phrase describes the patterns of relationships which emerged and developed during the first year of the learning and working in the Discovery Garden at Kohala Elementary School. Before entering the school garden, all students, regardless of age and academic standing, must recite a Hawai'ian *oli* (chant) to ask permission to enter the garden, as well as to set the intention for the time in the garden. This cultural practice set the atmosphere immediately in the school garden. The students realized that they were entering an honorable space, where only the best was expected out of them. This practice settled them before entering by giving them a few moments to think and breathe. After chanting the students entered the garden ready to learn and work. This ritual was predictable and rhythmic. It was most apparent one day when I was not at the school garden. The news that garden classes for the week were cancelled did not get to the GT class. They all gathered by the gate of the school garden and waited for me to show. A few

minutes later, the school counselor, whose office faces the garden, saw them and went to investigate. After realizing the situation, she sent them back to their respective homerooms. Later she told me what had happened and how impressed she was that the students respected the ritual and how that made it so easy to manage the situation (03/29/11).

Two more rituals contributed to the rhythmic structure of the school garden class. Two minutes of silent observation and the closing moving poem. After chanting, students enter the garden and find an area to observe for two minutes. They do not have to be stationary but do have to be silent and at least 10 feet away from each other. Often I provided a suggestion to help focus the students, such as, find as many different leaf shapes as you can, find simple flowers and complex flowers, look for tendrils, count the ladybugs, and which vegetables are also fruits. The time to settle deeper into the garden space while observing something of interest calmed the students down even more. Student observations were integrated into the lesson of the day which followed the two minutes of observation.

The closing moving poem provided an authentic and quick means of assessing the class. Students also came to expect this ritual and asked to do it even when we had to have garden class indoors in the homerooms during inclement weather. They took the initiative to gather in a circle at the end of class indoors and share what they learned and/or felt. I began to audio record these poems as they provided such rich data.

During the pilot study, I learned that for most of the garden tasks performed in this school garden, organizing the students into groups of four to five was best for the scale. This size grouping supported cooperation and safety, as the students could work closely together but still keep a distance of least 2-4 feet away from each other. A team of four to five students could

satisfactorily complete most of the tasks from start to finish in the time appropriated. This group size also provided diversity of ideas and opinions for problem solving in the school garden.

Sense of Place

During the pilot study, I conducted the interviews and focus groups in variety of places such as homerooms, the school garden itself, on the playground, at cafes, at parents' homes, and in the teachers' lounge. I noticed that the quality of answers changed with the location. Students were very distracted when I held focus groups in the playground, and seemed to rush through the answers or look away. Teachers were distracted by the work they felt they needed to do when being interviewed in their homerooms. The school principal was interrupted many times by phone calls or drop-ins when we held interviews in his office. The distractions and interruptions were the least in three locations, at the school garden, at a café or restaurant away from school, and at homes. From this experience, I learned to conduct all the student focus groups in the school garden, and as many of the adult interviews at the school garden or in a location removed from school where there would be few interruptions. The garden provided the best setting for collecting narratives as the participants could see and touch that which inspired them.

Awakening the Senses

I realized that I had to use all my senses simultaneously during observations. I had to take in the whole scene in detail. I found it very challenging to listen to a set of students, while watching another group work, and at the same time ensuring the safety of the students. I decided to give a video camera and my iPhone to two different groups of students with the instructions to capture what they did and learned. Later I would watch these short videos, annotate them, and transcribe some them if necessary. This method allowed me to focus all my senses on one group

of students at a time, and to be truly awake to each individual in that group. This was one of the most helpful lessons learned during the pilot study.

Qualitative Findings

Thematic statements were identified regarding the impact and effect of the interdisciplinary standards-based school garden curriculum on the experimental group of 20 students of learning and applying the six GLOs. Selected quotes and passages represent the major themes identified. Please note that all phrases in italics are direct quotes from the participant interviews and focus groups, phrases and words taken from the participants' written responses, reports and essays, and/or passages from my field notes.

Self-Directed Learner Themes

Responses from the school principal, school counselor, student services coordinator, and five of the nine homeroom teachers suggest that the skill of self-directed learning is *foundational to learning and applying all the six GLOs*, and is *fundamental to success in school* (School adult interviews #1, #2, #3, #5, #7, #8, #10, and #11). All the nine homeroom teachers, and three administrators indicated that the school garden program provided *opportunities for discovery* to deepen *personal interests in a particular area* developing the GT student's *expertise.* All the adults interviewed, school adults and parents, mentioned that the GT students *loved researching and learning about* their chosen areas of expertise.

> *My daughter jumped right into her research about food from Scotland. She asked me questions and looked stuff up on the internet, I did not have to make her do it. It was obvious she was excited about learning about her own past from the point of food, and that she would grow these foods in the school garden*. (Parent, interview #2)

> *Sometimes we create a conflict in the students' minds. We say, go find out what you want, and then we make them study for the test. Because the school garden program did not teach to a test, the kids could truly explore what they were interested in, and be self-directed like we want them to be*. (School principal, interview #1)
>
> *The school garden was an easy place for the kids to find something they wanted to be an expert in, like bugs or fruits. I think it's because it is concrete and real, they can see the bugs on the plants making holes in the leaves, and they can eat the fruit. There's a goal they can work towards*. (Homeroom teacher, interview #8)

All the students were asked to write and draw what it meant to be a self-directed learner, at the onset of the GT program. At the end of the program, students were asked to describe verbally the skill of self-direction.

The students in third and fourth grades found the activity of writing and drawing a description of the GLO more challenging than those in fifth. All but one male fifth grader completed the assignment. Only one of the two male third graders, one of the two female third graders, one of the three male fourth graders, and three of the four female fourth graders completed the assignment. Two of the fourth grade females found it easier to state what self-directed learning was *not*. One of these students drew a picture of someone looking at another's test and wrote – *a person is cheating for the answer*. Some students just repeated the outcome as the definition, for example: *A self-directed learner is someone who directs their own learning* (two males, both in fourth grade).

The themes which emerged from the written and drawn descriptions:

Initiative/Independence–*work by yourself*, *guide myself while doing work*, *work without being told* (three students), *I can learn things without getting taught*, *a person that learns by through self-direction*.

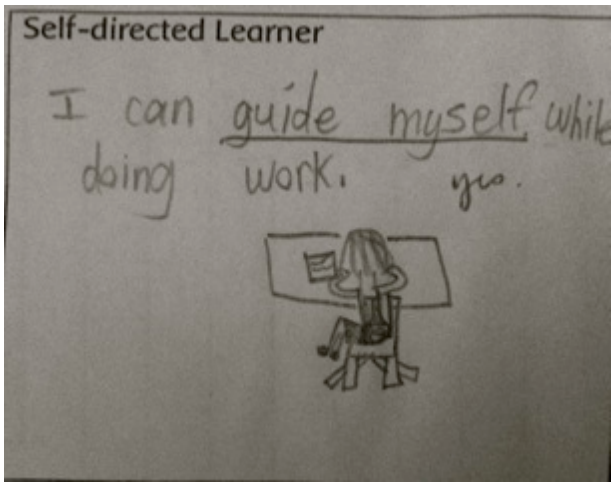

Figure 4. Illustration of GLO 1 by female fifth grade.

Responsibility–*responsible for own learning*, *I am in charge of my own learning*, *I mostly take my useful time for my responsibilities*.

Listening–*listen closely; you have to listen to how the person is talking*.

Academic achievement–*good grades*, *get good grades*.

In the post-program focus group interviews, the theme of academic achievement did not surface when we discussed self-directed learning, however, there were many mentions of GLO 4–**quality producer** when it came to *doing good* in the school garden.

Using those four themes as guides, while being open to the possibility of other emerging themes, I watched and listened for demonstrations of self-directed learning in the school garden and related activities. I will draw from my field notes.

Initiative/independence. I asked the students to observe during their 2 minutes of silent observation, what we needed to do in the garden today after being gone for two weeks. They walked --- ok not really --- they skipped, ran, rolled, scurried around and didn't keep very silent.

I did not have heart to quiet them as they were talking about what they saw–the weeds, the compost, the weed mat, and the sudden appearance of two pigs in the garden. When we gathered, they all tried to talk at once.

> *We need to weed!*
>
> *Can we feed the pigs?*
>
> *We really need to weed!*
>
> *What are the pigs' names?*
>
> *I let them self-organize into two groups, weeding, and gathering food for the pigs. Seven of the eleven here today choose to weed, and four to gather food for the pigs. Off they went. They chose tools from the tool shed, found a bucket to gather macnuts, and got working. I actually spent the rest of the time sorting their homework responses. They didn't need me. Every now and then I heard squeals of laughter when a pig snorted, or a loud exclamation when the weeds did not cooperate.*
>
> *Can we feed the pigs the weeds?*
>
> *We're recycling!*
>
> *I thought that was clever of them. The pigs snorted and the weeds disappeared.* (field notes, 10/12/11)

Transcribed from a video of the students in the garden measuring out new garden beds (10/26/11).

> Ms. Ming Wei: *Instead of using the measuring tape, you guys are using a new strategy, tell me what you are doing instead.*
>
> Student U: *We are using a pattern that student Q noticed. So…eight feet…uh…*

Student Q: *This is about six inches* (pointing at space between verticals of the hog fence) *and if we counted...well…by two…So we are counting the squares* (of the fence) *instead of using the measuring tape.*

Student U: *Yea, eight feet is about 15 or 16 of these spaces*.

Responsibility. One female fifth grade student began the program on a very shaky note. She did not turn in her school garden program homework on time, nor was she prepared for class (did not wear closed toed shoes or bring her garden journal). However, in the garden she worked diligently, cooperatively, took initiative, and seemed happy. When I checked in about her with the Student Services Coordinator the Coordinator shared that this student was also having self-organizing and management challenges in her homeroom. The symptoms were the same, not turning in paperwork or homework on time, and not having proper school supplies, but still working well with classmates, cooperative, and respectful of elders.

When the student finally turned in her assignments, they were done excellently. She spelled all her words correctly, wrote in complete sentences, drew and colored in detailed pictures. This student scored at least 90% on her tests and quizzes. For her end of semester presentation on fruit trees, she and her partner created a three-dimensional cut out of a tree, made fruit models out of clay, and as they talked about each fruit, they hung the fruit models on the tree. The leaves of the tree consisted of short descriptions of the fruits. It was obvious that they spent a great deal of time and effort on this presentation.

While this student did not get the hang of wearing closed toe shoes, she was responsible and reliable with all garden tasks. This student made me think about how children can be selective about the responsibilities we as adults put on them.

However, different children react differently to taking on the responsibility of tasks. A parent told this story:

> *"MOM! Smell my hands!" My son says that to me on the days he has GT garden class. He loves it, and I love it because it has empowered him to be more responsible at home. My dad died a few months ago, and he was an avid gardener. He had three levels of gardens in his back yard, one layer for fruit trees, another for vegetables, and the last one to sit in with lots of flowers. We have been going down to help my mom with the garden and house every 3 weeks since dad died. She isn't a gardener; it wasn't her thing. I am ok in the garden but honestly, I need to help her in the house with laundry and cleaning. And my husband, well you know, he loves the garden, but he needs to help mom with fixing stuff around the house. The house is old, you know, windows, screens, jalousies, plumbing…Since my son started gardening with you, not only does he have an outside place at school to do science…yes, we both know how he loves science, he actually has gained a lot of confidence to pull the right weeds, or trim branches, or make compost, or harvest at my dad's garden…He even tells his older high school sister what to do and she actually follows his instructions! It's so great, he is taking responsibility for his grandpa's garden, and grandma of course is thrilled*. (Parent interview, #4)

Listening. After several weeks of observation, I realized this theme could be more accurately called **observation**. The students were not only listening carefully to my lessons and instructions, and to their peers in the garden, they were also watching my actions and their peers' actions, and then imitating or adapting. Some students were also transferring their observations from home to the school garden. Here are two of my observations of the students' actions.

Student B and Student U discovered today that the new garden beds were longer than 16 feet. They were staking and stringing out more beds and noticed that their bed ended a few feet shorter than the bed next to them. They measured that bed and yelled at my direction,

Ms. Ming Wei, someone did the wrong thing!

They weren't listening.

I asked them what they needed to do to remedy the situation. They hesitated. I went over to them and worked the measuring tape, and showed them how to re-stake the bed.

Ms. Ming Wei, what if we made a long string from one end to the other and then everyone can follow?

A horizontal guide-line – brilliant. I got them more stakes and string for the guide-line. Interesting how a little guidance goes a long way. (field notes 11/15/11)

I noticed student Q immediately, he seemed so at home in the garden. When I asked him, he simply told me that he helped his mom at his home garden, and since what I asked him to do here in the school garden was the same as what his mom asked him to do, it was easy. He just knew. (field notes, 09/28/11)

Academic achievement. All nine of the fifth grade students, three of the four the female fourth grade students, one of the three male fourth grade students, one of the two female third grade students, and both of the male third grade students scored 90% on garden content written assignments, tests and quizzes. The 4 out of 20 students who did not score on the assignments, tests, and quizzes merely shrugged their shoulders, or said *I don't know*, when I inquired on their performance. One student, female third grade, offered that *my dad kept me very busy and so I did not have time to do my assignments or study*. This same student however, was a responsible and

diligent worker in the garden, and also provided deep and mature insights during verbal communications.

The homeroom teachers of the four above-mentioned students relayed information that these students were *somewhat dreamy*, or *young*, or *smart but little follow through* (homeroom teacher check-ins, 10/12/11, 11/02/11, & 11/30/11).

From my observations and from the interviews with the school principal and school counselor, one more theme emerged within the realm of self-directed learning, that of *resource management.*

Resource management. One student, female fourth grade, wrote this in the comments of her pre-survey/rubric for self-directed learner: *I enjoy my work when things are not too slow or too fast.* The design and curriculum of this school garden education supported that students stayed on task until the job is completed. This way, they could experience all the steps and resources it took to get the assignment done. As the garden teacher, I was comfortable with being very flexible with the content of the curriculum, stretching a topic such as living soils, beyond the pre-planned 4 weeks to engage fully the students. This gentler pace seemed to counter what was happening in a test-oriented school system. This also allowed the students to explore deeply and direct their learning based on experiences.

Community contributor themes. The quantitative data analysis showed that students demonstrated this GLO more frequently at the end of the program compared to the beginning. I found the descriptive drawings about this GLO #2 community contributor an important resource. On the first day of class, when I asked the students for verbal descriptions of this GLO, only two of the 20 could define *contribute*. There were a variety of descriptions of community including our garden community (plants and insects), school, family, and wider community. When I

realized that the students had limited vocabulary to describe the GLO, I encouraged them to draw me an example of what they thought this GLO meant.

From the 13 students who provided written and drawn descriptions, 6 drew/wrote themselves doing something specific for someone else including the elderly, the poor, and the homeless. Much of the writing consisted of speech bubbles where the characters in the drawing are conversing about the scene. Sketches included helping to build a house, carrying a heavy bag for an elderly person, and cleaning someone's house. Two students drew gardening as a means to contribute to the community. One student drew four people trying to divide three fish fairly, and two students drew sharing resources such as a pencil or paper at school. Two students drew listening or watching the teacher/figure of authority.

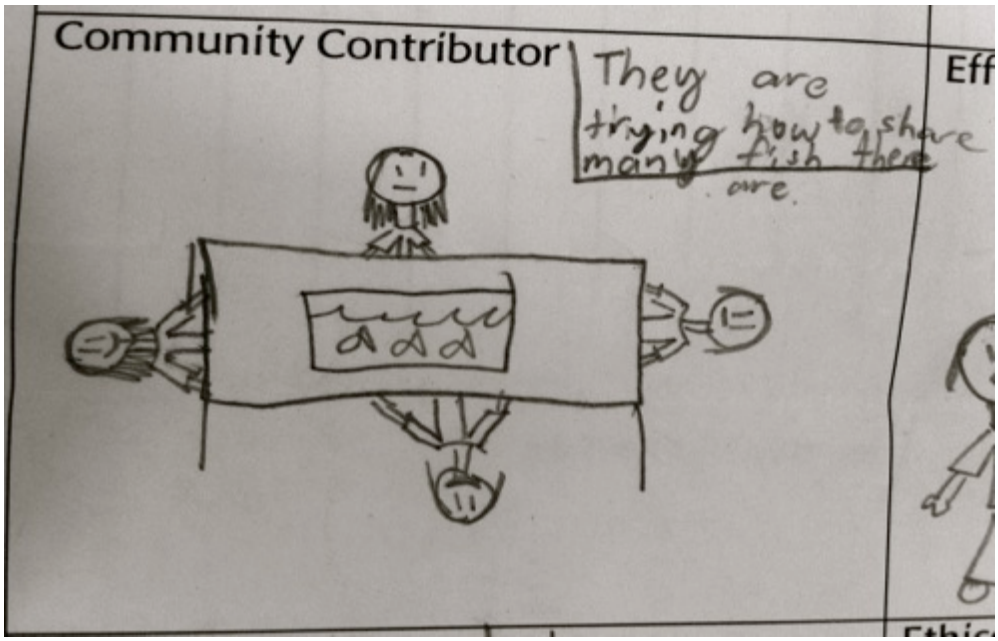

Figure 5. Illustration of GLO 2, female fourth grade.

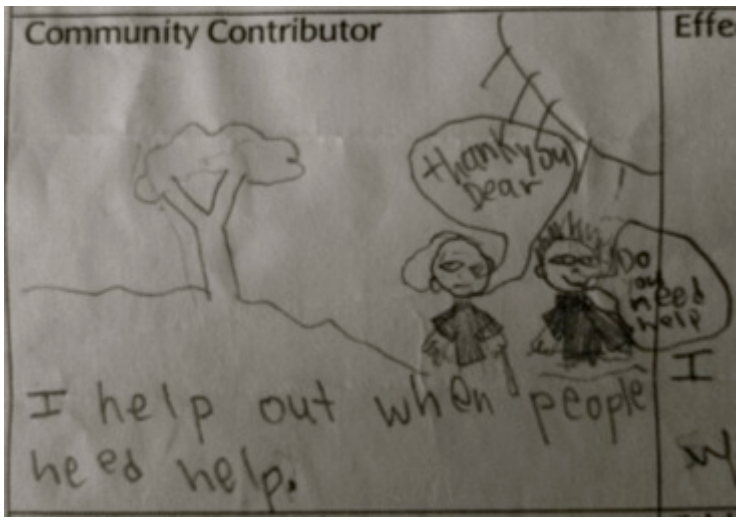

Figure 6. Illustration of GLO 2, male fourth grade.

Throughout the semester long GT program, I consciously pointed out the students examples and moments when I felt and thought they were demonstrating being a community contributor, and conversely, when they were being selfish and thoughtless of others.

Four themes emerged early on and remained constant throughout the program.

Cooperation/Working together/Teamwork–*work with other students, working together like teamwork*.

Helping others/Service–*be nice and helpful*, *I help out when people need help*, *you can help or teach people in your community*.

Sharing–picture of people working on sharing food (fish) fairly, picture of students harvesting from the garden and then giving the food away.

Pono – uprighteousness, righteous, just, goodness, properly.

Cooperation/working together/teamwork. For one of the third and one of the fifth grade homeroom teachers, community contributor was the most important GLO, especially because this GLO made cooperation and teamwork a standard to strive for and a behavioral expectation.

I never have time to let my students work together on something fun or helpful. It is always trying to catch up with the curriculum, or preparing for a test, or taking a test. Tests do not teach you to cooperate, shoveling in the garden does. You have to work together to get the mulch from the pile there to the paths. No one can do it on their own. (Homeroom teacher, interview #4)

The fifth grade homeroom teacher wrote:

When my class attends lessons at the school garden we arrive together. We chant at the gate together before we enter. We plan our goal for each day together. Cooperation is the most important skill we learn to grow a successful garden. Working together allows us to plant, cultivate, and maintain our plot. Divisions of labor in teams get things done. (03/30/11).

Student H, female third grade:

It's important to work together in the garden. It's important because you can get it done easier and faster. If you worked alone it will take you all day. I think you'll make other friends that you never like. You learn new things and bugs that you never knew. If you never saw that kind of bug or never knew that, other people will tell you. You should always cooperate in the garden with other people or kids. (Focus group, #3).

Helping others/service. *The school garden improves our community by having healthier food instead of shipped from a different country.* (Student K, female fifth grade)

I pick food from our garden for poor people. (Student H, female third grade)

You should help people that look like their (they are) *struggling you should help them*. (Student E, female fifth grade)

Sharing. There are so many examples to draw from to illustrate this theme, from sharing tools in the garden to sharing seedlings with families. Students weigh the produce before dividing fairly among the class. In my opinion, taking turns is a form of sharing, and in the school garden students take turns to do certain coveted jobs such as feeding the pigs or chickens.

Pono. Being *pono* is very important at Kohala Elementary School. I wrote in chapter 3 that being told that you were *pono* is one of the highest compliments a student can receive from the school principal. It was inevitable for the theme of pono to emerge. I had several discussions with the school principal and school counselor about where to place this theme. We all felt that pono was inter-GLOs, or even trans-GLOs. I finally chose to place the pono theme here under community contributor after I showed the essay written below to the school counselor. She felt very strongly after reading the essay that the theme of pono could be appropriately placed within GLO #2 (R. Watterson, personal communication, field notes, 05/12/11).

You can't always get the job you want, but you do it anyway, 'cos it's good to help the group, and then you can get the job you want next time!–Students W and Q, males fourth and third grade after coming to class late and getting the last job on the list (field notes, 11/02/11).

The following is taken from an essay collaboratively written by three female fifth graders.

How does the garden teach kids to be pono?

It helps by letting kids work together and be more responsible. It helps them to understand the community more and feel much more safer. When people are pono there are no bullies and makes everyone feel safe from harm.

It makes kids feel happier because the garden is a place to releasing their aggression. It puts energy into what your doing and makes you feel better. It gives you time to really think and understand things more.

Kids come to the garden to enjoy themselves and to forget their anger. The garden influences them and allows them to cool down their anger. It makes kids happy to know that there is somewhere that they can come and be at peace so it makes them pono.

The garden makes kids feel comfortable in school and allows them to feel pono and makes them understand why they come to school and no to bully others or not listen, it encourages them to pay more attention to what they are supposed to be doing. (05/10/11)

Complex Thinker Themes

The easiest GLO to use in the garden is complex thinker because we have to think in the garden and that is a good thing (Student B, male fourth grade, 11/30/11).

During the student focus group interviews, this GLO was most often mentioned in response to the question–which GLO do you use in the garden? Reasons for this choice fell into two categories, the first being **planning and sequencing**, the second was **creative problem solving**. It is interesting to note that these two categories can be related to the two Hawaiian culture-based interpretations of this GLO, by the Kamehameha Schools and by Kumu Keala Ching, as presented in Chapter Two, and again below.

From Kamehameha Schools–GLO 3: Complex Thinker.

Ho'okuano'o

Mai pono hana, hana pono.

Don't be busy with frivolous work; do what you need to do.

> When the going gets tough, the tough gets going, it's been said. In life we are faced with challenges that must be overcome. The first step is to stop and think. At first glance, a problem might seem too difficult. However, if we think on it long enough, we will find the answer. Never give up!

From Kumu Keala Ching–GLO 3: Complex Thinker

> **Ho'okauno'o**–learning center
>
> **No ka luna ko luna, No ka lalo ko lalo**.
>
> What is up belongs up, what is down belongs down.
>
> Understanding that everything has a purpose in life, the study of 'ahupua'a and complex thinking allows the comprehension learning that upland provides a nurturing source for gardening; where as, lowland provided sources from the ocean. Through 'opelu fishing, a blend of upland plants like pumpkin, taro, and sweet potatoes provide the chum used for fishing 'opelu. Understanding the resources of place–**Ho'okauno'o**.

The third theme which emerged was *I can think more than one thing at a time* (Student M, 08/18/11). Some students could only express it by saying **thinking complexly**. However after some discussion and drawing, I understood what they meant was they were able to multitask and hold more than one line of thought at a time, and that to them meant being a complex thinker.

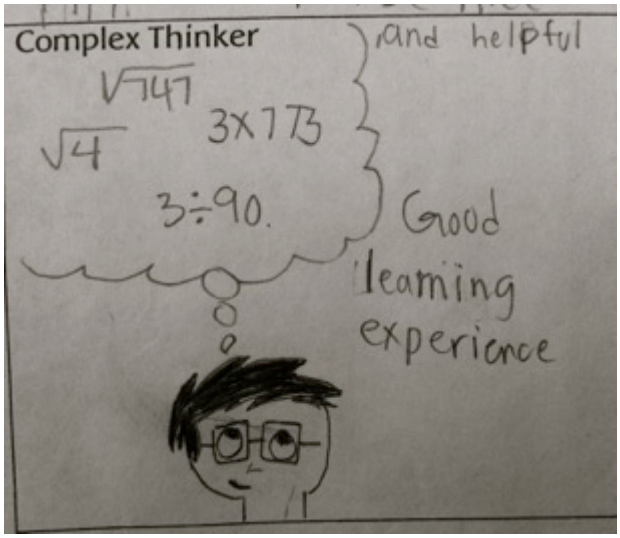

Figure 7. Illustration of GLO 3, male fifth grade.

The fourth theme of **resource management** echoed that which was mentioned under GLO #1 self-directed learner.

Planning/sequencing and understanding the resources of place. *You have to think about what you have to do first, you have to organize. You think about where to plant, like where are the trees shading the garden. Then you have to weed, and dig, compost, and then only you can plant. You got to take the time to make it all nice and good before you can plant* (Student U, female fourth grade, 11/30/11).

A practice I worked to instill in the students through the GT program was to draw the design or idea, and then to work backwards from the vision. I was working from the Williams and Brown Learning Garden principles of cultivating a sense of place and discovering rhythm and scale. During the first few classes, the students drew the design and plan of the intergenerational heritage garden for which the GT students were responsible. I asked them to observe sun and shade, where the trees were located, where the two gates were placed, and so on. I got them to think about the senior citizens we were going to invite to garden with us there, and of the plants we would grow for seed and stock. I asked the students to think about what we

would need to know to create a healthy, culturally based garden. Some students leaned towards wanting to know more about the soil, trees, bugs, worms, and irrigation, and others wanted to learn about plants from their culture that would be planted for seed and stock. In the North Kohala community where the Kohala Elementary School is located, many ethnic groups or cultural regions are represented including, Japanese, Chinese, Irish, Scottish, Portuguese, Puerto Rican, Hawaiian, Filipino, Pacific Islanders (Tonga, Samoa, and Marshall Islands) and Native American. All the above was incorporated into their drawings.

After the planning and design stage, I facilitated the planning of tasks and jobs necessary to reach the goal. I believed that the students could do this easily and enthusiastically because the 2011-2012 school year was the second year of school gardening at Kohala Elementary School. They could draw upon their experience of gardening at school and at home from the past school year, and list the pertinent tasks. Notably, the students could also sequence these tasks. Based on the standards-based lessons, and on their experience they knew that increasing the soil fertility is crucial to the overall health of the garden, and thus compost building was an important first step. Here are two examples drawn from a conversation with a student and field notes:

> *Composting also recycles weeds* (Student Q, male third grade, 10/11/11).
>
> *Every Friday, Mark and Eli [not their real names], fourth grade boys, give up afternoon recess to collect kitchen scraps from the school cafeteria and to work in the school garden. I had told the students that composting helped to create fertility for the garden, and also prevented organic material from entering the landfills. Aunty Priscilla, the cafeteria manager saves fruit peels, vegetable stalks and such for the compost piles. After one month, Mark and Eli could independently collect the compost without any reminders from their homeroom teacher or myself. They grab the boxes of kitchen scraps from the*

*school kitchen, bring them down to the garden, weigh them and then toss them in the kitchen scraps compost pit. They sprinkle a light layer of soil on the compost, and then look for me to be assigned the next job. They often ask to use the pick or the largest shovels, and want to dig deep holes, or dig up huge weeds. They seem to have a sense that I trust them to work hard. Today, Mark and Eli observed that there are lots of tomato plants sprouting up from the kitchen scrap compost pile. They asked if their next project can be to transplant those into the garden. I wonder what connections they are making about the scraps to plants to garden…(*field notes 01/21/11).

Creative problem solving. This was drawn/written to describe Complex Thinker.

Title: Solve Problems.

Two stick figures, the first one's speech bubble–*I don't want to take it home or throw it away.*" Second stick figure–*I'll use it as a bookmark* (Student E, female fifth grade, 09/14/11). See Figure 8.

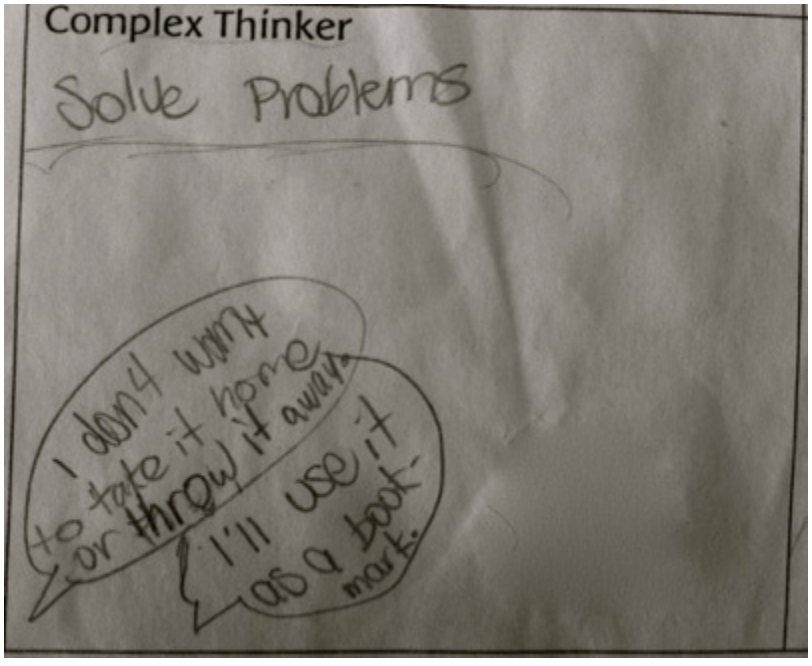

Figure 8. Illustration of GLO 3, female fifth grade.

Taken from a conversation about the school garden with the students:

You have to solve so many problems in the garden, like when it is too dry you have to water the plants, and make a irrigation to water them. Or like when there are all these bugs eating the plants, you have to kill them, but in a good way, you know, like no poison. (Student L, female fifth grade, 08/25/11).

A conversation among four female students during the garden furniture building project, transcribed from video (11/03/11):

Student J: *This wood sucks! It's rotten!*

Student E: *We have to change the design.*

Student F: *Ms. Ming Wei! Ms. Ming Wei!*

Ms. Ming Wei: *What?*

Student F: *The wood is rotten…we have to make the table shorter…*

Student J: *Or steal wood from the other project…*

Student K: *NO!!!*

Student E: *Ok… ok… let's just look for more wood on the pile…*

Student F: *Or just make it shorter…*

Student J: *I know…let's ask the boys if we can switch out wood. They are making a bench and it's shorter, we're making a table…*

Student K: *Ok! Let's go!*

Thinking complexly. When I asked Student M, male fifth grade, what he meant by *I can think more than one thing at a time*, he replied that he could *see other people's views of things*, and he could *think of a few things at a time* like gardening and math, or gardening and science. Student F, female fifth grade, indicated that she could *think like a fox*, meaning she could *think of*

many, many things at once and go here and go there to do things (08/23/11). Student P, female fourth grade, drew herself having multiple thought bubbles, each bubble contained a different pattern, one had squiggles, another lines and slashes, and another loops (09/28/11).

From a discussion about seeds on 12/14/11:

Seeds are for food and plants in the world, and that will help the nature still be there, like even if it all gets polluted. (Student G, female third grade)

Even a small seed, like a redwood seed makes a giant redwood tree…a small seed makes a big tree that helps our planet. (Student Q, male third grade)

Resource management. Student R, female fourth grade, drew herself working alone at her desk. She is smiling in the drawing and the title of the picture is She is working alone. She explained that a complex thinker can figure things out by themselves, using their own knowledge, time, and *by doing research* (11/02/11). Student H, female third grade, was listening in to our conversation and chimed in. She had drawn herself raising her hand and wrote *I'm raising my hand, I'm not just blurping out the answer*. What she meant by that drawing, she explained, was that she thought about the answer first, and checked in with what she already knew in her mind, and maybe with a friend or her mom, before she gave the answer (11/02/11). Student W, male fourth grade, drew himself taking a standardized test on a computer. He wrote in his thought bubble, *um…I should write this down*, and wrote underneath the picture *I take my time to think on how to answer the question* (09/28/11).

Quality Producer Themes

The quantitative data analysis showed that students increased the frequency of demonstrating this GLO over the course of the program. All the 13 students who wrote/drew a description of GLO 4 drew a picture of themselves doing some classroom related work such as

writing an essay, or making a poster, or answering a spelling test, or *getting an A+ on my paper test*. These descriptions can be divided into two themes, one of **neatness**, and the second of **good grades**.

Working (physically) **hard**, as a theme, did not come up among the students but it did with the adults. This was the most important GLO to one of the fourth grade homeroom teachers.

> *I like my students to work. I mean really work. Get them hot and sweaty, and do hard work. Digging dirt, and making a nice garden bed, moving mulch, that's all hard physical work. They don't do that enough. Just sit at the desks and listen to me. Not good. Not enough. Especially those kids who need to move around. Gardening is the kind of work they felt good doing and excel in. [He names two students not in the GT program] those two, in class, trouble, but in the garden, you see, always helping me, always ready to work*. (Homeroom teacher, interview #9)

The fourth theme was other indicators of quality production including **quality produce**.

Neatness. Two students specifically mentioned and drew being neat or not messy as an indicator of quality producer. In the garden this manifested as putting away tools neatly in the tool shed, creating neat garden beds surrounded by carefully placed rocks and mulch, and piling up the weeds in the composting area. (field notes, fall 2011)

Good grades. Four students drew papers or tests with a grade of *A+* as their descriptions of quality work. Getting good grades was the main theme about this GLO that emerged from the interviews with the four parents. All four parents felt that the GT garden program was a *reward* for their high achieving students. They felt that since their children *scored good grades most of the time*, they could *spend time outside the classroom doing hands-on things*, and *applying practically what they learned* (Parent interviews #1, #2, #3, & #4).

When I asked the fifth grade students if they thought they should get grades at garden class, all nine of them were horrified at the idea. Their responses included:

I love garden because we have no grades.

How would you grade us? On what? How well we weed?

Oh…maybe on how well we get along?

Or how well we know about plants and bugs?

Sorry Ms. Ming Wei, that's kinda dumb!

Garden is the funnest part of school, grades would wreck that. (field notes, 12/01/11)

Physical work. Three parents shared a similar view of physical work with the homeroom teacher quoted above. They all felt that working physically hard was important to *teach work ethics, to become physically strong and healthy, and to raise awareness of how other people labor to make our lives better and easier* (Parent interviews #1, #2, & #3).

One of the parents, who is also a teacher at Kohala Elementary School, echoed the sentiment of his colleague that *children nowadays don't know how to do physical work, like pulling weeds, they just play video games or watch TV* (Parent interview #1). One parent teasingly said that *she had to get her child a whole new wardrobe of clothes because her child, who loved the garden so much, always came home filthy*, and that was how she knew that her child *worked very hard* (Parent interview #3).

When I broached the idea of working physically hard in the school garden as a sign of being a quality producer with the third and fourth graders, they responded:

We're just having fun.

I suppose I get hot and sweaty, but I like it.

I love to feel strong.

I love digging holes – that's not work! (field notes, 12/01/11)

Quality produce. The school counselor's office faces the school garden. She is the self-proclaimed garden mother (R. Watterson, personal communications, 03/03/11). Whenever she can, she greets the students when they return from the garden to class. The students enjoy showing her the produce they grew and harvested. It was she who pointed out to them that *quality produce came from quality producers* (field notes, 04/05/11). This concept soon spread among the students, and carried into the 2011-2012 school year. Even though the students did not include growing quality produce as a descriptor in their written and drawn description, five of them mentioned it during the focus group interviews echoing what the school counselor had suggested (Focus groups #2, #3, & #4).

All four parents mentioned how they *appreciated* and *enjoyed* the fresh produce that came home with their children from the school garden. They also talked about how *proud* they were of their children who *worked hard to grow such beautiful food*. The parent who is also a teacher made the connection between quality produce and good grades. He saw that the food produced was a reflection of the effort of the students and thus like *getting an A on a test* (Parent interviews #1, #2, #3, & #4).

Effective Communicator Themes

Talking/speaking clearly and loudly was most promptly and frequently mentioned by the students when it came to describing this GLO. They wrote:

I can speak clearly.

You talk clearly.

Talking clearly.

A person that communicates loud enough for a person to hear.

This is my favorite: This student drew herself talking, and each word was written larger than the first–*Blah! Blah! BLAH!* (field notes 08/23/11 & 09/28/11).

Writing and presenting (using posters and PowerPoint) was the next most frequent mentioned theme, especially by the homeroom teachers observing the GT students presenting their knowledge to others. The skill of **listening** as a form of effective communicate arose as a theme from daily observations, student focus groups, and adult interviews, and the theme of **social communication** was created after analyzing field notes, focus group interviews, and discussions with homeroom teachers, the school principal, the school counselor, and the student services coordinator.

Talking/speaking. After observation and some student clarification, a caveat was added to the theme–talking/speaking **to be understood and heard**. The students delineated between *fun talking* and *serious talking*. Fun talking was *chit-chatting*, or *hanging out*, or *joking*, or *talking story*. Serious talking was when the *teacher or an adult talks,* or *giving instructions* (student or adult), *solving a problem, fixing a fight, making an announcement,* or *giving a speech*, and chanting the traditional Hawaiian oli. (field notes, focus groups).

In the school garden setting, giving instructions *was very important so that everybody would do the right thing* (Student U, 11/30/11). Student V thought that effective communicator was the most important GLO in the school garden as you have to give good (clear) *directions to get the garden jobs done quickly and easily* (11/30/11).

Writing/presentations. Students wrote every week in their garden journal about their experiences in the GT program. The third and fourth graders also wrote a short essay at the end of the semester. The fifth graders had to write and deliver a short speech as part of their poster

presentation about their garden expertise to second graders. Homeroom teachers of the second grade rated the speeches and presentation using the scoring rubric (Appendix D).

Social communication. There were two kinds of drawings created to describe effective communication. The first set was just one individual drawn with a speech bubble or writing. The second set of drawings had two or more people communicating. The following are captions or speech bubbles for the second set of drawings and/or brief descriptions of the drawings:

Teaching other kids–one student instructing two other students about insects.

Two people waving–they are saying *Hi.*

You can talk to other members of your group–a group of six students siting in a circle.

A person that communicates loud enough for a person to hear, the drawing is of person speaking through a microphone, speech bubble - *is this loud enough for you?*

Effective communicator is when you say please stop bothering me–one person is frowning at the other person.

Sorting things out in the garden story.

Figure 9. Illustration of GLO 5, female third grade.

Listening. The student responses about listening clustered mainly around listening to instructions from the teacher in the garden or in the classroom (focus groups #1, #2, #3 & #4). Two students (U and V) mentioned that *it is important to listen to each other.* None of the students indicated that listening was an element of effective communication in their GLO descriptive drawings and writing. I observed that the students made an effort to listen to each other during the closing moving poem. They were generally quiet and attentive. Several students, J, K, F, H, and Q in particular attempted to use an exceptional word or phrase as their contribution to the moving poem to be different from the rest of the group. They listened closely to the other students' responses, and chose different words or phrases (field notes, fall 2011). Students practiced active listening during lessons and presentations. They took notes in their garden journals which I read regularly. Students also asked clarifying and follow up questions indicating that they were listening to receive information and knowledge (field notes, fall 2011).

Ethical and Effective User of Technology Themes

The student descriptions of this GLO, ethical and effective user of technology, focused almost entirely on computer and electronic technology. Eleven of the 13 students drew computers as part of their definition of this GLO. Students drew themselves using the computer and Internet to *do quality research* and to conduct *studies and research* (field notes, 8/25/11). One student drew herself in the garden using garden tools, and another drew wind turbines. Over the course of the semester, the students also had access to and used other electronic tools such as temperature probes, pH meters, soils moisture probes, and such. Using the information mentioned, I created three themes for this GLO: **Computer-based technology**, **garden-based technology–tools and equipment**, **renewable energy technology**, and **other electronic technology**.

Computer-based technology. Students used computer-based technology to conduct research about their chosen specialty. They used the Internet to gather information. Then they typed out their reports, printed the notes, and glued the printouts on their poster boards for their presentations. Some students, especially in the third grade, needed help with information discernment. They were overwhelmed with the amount of information presented on the Internet, and needed guidance to clarify terms, and how to choose specific search terms. All of the nine fifth grade students were able to read through the information downloaded from popular sites such as *WikiPedia* and extract pertinent information. Out of the 11 third and fourth graders, only three did not need my help with understanding and summarizing the information downloaded. The three students (H, P and W) who did not need my help asked for help from their parents. Student H's mother also taught at Kohala Elementary School, student P is being raised by her grandparents, and student W's father is a teacher at Kohala Middle School. These three parents/caregivers are very active in their children's lives and learning process (parent check ins, 10/ 27/11, 11/03/11 & 12/01/11).

Garden-based technology. There were mini-lessons every few weeks on garden tools: how to use them appropriately, how to care and maintain the tools after use, and how to put the tools away neatly. Time to do the above was included into the curriculum and lesson schedule. Proper tools use is very important to me personally, and this interest was passed on to the students. Students had to earn their privilege to use garden tools. They first had to show the teachers that they could use garden gloves well, and then they moved on to using small trowels and short hoes. After they mastered that they moved on to full sized shovels, spading forks and hoes. The GT students being in third through fifth grades worked their way to using all the tools including full size pick axes, wheelbarrows, posthole diggers, and sickles. The larger sized,

bigger bodied students could handle to heavier tools more deftly then the smaller sized students. Thus, the fourth and fifth grade males, and two taller, bigger fourth and fifth grade females often chose garden tasks which needed the use of pick axe and larger shovels to complete.

Although only one student drew using garden tools as a description of this GLO 6, 14 students made mention of *ethical and effective garden tool use* during the student focus group discussions (focus groups 31, #2, #3, & #4). They mentioned the following:

Carry the tools sharp part down, below your knees.

Put the tools away NEATLY (capitals denote emphasis).

Don't break nothing!

Shovels are for digging not hoes.

I love to push the wheel barrow full of mulch.

Swing the sickle AWAY from yourself (capitals denote emphasis).

Try to work 10 feet away from each other.

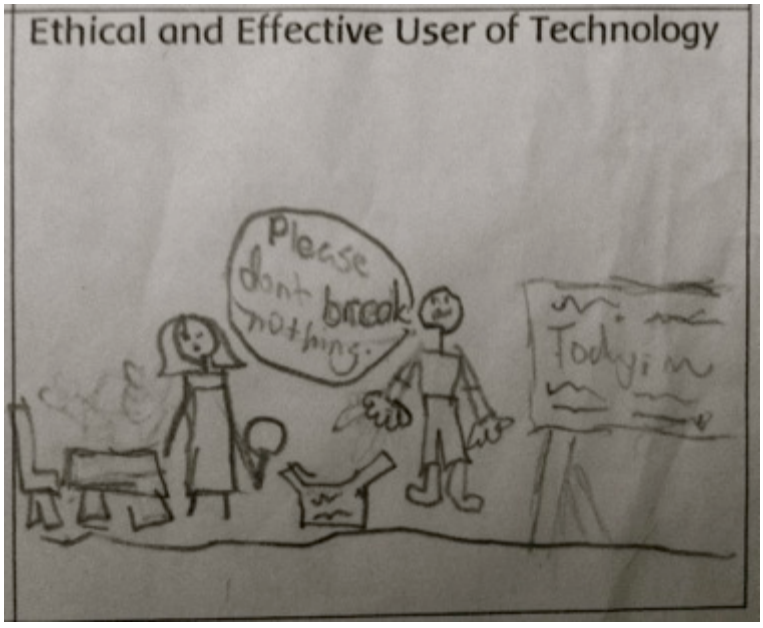

Figure 10. Illustration of GLO 6, female fifth grade.

In Hawai'i, many students do not own shoes. They wear slippers or flip-flops to school. Although students were asked to wear closed toe shoes to the garden, not all could financially afford to comply. In the three semesters I was at the Discovery Garden of Kohala Elementary School, not a single child lost a toe or cut themself with a garden tool. This includes all the Kohala Elementary School students in the garden, not only the 20 GT students studied (field notes, fall 2010, spring 2011, and fall 2011).

All the adults interviewed mentioned proper garden tools use as an important and useful skill for the students to learn and practice. The fourth grade homeroom teachers and I discussed during a check-in that students only use about seven to eight different tools in the classroom, such as writing utensils, a ruler for measuring, an eraser, pencil sharpener, scissors, stapler, and paper. The addition of garden tools such as a shovel, trowel, spade, pitch fork, hoe, pick axe, wheel barrow, rake, cultivator, mattock, post-hole digger, potato fork, and sickle, nearly tripled the number of tools the students could master (check-in notes, 10/18/11).

Renewable energy technology. The long-term plan for the Discovery Garden of Kohala Elementary School includes the integration of renewable energy technology. This way the school garden can be self-sufficient and have electrical energy to run water pumps, laptops, microscopes, and a weather station. In the climate section of the curriculum, I included a study on solar and wind energy. The students visited the Energy Lab at Hawai'i Preparatory Academy in Kamuela, a town about 30 minutes from Kohala Elementary School (field trips, 10/05/11 & 10/06/11). After learning about solar PV and thermal technology, and wind turbines at the Energy Lab, students conducted experiments and observations back in their school garden. They tracked the path of the sun in the sky, noted, wind speed, cooked with a solar oven, and so on

(field notes, 10/11 & 11/11). Two students designed a simple solar panel system for the school garden (field notes, 10/26/11).

Although only one student drew a wind turbine as part of her description of this GLO, 16 of the 20 students mentioned the field trip to the Energy Lab, and the follow up experiments conducted back at their own school garden. They also discussed what they would need to get the school garden electrically self-sufficient (focus groups #1, #2, #3, & #4). Some of their comments:

There is a lot of different types of energy.

There is potential energy and kinetic energy.

The sun is reflecting on the mirrors and making it focus in the liquid (describing the solar oven experiment).

You don't have to burn stuff to get renewable energy.

Renewable energy is better for the planet.

We have sun in the garden; we can put panels on the roof to run the water pump.

Our whole school should go solar!

Other electronic technology. The students clearly enjoyed using the electronic probes to conduct soil tests, to measure temperature changes in the solar oven and Energy Lab. They treated the electronic tools carefully; taking turns to use the probes, sharing information with each other, and putting the tools away carefully and neatly after use. Students also used wattmeters to measure the energy use of different appliances. The use of these probes and tools was not new to these students as Kohala Elementary School has a privately funded, supplementary science program with a veteran teacher. This teacher integrates the use of such tools in her science program (field notes, fall 2011).

Other Non-GLO Themes

Three non-GLO themes emerged very clearly and early on in the program. They are ecological literacy, motivation, and gratitude. I present definitions of each term within the discussion of the related theme. As with the GLO themes presented earlier, I weave in quotes, stories, and observations that support the categorization.

Very early in the program, it became apparent to me that the practice of the moving poem was a consistent, regular, nonthreatening, and authentic means of assessment. The moving poem was the closing activity of every class. After all the tools were put away neatly, the children gathered in a circle in the outdoor classroom. They would think of a word or phrase that would describe a combination of what they did in the garden, how they felt, and/or what they learned. I paid close attention to what was said, and to who said it. These poems were audio recorded and then notated in the field notes for the day. I present briefly, a selection of words and phrases from the transcription of the first moving poem of the program. This is to show the reader how the above-mentioned three themes began to emerge very early in the study.

The first moving poem of the semester on August 18, 2011 included these words/phrases:

Happy.

Grateful.

Do good for the earth.

I like coming to GT in the garden.

I like planting.

Cow manure is stinky, but compost isn't.

Not in boring classroom!

Soil, soil, soil.

Ecological literacy

Orr (2005) wrote, "An ecologically literate person would have at least a basic comprehension of ecology, human ecology, and the concepts of sustainability, as well as the wherewithal to solve problems" (p. xi). According to Hardin, as cited by Orr, ecological literacy is the ability to ask "what then?" (p. 85). The students demonstrated caring for the earth (*malama 'aina*), stewardship, and judiciousness by managing limited resources such as water, plant starts, and seeds, and by composting. The following is taken from a conversation while working in the garden:

Ms. Ming Wei!

Yes?

Gardening helps the earth doesn't it?

What do you mean?

We are cleaning up the rubbish and then planting plants and trees. Plants give oxygen and take carbon dioxide. That's a good thing right?

Plants are very beneficial, they do provide oxygen.

Yup! I knew it; gardening is good for the earth (field notes, 09/21/11).

A fifth grade homeroom teacher shared:

Most kids don't know where their food comes from, or oxygen, or houses. It all comes from plants that rely on the sun and soil. I use what the kids learn in the garden with you in my class, extending the discussion into ecology and economy. I talk about interdependence and symbiosis. They all get that we have to mālama the 'āina (care for the earth). (Homeroom teacher, interview #12).

Student F wrote: *I think garden was a good idea because it makes us more ready for the world* (11/02/11).

Motivation

Intrinsically motivating activities are those in which people will engage for no reward other than the interest and enjoyment that accompanies them. After one month of the GT program, six students, all females, four fifth graders and two fourth graders, asked if they could give up recess and come to work in the garden instead. I could not say no to such a request. They came faithfully of their own accord; I offered no extra credit grades, no privileges, nor a reduction in GT homework. I did let them harvest extra produce to take home, many declined, they just wanted to help (field notes, fall 2011). Some of these students gave up recess twice a week, once to help generally, and the other time to assist the first graders in the garden (reported by school counselor, 12/12/11). According to the first grade homeroom teachers these students were very helpful, and the younger students really looked up to them. Again, it seemed that intrinsic motivation was driving the action as the first grade homeroom teachers also did not offer anything to the students but an occasional bookmark or pencil as a thank you gesture (field notes and weekly check-ins, fall 2011).

Gratitude

This theme became clear only after several discussions and check-ins with teachers and school administrators. Several teachers had used the following writing prompts in various combinations with their whole class in October 2011:

- What did you learn in the garden?
- Which GLO did you practice in the garden?
- What do you like best in the garden?

- Why do you think having a garden in school is important?

I culled the essays of the GT students and found the following words and phrases, I kept the original spellings:

Student T: *Thank you, thank you, thank you for letting us have a garden in school.*

Student P: *I realy appreciate it* [the garden].

Student D: *The garden is one of the most exiting [exciting] places for me so far. It has taught me a lot of stuff and I hope other people feel the same too. I hope it last. I want to do way more with the garden still*.

Student J: *I learned about soil tests, growing veggies tricks, and of course the taste of good veggies. Thank you!*

Student H: *I am so gretful* [grateful] *they let us have a garden at school. Here we have flowers and veggies and butterflys and beauty*.

Other Findings

This is a very brief section to report on the subject content acquisition of the students in the interdisciplinary standards-based school garden education program. The highlight performance for these GT students was the end of program mini-STEM fair. Students set up stations around the school garden where they had posters, PowerPoints, sample experiments, preserved bugs, and such on display. These were based on their areas of expertise (see Table 3). Kohala Elementary School students, teachers, administration, and school community were invited to come to the school garden to watch and listen to the 10 minute long presentations. In order to accommodate about 400 people, the students had the fair for two days. The visitors rotated around the stations. All the teachers and administrators, and a few community members, where given rating sheets to score the students' presentation (Appendix D). The results were

unanimous. All who attended could tell that the students knew their topics and subjects very well. Some feedback included ways to improve on communication skills such as, keep eye contact, or don't talk as you turn away from the audience, and so on. This feedback was shared with the students who quickly assimilated the information and showed an improvement on their second day. This improvement was noted by three administrators and one community member who attended both days of the fair. (field notes, 12/07/12, 12/08/12, & 12/14/12).

A short essay by student T, female fourth grade (12/15/11) with original spelling:

I learned how to not over water plants. I learned how to use a plant in a diffrent way instead of eating it. A taro leaf can be used as a umbrella and the green onion can be used as a straw. I learned how to harvest taro leaves. First you need gloves on and a bag to put the taro leaves in and you need scissors. I learned how to harvest a zukini. First you need gloves on then you just try to deatache it from it vine. I learned what plants store in other places besides the fruit. I learned how to work together with others to make a nice successful garden.

Quantitative Analysis of Rubric

Students filled out a self-reporting rubric prior to and at the end of the program (Appendix C). This rubric looked for frequency of demonstration of the GLOs and the motivation to apply and demonstrate the GLOs. I also requested and received copies of the GLO ratings given by the nine homeroom teachers to the 20 students for quarters one and two of the fall semester 2011. These ratings from the homeroom teachers allowed me to triangulate the findings. I compared each student to him or her self and not to the group, looking for individual changes in each student.

Three of the 20 responses turned out to be invalid, the students were absent for either the pre- or the post-survey. Of the 17 valid responses, 6 showed very little or no changes in the responses. Four of these were fifth grade students who were in the GT program for three semesters, fall 2010 to end of fall 2011. They were part of the pilot study school year 2010-2011. The other two were fourth graders, one male and one female, both new to the program. The self-reported ratings of five of these students matched closely the ratings given by their homeroom teachers. One fifth grade female (student K), self-reported at a higher rating than her homeroom teacher for the pre-survey. However, her post-survey self-reported results matched her homeroom teacher's ratings. The teacher reported that she felt that student K made noticeable improvements in her conduct and GLO demonstration over the course of the GT program (check-in 01/12/12).

The rest of the rubrics were sorted into two groups. A group with significant changes in the frequency of demonstration, and the other group showed changes in motivation. One student D, fifth grade male reported both, changes in frequency and motivation.

Seven students self-reported an increase of frequency in demonstrating the GLOs. Four of these students were in the fifth grade, of which two (students A & E) were new to the GT program. They did not participate in the pilot study. Two others were fourth graders, one male and one female, and the seventh student was a third grade male. Six of the seven reported increased demonstration of GLO 2–community contributor. Five reported an increase in demonstrating GLO 4–quality producer. Five reported an increase in demonstrating GLO 1–self-directed learning. Two students reported an increase in GLO 3–complex thinking, and two reported an increase in GLO 6–ethical and effective use of technology. Only one reported a change in demonstrating GLO 5–effective communication. This data was compared to the

ratings given by the homeroom teachers, and found to be closely matched and congruent. It seemed that most of what the students self-reported about their conduct in the garden was also seen by their homeroom teachers in the classroom.

Five students reported changes in the motivation to apply or demonstrate the GLOs. They progressed from being externally motivated, *my teacher says I have to*, or *my friends*, or *my parents expect me to*, to being internally motivated–*I want to*. Two were fifth grade males, both in the program for three semesters. Two were fourth grade females, and the fifth was a third grade female. The self-reporting for the motivation element is congruent with the observations and interviews of the five above-mentioned students.

One student, fifth grade male, reported a decrease in frequency of demonstrating GLOs and a shift towards more internal motivation. The GLO ratings from his homeroom teacher matched this student's self-reported rating. This teacher mentioned that she was concerned about this student in general, seeing how he was overall *doing worse as the school year went on* (check-in 01/12/12).

Discussion of Findings

When I got back to Kohala Elementary School in late July 2011 to begin setting up for this research project, I felt a joyous, accepting welcome. The establishment of the Discovery Garden at the school during the 2010-2011 school year, and pilot study of the GT program in the same year were both viewed by the school community as very successful. Then in August 2011, Danny Garcia, school principal received some fantastic news. Kohala Elementary School not only met and exceeded expectations for the Adequate Yearly Progress (AYP), the school was also awarded the Distinguished School: Continuous Growth Category Award by the State of Hawaii Department of Education for the 2010-2011 school year (D. Garcia & J. Colson, personal

communication, 08/20/11, & Hawaii State Assessment Report, 8/22/11). On October 27, 2011, Danny Garcia took two of the fifth grade GT students with him to the Distinguished School Awards ceremony in Honolulu, Oahu.

Both Danny Garcia and the Edison Learning consultant, Jane Colson, attributed some of the success of the school in meeting the AYP to the school garden program. They noted that the school garden offered the teachers an *outdoor laboratory in which they could integrate science and math,* as well as aesthetically pleasing setting where students could *just go and look and be inspired by beauty.* They also mentioned that the garden was a place where pecking orders were shifted and student roles changed. In the garden students who may be *underperforming on academic studies can excel as agricultural leaders, and students such as the GT ones can learn to improve their interpersonal skills* (talk story, 8/22/12, 9/14/11, & 10/5/11).

The objectives of the interdisciplinary standards-based school garden curriculum are to:

1. Teach the six GLOs.
2. Provide opportunities and settings for the learning of the six GLOs.
3. Support the students' continued development and demonstration of the six GLOs.
4. Reinforce lessons, skills, and knowledge of STEM subjects.
5. Reinforce and integrate standards-based knowledge and skills of science, mathematics, social studies and language arts disciplines.

I believe that the findings presented in the previous section show that the objectives were met. But why, and how did it work?

The Curriculum is Consciousness Appropriate

As discussed in the section on child consciousness development in the literature review, though leaders and exemplars in this field posited that children, ages 9-12, the ages of the GT

participants, learn by experiencing and doing. Steiner (1996b) wrote, “we must not chain children’s minds to finished concepts, but give them concepts that can grow and expand further. We must give them living concepts that can be transformed” (p. 109). The lifecycle of a plant is a metamorphosis of shape, size, color, and smell. There is noticeable change every day.

After the students chant their entering oli, they have 2 minutes to explore the school garden quietly. They excitedly skip towards their favorite plant, or area, or to the animals. They look at what has changed and developed, reacquaint with nature, and smell and touch anything they can in the garden. Piaget concluded that the child’s “development of an accurate representation of physical reality depends on the gradual coordination of schemes of looking, listening, and touching” (Bransford et al., 2000, p. 80). They notice how much a plant has changed and grown overnight and from week-to-week. They develop a strong relationship with the place and become very protective.

After being in the school garden for several weeks and developing an understanding of the needs of the place, they can self-direct in a responsible manner for a positive garden outcome. Kellert (2002) has reminded us, “Rapid cognitive and intellectual growth occurs including many critical thinking and problem-solving skills achieved through interaction and coping in the nonhuman environment” (p. 133). The garden provides such direct, clear, and quick feedback. Neglect to water; the plants die. Water too much; the plants die. Walk off the paths; the plants die. Conversely, spread compost into a garden bed, work it in, and tasty vegetables grow. Or keep track of watering and you get to eat delicious fruit. Carefully weed and hoe, and large carrots grow. The feedback from the garden can be seen, felt, smelled, and tasted. Some children claim they can hear the plants; who I am to question that? (field notes, spring 2011 & fall 2011). The feedback from the school garden matches and fit these elementary age

children (years 8 – 11). It is tangible and concrete. No wonder Piaget (1954) called this the concrete operational stage of child development. The plants provide feedback so that the children know they have solved the problem well or not.

During this age, children learn by doing, and when there is an artistic reflection on the doing, the experience can be very educative (Dewey, 1934 & 1938). Experiences which are "interactions across the boundaries of conventional knowledge" (Orr, 1992, p. 90) or interdisciplinary can be even more educational. The curriculum used for the GT garden program was interdisciplinary and included reflection opportunities in the form of art, prose, and poetry.

As shown in Figures 8 through 11, the illustrations reveal that the students pay close attention to their surroundings, echoing Kellert (2002) who wrote, "this [age] is a time of greatly expanded interest, curiosity, and capacity for assimilating knowledge and understanding the natural world" (p. 133).

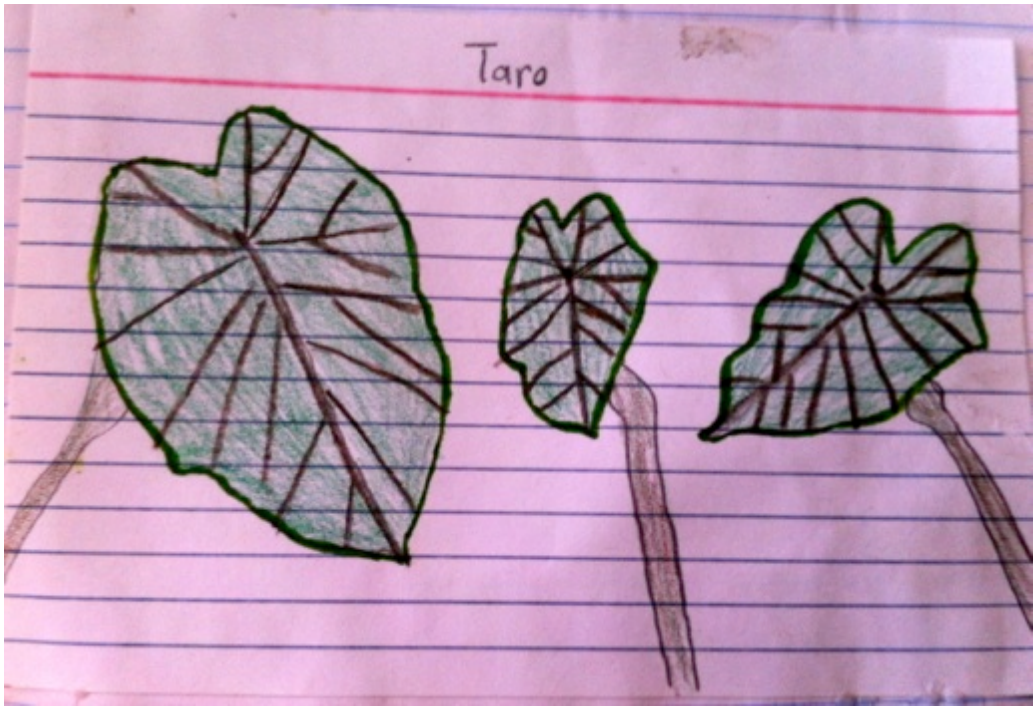

Figure 11. Taro leaf and stem, illustrated by female fifth grade.

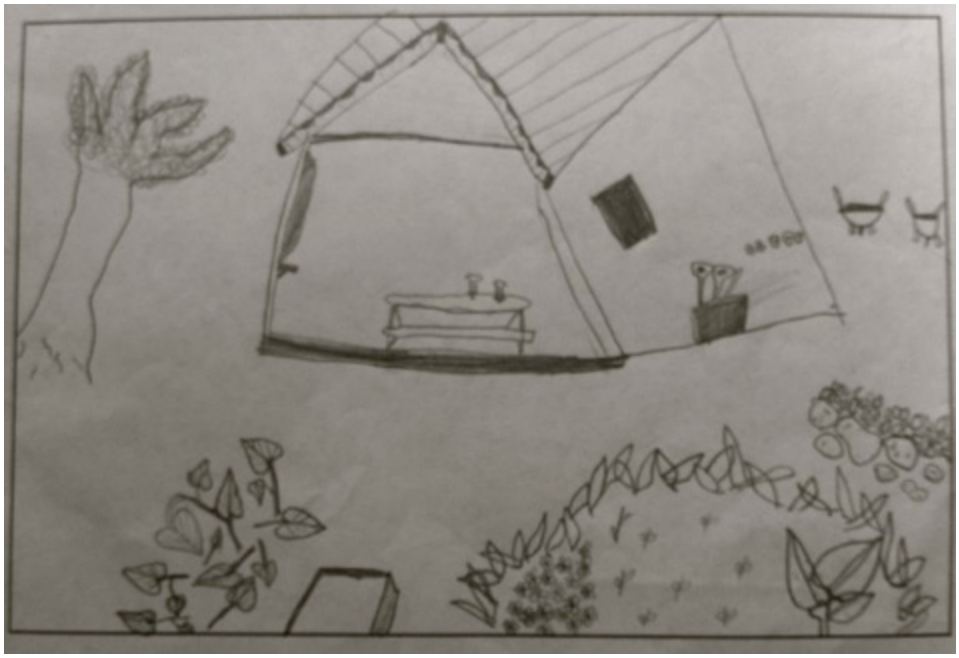

Figure 12. Sketch of the school garden outdoor classroom, illustrated by female fourth grade.

Figure 13. Sketch of her own hand, reaching to plant, illustrated by female fourth grade.

Figure 14. Sketch of leaf from a collected specimen, illustrated by male fifth grade.

The analysis of the quantitative data showed that GLO 2, community contributor, and GLO 4, quality producer were the two skills the students increased in demonstrating. Growing and sharing healthy produce provided the opportunity to combine the demonstration of those two GLOs simultaneously. This sentence by student K captures the two-foldness perfectly, *the school garden improves our community by having healthier food instead of shipped from a different country.* Students recognized that the produce we grew in the school garden was fresher as it did not come from the mainland on a barge travelling for a week across the Pacific Ocean. The students also compared the produce from the school garden and store bought produce using a Brix meter, and noted that the school garden produce had a higher sugar, nutrients, and dissolved minerals count than the produce from the mainland acquired from the local grocery store. The effective use of technology supported the students' claim of growing healthier food in the school garden.

When I shared this data with the student services coordinator of Kohala Elementary School, she was not in the least bit surprised. She shared:

> *Of course, that makes sense. Now they have something tangible to show for quality. Sure an A on a test is good work or a good producer. But quality, now that is a whole other value. With the veggies they grew and shared, they could taste and smell the quality. They could feed their families, they could produce something really helpful. Food, as you know here in Hawai'i, food is very important, and is sometimes a struggle. Now they know what quality food is, and most importantly how to grow it, and how that knowledge is an asset in the community*. (phone conversation, 01/12/12)

I presented in the Children and Nature section in Chapter Two how crucial it is for a child to keep alive his/her inborn sense of wonder through the discovery of nature with the companionship of an adult (Carson, 1956; Kellert, 2002; Pyle, 1993). Inherently built into the curriculum, were opportunities for the students to work alongside a school garden teacher who sincerely cared for the school garden. This adult was an intrinsic part of the school garden community. The other adults such as homeroom teachers, administrators, parents, and community members were direct recipients of the students' honorable labor through the partaking of the quality produce grown by these children.

Kellert (2002) posited that during the years of middle childhood, ages 6 – 12 approximately, children are most able to develop the following four values of nature: humanists – emotional bonding with nature; symbolic – nature as source of language and imagination; aesthetic – physical attraction and appeal of nature; and scientific knowledge and understanding of nature (p. 132). Developing these values of nature in the school garden is also beautifully illustrated in Figures 8 – 11. As the children discover nature in a consciously appropriate manner through emotionally bonding with nature, being inspired by nature, recognizing the beauty and intricacies of nature, and through scientifically studying nature, the children learn to discover and

explore the self. They discover that by practicing the Hawaiian value of *malama 'aina* (caring for the earth) they discover themselves as community contributors and quality producers.

The Curriculum is Situated in the Structural-Development Theory Framework

In *Experience and Education*, Dewey (1938) wrote, "Every experience is a moving force…every experience lives on in further experiences. Hence the central problem of an education based on experience is to select the kind of present experience that live fruitfully and creatively in subsequent experiences" (pp. 27-28, 38). As the designer of the interdisciplinary standards-based school garden curriculum and educator using the curriculum, I have the responsibility of choosing consciousness appropriate activities and reflections, and am duty-bound to scaffold these activities and reflections so that they support accumulatively the development of self-directed learners, community contributors, complex thinkers, quality producer, effective communicators, and ethical and effective users of technology. For this very reason, I chose to begin the program with an in-depth study of living soil.

Just as the plants must be rooted in the soil to thrive and grow, the students needed to be grounded in behavior expectations that exemplified the six GLOs. Over and over again during the course of the program, I discussed what the six GLOs meant and how they may be demonstrated. I encouraged the metacognition of the GLOs in the students' reflection of their time in the school garden. Collectively, the students and I built upon each positive experience of all the six GLOs, and most importantly we had fun. The following is taken from my field notes, 08/31/11.

> *Ms. Ming Wei! Look! We are community contributors! shouted students C and D, both fifth grade males. The two boys were standing on a spading fork, on each side of the handle, rocking the fork back and forth, digging deeper and deeper into the soil.*

And we're having fun! one exclaimed laughing as the other fell off the fork.

I had to admit, they were getting the assigned task done, which was to loosen the soil in the garden, bed, and working together. I walked away, smiling.

A few minutes later, I heard my name again. When I walked over, students C and D had recruited students L and M. Now there were three spading forks in the ground in a line, and four students working the forks by standing on them and rocking back and forth.

Community contributors – wooohooooo! they yelled.

I wonder if Bandura ever had this experience.

As the students discovered different ways of learning through projects, garden tasks, and nature observation, they were learning more about what it means to discover a sense of self through their relationship with food and place. They were learning about their own physical, mental, and emotional capacities through the experiences in the school garden. The organization of the curriculum created a somewhat predictable setting in the school garden. The students knew how to enter the school garden, what behaviors were expected and approved of, and how to exit. This rhythm and routine supported their scaffolding of knowledge and encouraged personal and intellectual growth. The school garden was not only a place at school safe from crime and other undesirable activity; it was also a safe place to experience nature and self.

The Curriculum is Food, Place, and Relationship Based

Noho ana ke akua i ka nahelehele	The god resides in the thick vegetation
i ālai ʻia e ke kīʻohuʻohu	That is hidden by the clinging mists,
e ka ua koko	By the low-lying rainbow.
E nā kino malu i ka lani, malu e hoe	Beings sheltered in the heavens,
E hoʻoulu mai ana ʻo Laka	Continually watch over us.
i kona mau kahu	Laka will confer growth on her caretakers.
ʻO mākou, ʻo mākou nō, a	It is us, Us indeed!

We began every school garden class by chanting the Hawaiian oli above. Kumu Gonsalves, the Hawaiian Culture teacher at Kohala Elementary School taught it to the students as part of Hawaiian studies class, and we adopted it as the opening chant to ask permission to enter the fenced in area of the school garden. Rhythmic clapping accompanied the chant which added to the excitement and joy of reciting it. This precept to every class quickly and easily set us in the place and space of Hawai'i, in the relationship of being caretakers of the *'āina* (earth), and in deep respect of the work we were about to do in the garden. After all, the gods were watching. We used our voices, ears, hands, and eyes to establish a connection with the school garden, all that is contained within the fences, and all that surrounds it. Sometimes we noticed a flowering tree by the school garden, and directed our chant toward it. Sometimes the chickens joined us by clucking along. Sometimes it sprinkled on us even when the sky was blue as we chanted. Hawaiians regard being rained on highly; it is deemed a blessing.

We did not cook as a class as often as I would have liked, just twice in the fall of 2011. Once we used the solar oven to steam vegetables, and another time we made a huge salad. But we grazed every time we were in the school garden, and the students took home produce for their families weekly. When I shared the data that the students showed an increase of frequency in demonstrating GLO 4 quality producer, to other school garden teachers outside of Kohala Elementary School, one veteran teacher said the following:

> *An A on a test is nice but it is not relevant to Hawaiian values. Food is. Recall the story of taro, we are the younger brothers and sisters of taro. We would not be here but for the food and sustenance the 'āina provides. They have a relationship to the food, not to the letter grade. That is fleeting, food is permanent. Yes, I can see why they understand and*

connect quality producer to quality produce. (N. Redfeather, personal communication, 01/05/12)

As the students established ties with the school garden through their learning, working, and playing in the blessed space, the sense of community became more tangible. They collaborated to solve complex problems; they pushed the heavy wheelbarrows together; and they clustered close to each other and the plants. The children often touched and stroked the plants in a gentle, kind manner. Maybe they felt they this was one of the ways to touch the gods who watched over us in the school garden, to be in community with them as well. Whatever the reason, having a curriculum that supports a deep and delicious exploration of food, place, relationships, and self supported the students in being *more ready for the world* (Student F, 11/02/11), and in their understanding of *'Ā'ohe hana nui i 'alu like kakou* - No work is large if we work together.

The Curriculum Provides for the Realization of the Dimension of Time

The second unit of study in the interdisciplinary standards-based school garden curriculum is climate, and our school garden's relationship with the sun, wind, and weather patterns. Students tracked the path of the sun, noticing where it is sunny and shady in the garden, and when. They took note of the wind patterns, and when it blows, and from where. They became more cognizant that we have seasons in Hawai'i. There is a distinct rainy, wet season with shorter, cooler days, and a drier, warmer season with longer days. They experimented and saw that the same vegetable will take longer to mature in the shorter day period, than during the longer day season. And they learned to wait, and wait, and wait for a seed to germinate and sprout. I remember when I first started school garden classes in the fall of 2010 at the Discovery Garden of Kohala Elementary School. A little child in first grade, was every excited when he got

the task to plant sunflower seeds in a freshly prepared garden bed. He carefully dug a small, shallow hole, imitating exactly my actions. He gently placed the seed in the hole, carefully brushed a little soil over it, ran to get the watering can, watered the seed, and then stared. He stared and stared at the wet spot in the ground. After a few minutes, looking very disappointed, he turned to me and said, *nothing happened. The seed must be broken.*

In our fast paced, video game world, we are encouraged to focus on achievement, not self-realization (M. Holt, 2005, p. 57). We all need time to think, reflect, and assimilate. How much time each individual needs to self-actualize is unique to that individual. You cannot rush learning and understanding, just as you cannot rush the germination process of a seed. They know that quality produce take time to grow. Student R wrote: *something that I'd like to know next year, is why plants take so long to grow or why do they take so long to grow flowers, fruits or vegetables?* (journal entry, 12/14/11).

The intention of this school garden curriculum is to achieve understanding of the GLOs, related STEM content, and other subjects, not compliance. The students very seldom complete all that I have planned for the day in the school garden, and they almost never want to leave (field notes, fall 2010 through fall 2011). They enjoy the time in the school garden, for it is real time.

Summary

The garden helps me learn form my mistakes and makes me do it over. The garden also helps our health because we work hard and get plenty of exersize. Bit the best thing is that we make our bond stronger and make Kohala a better place. Fifth grader, with original spellings.

The garden can help you learn by discovering new plants. The garden helps your health by eating well and losing wheight. The school garden improves peoples moods, leading to a happier community. Fifth grader, with original spellings.

The garden helps you learn by learning how the plants grow and how to work together. The garden helps your health by eating healthier food without chemicals and you get a lot of exercise

doing the work. The school garden improves our community by having healthier food instead of shipped from a diffrent country. Fifth grader, with original spellings.

The paragraphs above were written in response to:

1. How does the school garden help you learn?
2. How does the school garden improve health?
3. How does the school garden improve our community? (field notes, 03/03/11).

Moving poem composite (field notes fall 2011):

Having fun and doing well

Being a community contributor

Break from class and substitute

BEING AWESOME!

Having fun and learning

Pitchforks

Feeding a giant

Teamwork makes for beautiful garden

Beautiful feats

Enjoy

Fun and challenging

Working and planting

CAN

Growing

Soil

CHAPTER VI

CONCLUSIONS, CHALLENGES AND RECOMMENDATIONS

> *Through learning gardens, we are seeking to help students to reflect on the fundamental questions of what it means to be human. In the process of learning from the gardens, children and youth begin to appreciate ways in which the health of individuals, the health of the land, and the health of their communities are intertwined. Learning gardens on school grounds provide diverse and rich texts for nurturing students' connection with the more-than-human world. Direct engagement with life in the gardens brings children into contact with a richly biotic world of living soil that is too often "out of sight' and out of mind." Much more than a fanciful educational trend, learning gardens challenge mechanistic perceptions of living systems as complex machines and remind us of the interconnectedness of all life. Beyond the blossoms and bountiful harvest of the garden themselves, though, lies the hidden living soil that sustains the entire system.*
>
> Dilafruz Williams & Jonathan Brown

Conclusions

I returned to the Discovery Garden of Kohala Elementary School for a visit in February 2012. When I arrived, I was mobbed by a group of second graders. They wanted to know why I have not been around. Telling them that my data collection period was over seemed rather lame. So, I just smiled and hugged as many of them as I could, and headed toward the school garden.

Auntie Hoku, the new garden teacher, looked at home and at ease in the garden. There are flowers, vegetables, and herbs thriving. There are now three new dry-land taro patches, one for every fourth grade homeroom. Several fifth grade students were pruning the pigeon pea shrubs, and collecting the pods for distribution among the younger students. The chickens were clucking contentedly, and scratching for the pigeon peas tossed in the chicken tractor by the students. Auntie Hoku was writing the lesson of the day on the chalkboard in the bamboo outdoor classroom. My heart was filled with joy at the scene, seeing so much of my efforts paying off.

A fourth grade homeroom came with their homeroom teacher to the garden. They began by chanting an *oli* at the gate to ask permission to enter, to evoke positivity and blessings. They walked in calmly and sat on the floor of the outdoor classroom. Auntie Hoku taught the lesson of the day about the connection of *wai* (fresh water) and forests. She is following the curriculum I created for the garden, but with her own cultural adaptations and scientific expertise. She made connections from the water in the forests to the water cycle in the garden. She guided in the students in recalling the Hawaiian names for the moon phases and related the moon cycle to water cycle. When prompted, the students provided excitedly, examples of water conservation, water cycles, moon phases, and plant and water relationships.

After the lesson, the students chose garden tasks, gathered tools, and spread out all over the garden to work. Auntie Hoku, the homeroom teacher, and I used that time to catch up with each other. The children needed very little adult supervision for they were so home and at ease in the garden. They knew exactly what was expected of them and without any argument or hesitation, performed their tasks happily. We talk story while we watched them.

When it was time to end the lesson, most of the students put away their tools carefully. Their peers reprimanded those who did not put their tools away neatly. Then they gathered back in the outdoor classroom for closing moving poem. This time, as an observer, I was the one who was moved.

Another class came into the garden, and a similar rhythmic, pedagogically structured lesson took place. Auntie Hoku did not repeat the lesson described above. Instead, she adjusted her teaching in response to a question a student had. The children are calm though excited, respectful of the land and of each other. Auntie Hoku told me a funny story. One day, two fourth graders were sent to her for a day's work of detention. They spent the day digging holes for

fence posts, wearing huge smiles on their faces. At the end of the day, while putting their tools away, Auntie Hoku overheard them plotting to misbehave again so that they could come back to work in the garden all day. It seems that they did not learn the lesson that this action was meant to teach. Auntie Hoku laughed, "They practiced GLOs while working all day, I hope it transfers."

I often found myself surprised when I asked the students, "what did you learn in the garden today?" to receive answers which were the exact concepts I sought to teach.

"I learned how plants and soil are connected."

"I learned about bugs above and bugs in the soil. We need them all. "

"I learned that teamwork is important."

"I learned how we need the sun for everything."

"I learned that experiments don't always give you the answers you think you will get."

I wondered at my surprise. Did I think that the children were just saying things they thought I wanted them to say? Why did I doubt that they were truly learning? After all, I did set out through this project, to demonstrate the pedagogical prowess of school gardens. When I visited the Discovery Garden in February 2012, I was not surprised when everything was running smoothly, beautifully, and with rich academic content. I was honored. Then I understood. When they recounted what they learned in the garden, my students honored me, their families, their teachers, the school, and their community. When the students shared what they experienced and learned in the school garden, they were showing us in their own way how and what they discovered of themselves. When they chanted their *oli* and behaved in a *pono* manner, they were respecting and perpetuating their Hawaiian culture as was the hope of their *ali'i* King

Kamehameha III who gave Hawai'i the state motto: *Ua mau ke ea o ka 'āina i ka pono* - The life of the land is perpetuated in righteousness.

In *Learning Gardens and sustainability education, bringing life to schools and schools to life*, Williams and Brown (2012), shared the perspective of Carlos Garcia, superintendent of San Francisco Unified School district, an avid school garden proponent.

In his words:

- I would not want people to think of gardens as "just a garden." Rather, I want them to think of gardens as being better than a textbook.
- To me, school gardens are an academic issue.
- I believe that we can use gardens as an educational tool, make learning joyful, fun and relevant. Every child eats food. Gardens create connections between what students see in the market and what they get in science and in writing. The educational value is most important – gardens make education relevant. (p. 194)

Across the large pond of the Pacific Ocean, Danny Garcia, principal of Kohala Elementary School shared this perspective:

> I wanted all my students to use the garden as a laboratory of discovery. That's why I call it the Discovery Garden. My most involved student, Na'a (not his real name), is autistic, and has a full time aide with him all day, and weekly occupational therapy (OT), and physical therapy (PT) sessions. When his OT suggested that she use gardening as a tool for teaching Na'a, I jumped to support it 100%. Ming Wei, the school garden teacher worked with Ms. N to create situations in the garden for Na'a to learn particular skills. For example, Ms. N wanted Na'a to practice crossing his midline by twisting a piece of rope of string around a vertical stick. Ming Wei got Na'a to plant pea plants, and to

> weave the plants up the trellis behind it. Na'a built a rock wall for the school garden to learn how to sort sizes, largest rock on the bottom, smallest on top. And then he planted pollinator-attracting plants on top of the wall. The Discovery Garden can meet the academic and educational needs of all my students, from the youngest to oldest, from the most involved student like Na'a, to the gifted and talent students. The garden does not discriminate. It is open and giving, a reflection of the *pono* culture we need to promote. The GLOs, they give some direction to understand the pono culture. Self-directed learning, complex thinking, community contributor, quality producer, effective communicator and ethical use of technology, they are all outcomes of a pono culture. (personal communication, field notes, fall 2010 – 2011)

When Danny shared the above with me, it validated the work and effort taken to understand the six GLOs from a Hawaiian cultural and value perspective. Less than a hundred years ago, the Hawaiians were self-sufficient, feeding themselves from land and sea. We are so far removed from that practice in this century, importing 85% of our food and 90% of our energy sources. We are educating our students for a future we do not know about. Changes in technology, climate, globalization, and culture are happening rapidly. Some of the skills I learned as a child are now obsolete. However, the six GLOs are life-long skills, culturally pertinent and ageless. I believe that these are some of the skills needed to help us create a sustainable future.

I stated before that my first assumption of education was: the purpose of education is to help us create values in our actions, develop love in our thinking, and foster equality and righteousness in our emotions. I believe that the findings of this research project exemplify that the interdisciplinary standards-based school garden curriculum used in the Discovery Garden at

Kohala Elementary School was a positive step in the direction to meet the purpose stated above. As students develop and apply the six GLOs, they can create values in actions; they can care for the earth in the place and space of the school garden and thus, can develop love in their thinking; and they can foster equality and righteousness (pono) in emotions as they work with their community around food.

Challenges

The diversity of learners in the GT class

As stated in Chapter Four, the participants for the GT program, which was the convenience sample for this research project were selected without any input from me. The third, fourth, and fifth grade homeroom teachers chose the participants based on knowing that those students would benefit from an academically challenging, socially engaging, and physically active program. As I conducted the program, I realized that the criteria of being in a program that was "socially engaging and physically active" played a more important role in the selection process than I originally perceived. After discussions with several expert Hawaiian educators and a deeper look into test scoring, I realized that the score of 300 on the Hawai'i State Assessment, while it may have been perceived initially as high, actually meant "meeting proficiency" (Family Score Report, 2010-2011). Thus, instead of having only high participants in the program, these participants presented as having a wide range of learning styles and abilities. The students in this GT program may not have been labeled as GT under different criteria and standards. To me this meant that the sample of 20 students, while convenient, could also be a close representation of Hawaiian students in that age group. I will not go as far as to generalize my findings but knowing the above has aided my work in developing the curriculum further to meet the academic needs of all students in the selected age group.

I write about the diversity of the GT class here, not because it was a negative challenge to work with these students. On the contrary, it was always a delight and invigorating to adapt plans and lessons on the spot to meet the students were they were. I write about it here because I want to challenge the mechanistic, transmissive, and formulaic education we force on our students. All students benefit from experiential-, place-, and project-based education. Now, I am even more motivated to continue to be a proponent for experiential-, place-, and project-based learning such as this program at the Discovery Garden of Kohala Elementary School.

Not "Just a garden."

The modern challenges we face include a mechanistic world view and an unquestionable trust in technology (Orr, 1994; Williams & Brown, 2012), a reduction in access to natural spaces and engagement with more-than or other-than human phenomena (Chawla, 1988, 1994, 2002; Kellert, 2002; Louv, 2005), and food insecurity coupled with diet-caused illness (Kirschenmann, 2008; Williams & Brown, 2012).

Computer animated games and illustrations where a seed instantly germinates and sprout into a plant are not accurate or truthful. It is becoming the norm for children to spend less than 5% of their waking hours outside, while many of them spend more than six hours a day in front of a television or computer screen (Williams & Brown, 2012, p. 9). The amount of personal income spent on health care for a typical United States citizen (when Medicare taxes are included) has increased to 18% while the percentage spent on food decreased to 10% (Kirschenmann, 2008, p. 108).

As demonstrated in this research project, an interdisciplinary standards-based school garden curriculum provides an opportunity to teach children about the link between the biosphere and culture-sphere, and about sustainable food systems and health, while practicing

and applying life-skills such as complex thinking. What else needs to be done so that there is *a garden in every school*, as envisioned by Delanie Eastin, former California State Superintendent of Schools, and that these gardens are an *academic issue*, as stated by Carlos Garcia (Williams & Brown, 2012, p. 194).

There are three challenges. The first is the need to prove the validity and rigor of school gardens as a means to teach academic and indirect outcomes. The second is the lack of school garden coordinator and teacher training that is rigorous, and standards-based; and the third challenge is the lack of financial support for school garden programs.

As part of my work as an educator, and largely during my time as a researcher, I was questioned by a variety of people on the validity of the school garden as an educational tool. These people included school administrators, parents, community members, college students, teachers, and coaches. The need to continue authentic assessments of school gardens is high. Those of us in the school garden movement are challenged to *prove*. Williams and Dixon (in review) suggested a framework which can set the stage for rigor in future research on garden-based learning. They suggested that there be more rigorous research into that which they classified as indirect or related outcomes, as well as into academic outcomes. They have the belief that research into indirect or related outcomes offer "important information on the impact of garden-based learning on the entire learning experience of participating children and youth" (p. 4). My research project and dissertation attempts to begin to fill the void of such research through the use of the rubric created, and through deep and delicious observations.

Another challenge the school garden movement faces is the lack of teacher preparation to use school gardens as a tool to teach academic subjects as well as indirect outcomes. Rudolf Steiner (1997) postulated, "the problem of education is actually a problem of training teachers"

(p. 70). There are very few formal, certified programs directly linked to an academic institution. One is the Cornell University Department of Horticulture distance-learning course, a second is Learning Gardens, Portland, and the third is at Occidental Arts and Ecology Center.

According to the Bayer (2004) Report on Science Education, 38% of teachers in elementary classrooms lack full confidence in their qualifications to teach science. Almost as many say that they rely more on what they learned in high school science than on what they learned in their teacher preparation courses in college. School garden teacher and coordinator training programs will be very beneficial to educators when these programs include a strong standards-base science curriculum.

The Kohala Center located on the Big Island received a USDA agriculture in the classroom grant and will be conducting *Ku ʻĀina Pa*, the first Hawaii School garden teacher training in June 2012. This training will provide State of Hawai'i Department of Education professional development credits to the participants in the first year, and expand to offering college credits in the second year. Some of the participants of *Ku ʻĀina Pa*, will use the interdisciplinary, standards-based school garden curriculum I created in their own school gardens in the State of Hawai'i. Knowing that more and more educators will adopt and then adapt my work is very exciting to me and also validates the process thus far.

I believe that once school gardens can be seen as an academic issue, the challenge of the lack of funding will be decreased. Currently, many school garden programs are grant-funded (Parajuli et al., 2008; Williams & Brown, 2012). Financially successful school gardens engage partnerships to leverage the work. These include community-based organizations and local foundations, parents, and senior citizens, and funding from the Department of Education. Programs such as Food Corp (http://foodcorps.org/), and Ameri Corp

(http://www.americorps.gov/) can also be utilized to provide personnel to manage, coordinate, and teach at school gardens.

Recommendations for Further Research

To meet the challenges listed above, I recommend that there be longitudinal studies of school garden education, a close look at exemplary school garden teachers and coordinators, and deeper evaluations of school garden teacher training programs. The longitudinal study could include several school districts and begin with the same cohort of children. Variables such as location, curriculum, teacher experience, and administrative support will need to be addressed. Following a group of special education (SPED) students being educated in school learning gardens for several years could also provide an in-depth look at school garden education addressing specific academic and indirect-academic needs. The data could be compared with a longitudinal study of regular classroom students.

Research into the pedagogical practices, education and training, and community outreach skills of exemplary school garden teachers and coordinators could provide insight into areas of strengths and weakness of school garden education. Understanding these strengths and weakness will enable the development of school garden training programs that address real needs of educators. From my personal experience, the experience of Parajuli et al. (2008), and Williams and Brown (2012), many school garden coordinators often lack classroom management skills, and science-based knowledge while being strong and confident in the agricultural realm. School garden teachers, who have classroom management skills often lack experience and knowledge to integrate gardening into academic subjects such as science, mathematics, and social studies. Exemplary teachers and coordinators would be those educators or team of educators, who can combine academic instruction with creativity in a structured school garden environment.

Furthermore, there needs to be both formative and summative evaluations of past and current school garden educator training programs. What are the outcomes of the program? How were these met? What educational needs were addressed and met? How well did the knowledge from the training transfer into real-world applications? How academically rigorous was the program? Did the programs include a practicum for the educators to experience first hand teaching and learning in a school garden? Can the educators develop integrated curriculum after the training? All these questions and more could be addressed in the evaluations and the findings used to continuously improve and validate the training programs, as well as the school garden movement in general.

I will be conducting research over the next two academic years of 2012 – 2014 into the adoption and adaptation of the interdisciplinary standards based school garden curriculum by the participants of *Ku ʻĀina Pa*, the first Hawai'i school garden teacher training program. I will be able to evaluate, this time exclusively as a researcher, the effect of the curriculum on a diverse range of students in different schools statewide. I trust that I will be able to be even more objective as I observe these teachers deliver the content in the context of their own school garden. I plan on using the GLO Outcomes pre- and post-survey (Appendix C) and the GLO Universe Matrix (Table 4) to guide my observations.

Moving Forward

The interdisciplinary standards-based school garden curriculum I created is currently being used and adapted by two school garden teachers in two different schools, who teach kindergarteners through fifth graders, in the North Kohala region of the Big Island of Hawai'i. I work closely with both teachers supporting their understanding and treatment of the curriculum. One teacher is including even more Hawaiian cultural elements and her understanding of place-

based education in the curriculum. The other teacher, a huge proponent of increasing soil fertility through Indigenous Microorganisms (IMO), is adapting the science and math to reflect his passion for fungi, bacteria, and invertebrates. His students learn ratios as they dilute compost tea, and area as they spray the compost tea.

I am so encouraged that others are using my work. I am even more encouraged and pleased that there are adaptations to the curriculum as the teachers follow their own passions and interest. The curriculum is contextually specific and yet academically universal. The garden tasks in the curriculum, such as composting and irrigation, are tasks that need to be done in all gardens. Integrating those tasks to science, math, other subject standards, and to the GLOs models experiential-, place-, and project-based learning.

There is no end for garden work and play in my realm. As I transition from teaching children to teaching adults in school gardens, I learn to share my experiences in other ways. I use the six GLOs to guide my teaching and learning. I learn more about developing adult self-directed learners. I support school garden community outreach and development initiatives from a policy and management perspective. I practice complex thinking as I look at the whole education system and where and how school garden education can integrate or catalyze the components of the system. I produce quality articles and observations which can be of benefit to other educators and practitioners. I accept any opportunity to effectively communicate about the qualities and benefits of school learning gardens. And I continue to use and manage garden-technology, computer-technology, and renewable energy technology.

This dissertation process has supported my development in three areas. I had to practice observing objectively, so as to gather facts instead of emotionally laden scenarios. I had to refine

my writing, and thirdly I had to let go. Letting go of the Discovery Garden project and entrusting it into another pair of capable hands was not easy, but I did it, and am now richer for it.

> *Making a garden is not a gentle hobby for the elderly, to be picked up and laid down like a game of solitaire. It is a grand passion. It seizes a person whole, and once it has done so he will have to accept that his life is going to be radically changed…Whatever he had considered to be his profession has become an avocation. His vocation is his garden.*
>
> May Sarton

References

Addison R. B. (1999). A grounded hermeneutic editing approach. In B. F. Crabtree & W. L. Miller (Eds.), *Doing qualitative research* (2nd ed.), (pp. 145-162). Thousand Oaks, CA: Sage Publications.

Agostinho, S. (2004). Naturalistic inquiry in e-learning research. *International Journal of Qualitative methods, 4*(1), Article 2. Retrieved from http://www.ualberta.ca/~iiqm/backissues/4_1/pdf/agostinho.pdf

American Association for the Advancement of Science. (1989). *Project 2061: Science for all Americans.* New York, NY: Oxford University Press.

American Association for the Advancement of Science. (1993). *Benchmarks for science literacy*. New York, NY: Oxford University Press.

American Association for the Advancement of Science. (2001). *Atlas of science literacy.* New York, NY: Oxford University Press.

American Association for the Advancement of Science. (2007). *Benchmarks online.* Retrieved from http://www.project2061.org/publications/bsl/online/index.php

Armstrong, J. (1995). Keepers of the Earth. In T. Roszak, M. Gomes, & A. Kanner (Eds.), *Ecopsychology: Restoring the Earth, healing the mind.* (pp. 316-324). San Francisco, CA: Sierra Club Books.

Ashton-Warner, S. (1963). *Teacher.* New York, NY: Simon and Schuster.

Athens, L. (2010). Naturalistic inquiry in theory and practice. *Journal of Contemporary Ethnography, 39*(1) 87-125.

Bachert, R. (1976). *History and analysis of the school garden movement in America, 1890-1910* (Unpublished doctoral dissertation). Indiana University, Bloomington, IN.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory.* Englewood Cliffs, NJ: Prentice-Hall.

Barker, S. L. (1992). *The meaning of a youth gardening program: A naturalistic inquiry* (Unpublished doctoral dissertation). Indiana University, Bloomington, IN.

Barrows, A. (1995). The ecopsychology of child development. In T. Roszak, M. E. Gomes, & Ad. D. Kanner (Eds.), *Ecopsychology: Restoring the earthy, healing the mind* (pp. 102-110). San Francisco, CA: Sierra Club Books.

Bassett, T. J. (1981). Reaping on the margins: A century of community gardening in America. *Landscape*, *25*(2), 1-8.

Bayer (2004). *The Bayer facts of science education x: Are the nation's colleges and universities adequately preparing elementary schoolteachers of tomorrow to teach science?* Report by Market Research Institute, KS. Retrieved September 3, 2010 from http://www.bayerus.com/MSMS/web_docs/040511_Exec_Summary.pdf

Benham, M. K. P., & Heck, R. H. (1998). *Culture and educational policy in Hawai'i.* Mahwah, NJ: Lawrence Erlbaum Associates

Benyus, J. M. (1997). *Biomimicry: Innovation inspired by nature*. New York, NY: HarperCollins.

Berkes, F. (1999). *Sacred ecology: Traditional ecological knowledge and resource management.* Philadelphia, PA: Taylor & Francis.

Berry, W. (1977). *The unsettling of America: Culture and agriculture*. New York, NY: Avon Books.

Berry, W. (2005). Solving for pattern. In M. K. Stone & Z. Barlow (Eds.), *Ecological literacy: Education our children for a sustainable world* (pp. 30-40). San Francisco, CA: Sierra Club Books.

Bethel, D. M. (1989). *Education for creative living, Ideas and proposals of Tsunesaburo Makiguchi.* Ames, IA: Iowa State University Press.

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

Bowers, C. A. (1995). *Educating for an ecologically sustainable culture: Rethinking moral education, creativity, intelligence, and other modern orthodoxies*. Albany, NY: State University of New York Press.

Bowker, R., & Tearle, P. (2007). Gardening as a learning environment: A study of children's perceptions and understanding of school gardens as part of an international project *Learning Environmental Research*, *10*(2), 83-100.

Bransford, J. D., Brown, A. L., & Cocking, R. R. (Eds.). (2000). *How people learn: Brain, mind, experience, and school*. Washington, DC: National Academy Press.

Braun, J., Kotar, M., & Irick, J. (1989). Cultivating an integrated curriculum: The school garden. *Social Studies and the Young Learner*, *1*(3), 19–22.

Braus, J., & Wood, D. (1993). *Environmental education in the schools: Creating a program that works!* Washington, DC: North American Association for Environmental Education.

Brookfield, S. D. (1987). *Developing critical thinkers: Challenging adults to explore alternative ways of thinking and acting.* San Francisco, CA: Jossey-Bass.

Brown, K. (2010). *Wind power project offers a new spin for students*. Retrieved April 11, 2011, from http://www.ecoliteracy.org/blog/wind-power-project-offers-new-spin-students

Canaris, I. (1995). Growing foods for growing minds: Integrating gardening and nutrition education into the total curriculum. *Children's Environments*, *12*(2), 264-270.

Capra, F. (1997). Understanding nature's cycles. In Center for Ecoliteracy (Ed.), *Getting started: A guide for creating school gardens as outdoor classrooms* (pp. 45-50). Berkeley, CA: Author.

Capra, F. (2005). Speaking nature's language: Principles for sustainability. In M. K. Stone & Z. Barlow (Eds.), *Ecological literacy: Education our children for a sustainable world* (pp. 18-29). San Francisco, CA: Sierra Club Books.

Carson, R. (1956). *The sense of wonder*. New York, NY: Harper Collins Publishing.

Cason K. (1999). Children are "growing healthy" in South Carolina. *Journal of Nutrition Education*, *31*, 235A.

Cavaliers, D. (1987). How zucchini won 5th-grade hearts. C*hildren Today*, *16*(3), 18-21.

Center for Ecoliteracy. (2004 – 2012). Retrieved January 2, 2012, from http://www.ecoliteracy.org/essays/dispatch-hawaii-supporting-growing-school-garden-movement

Charmaz, K. (2000). Grounded theory: Objectivist and constructivist methods. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of qualitative research* (2nd ed.; pp. 509-535.) Thousand Oaks, CA: Sage Publishing.

Chawla, L. (1988). Children's concern for the natural environment. *Children's Environmental Quarterly, 5*, 13-20.

Chawla, L. (1994). *In the first country of places*. Albany, NY: State University of New York Press.

Chawla, L. (2002). Spots of time. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 199 -225). Cambridge, MA: MIT Press.

Clark, W. C. (1989). Managing planet earth. *Scientific American, 261*(3), 46-54.

Clark, M. (1991). Rethinking ecological and economic education. In R. Costanza (Ed.), *Ecological economics: The science and management of sustainability*. (pp. 400-415). New York, NY: Columbia Press.

Cornville, T. A., Rohrer, G. E., Phillips, S. G., & Mosier, J. G. (1987). Horticulture therapy in substance abuse treatment. *Journal of Therapeutic Horticulture 2*, 3-8.

Cronbach, L. (1980). Validity on parole: Can we go straight? *New Directions for Testing and Measurement, 5*, 99-108.

Cross, K. P. (1981). *Adults as learners.* San Francisco, CA: Jossey-Bass.

Cutter-Mackenzie, A. (2009). Multicultural school gardens: Creating engaging garden spaces in learning about language, culture, and environment. *Canadian Journal of Environmental Education 14*, 122-135.

Dahm, L. M. (2010, November 28). The garden echoes what happens in the classroom. *West Hawaii Today, Special*, pp. 1-2.

Damon, W. (1977). *The social world of the child.* San Francisco: CA: Jossey-Bass.

Darling-Hammond, L. (2010). *The flat world and education: How America's commitment to equity will determine our future*. New York, NY: Teachers College Press.

Deal, T. E., & Peterson, K. D. (1999). *Shaping school culture: The heart of leadership*. San Francisco, CA: Berrett-Koehler Publishers.

DeMarco, L. W. (1997). *The factors affecting elementary school teachers' integration of school gardening into the curriculum* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 9939669)

Desmond, D., Grieshop, J., & Subramaniam, A. (2004). *Revisiting garden-based learning in basic education*. Rome, Italy: Food and Agriculture Organization and International Institute for Educational Planning of the United Nations.

DeVries, R., & Zan, B. (1994). *Moral classrooms, moral children: Creating a constructivist atmosphere in early education.* New York, NY: Teacher College Press.

Dewey, J. (1934). Individual psychology and education. *The Philosopher*, *XII*, 1- 6. Retrieved April 4, 2011 from http://www.the-philosopher.co.uk/dewey.htm/

Dewey, J. (1938). *Experience and education*. New York, NY: Touchstone.

Dewey, J. (1997). *How we think*. Mineola, NY: Dover Publications Inc.

Dewey, J. (2009). *The school and society and the child and the curriculum*. Lexington, KY: Feather Trail Press.

Dirks, A. E., & Orvis, K. (2005). An evaluation of the junior master gardener program in third grade classrooms. *HortTechnology, 15,* 443-447.

Disinger, J. F. (1998). Tensions in environmental education: Yesterday, today, and tomorrow. In H. R. Hungerford, W. J. Bluhm, T. L. Volk, & J. M. Ramsey (Eds.), *Essential readings in environmental education*, (pp. 1-12). Champaign, IL: Stipes Publishing.

Dobbs, K. & McDaniel, A. (1996). Horticulture/gardening in kindergarten through fifth and sixth grade education in Virginia: A survey of teachers. *HortScience, 31*(4), 608.

Dwight, E. (1992). A tree grows in Harlem. *The American School Board Journal*, *179*(6), 31-33.

Dyment, J. E., & Bell, A. C. (2008). Grounds for movement: Green school grounds as sites for promoting physical activity. *Health Education Research, 23*(6) 952-962.

Dyment, J. E., & Reid, A. (2005). Breaking new ground? Reflections on greening school grounds as sites of ecological, pedagogical, and social transformation. *Canadian Journal of Environmental Education, 10*, 286-301.

Edison Learning. (2011). Retrieved October 10, 2010, from http://www.edisonlearning.com/our_offerings/achievement_services/alliance_about).

Edwards, A. (2005). *The sustainability revolution*. Gabriola Island, BC: New Society Publishers.

Ehrenfeld, D. (1997). The management explosion and the next environmental crisis. In H. Hannum (Ed.). *People, land, and community* (pp. 53-68). New Haven, CT: Yale University Press.

Elmore, R. F., Peterson, P. L., &McCarthy, S. J. (1996). *Restructuring in the classroom: Teaching, learning and school organization*. San Francisco, CA: Jossey-Bass.

Family Score Report. (2010-2011). Hawai'i State Assessment reports for families. Retrieved February 23, 2012 from http://www.alohahsa.org/resources/ScoreReports/Hawaii_Mockups-Family_RM.pdf

Fiske, E. B. (1991). *Smart schools, smart kids: Why do some schools work?* New York, NY: Touchstone.

Foster, S., & Powell, J. (1991). *Gardening ideas for children with special needs*. Corvallis, OR: Oregon State University Extension Service.

Gardner, H. (1991). *The unschooled mind: How children think and how schools should teach them.* New York, NY: Basic Books.

Gardner, H. (1999). *Intelligence reframed: Multiple intelligences for the 21st century.* New York, NY: Basic Books.

Gardner, H. (2000). *The disciplined mind: Beyond the facts and standardized test, the K-12 education that every child deserves*. New York, NY: Penguin.

Gatto, J. T. (1992). *Dumbing us down: The hidden curriculum of compulsory schooling*. Gabriola Island, BC: New Society Publishers.

Gatto, J. T. (Ed). (1993). *The exhausted school: Bending the bars of traditional education*. Berkeley, CA: Berkeley Hill Books.

Gatto, J. T. (2001). *A different kind of teacher: Solving the crisis of American schooling*. Berkeley, CA: Berkeley Hill Books.

Gatto, J. T. (2006). *The underground history of American education*. Oxford, NY: The Oxford Village Press.

Gick, M. L., & Holyoak, K. J. (1983). Schema induction and analogical transfer. *Cognitive Psychology, 15*, 1-38.

Gokhale, A. A. (1995). Collaborative learning enhances critical thinking. *Journal of Technology Education, 7*(1), 22-30.

Golley, F. B. (1998*). A primer for environmental literacy*. New Haven, CT: Yale University Press.

Goodall, H. L., Jr. (2000). *Writing the new ethnography*. Lanham, MD: AltaMira Press.

Graham, H., Beall, D. L., Lussier, M., McLaughlin, P., & Zidenberg-Cherr, S. (2005). Use of school gardens in academic instruction. *Journal of Nutrition Education Behavior, 37*, 147-151.

Greaney, E. (1976). *Hawai'i's big six: A cyclical saga*. Retrieved December 23, 2008, from www.judyvorfeld.com/Greaney.pdf

Greenway, R. (1995). The wilderness effect and ecopsychology. In T. Roszak, M. Gomes, & A. Kanner (Eds.), *Ecopsychology: Restoring the Earth, healing the mind* (pp. 122-135). San Francisco, CA: Sierra Club Books.

Growing Gardens. (2006 -2012). Retrieved April 4, 2011, from http://www.growing-gardens.org/portland-gardening-resources/school-gardens.php

Growing Pono Schools. (2011). Retrieved February 23, 2011, from http://growingponoschools.com

Guba, E., & Lincoln, Y. (1998). Competing paradigms in qualitative research. In N. Denzin & Y. Lincoln (Eds.), *The landscape of qualitative research* (pp. 195-218) Thousand Oaks, CA: Sage Publications.

Gwynn, M. (1988). A growing phenomenon. *Science and Children*, *25*(7), 25-26.

Hammer, D. (1997). Discovery learning and discovery teaching. *Cognition and Instruction*, *15*(4), 485-529.

Harper, D. (2000). Reimagining visual methods. In N. Denzin& Y. Lincoln (Eds.), *Handbook of qualitative methods* (wnd ed.; pp. 717-730). Thousand Oaks, CA: Sage Publishing.

Harper, S. (1995). The way of wilderness. In T. Roszak, M. Gomes, & A. Kanner (Eds.), *Ecopsychology: Restoring the Earth, healing the mind* (pp. 183-200). San Francisco, CA: Sierra Club Books.

Hawai'i State Department of Education (n.d.a.). Retrieved September 6, 2010, from http://doe.k12.hi.us/about/intro_standards.htm

Hawai'i State Department of Education (n.d.b.). Retrieved September 6, 2010, from (http://doe.k12.hi.us/curriculum/GLO_rubric.htm).

Hawai'i State Department of Education (2010). *Framework for school improvement*. Retrieved April 17, 2012, from (http://doe.k12.hi.us/nclb/educators/100401FramewordForSchoolImprovement100129.pdf).

Hayden-Smith, R. (2007). "Soldiers of the soil": The work of the United States school garden Army during World War I. *Applied Environmental Education and Communication, 6*, 19–29.

Hazzard, E. L. (2010). *Utilization of garden-based education to positively impact children's nutrition knowledge and behaviors* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3415445)

Heath, C., Hindmarsh, J., & Luff, P. (2010). *Video in qualitative research: Analysing social interaction in everyday life.* London, UK: Sage Publishing.

Hedley, A., Ogden, C., Johnson, C. Carroll, M., Curtin, L., & Flegal, K. (2004). Overweight and obesity among U.S. children, adolescents, and adults, 1999-2002. *Journal of the American Medical Association, 291*(23), 2847-2850.

Hertz, R. (1997). *Reflexivity and voice*. Thousand Oaks, CA: Sage.

Hess, A. J. (2010) *Starting a learning progression for agricultural literacy: A qualitative study of urban elementary student understandings of agricultural and science education benchmarks* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3422637)

Hess, F. M., & Petrilli, M. J. (2006). *No child left behind: A primer*. New York, NY: Peter Lange.

Hess, F. M., & Squire, J. P. (2009). "*Diverse providers" in action: School restructuring in Hawaii.* American Enterprise Institute for Public Policy Research No. 8. Retrieved from www.aei.org/outlook/100064

Holt, J. C. (1967). *How children learn*. New York, NY: Merloyd Lawrence Book.

Holt, M. (2005). The slow school: An idea whose time has come? In M. K. Stone & Z. Barlow (Eds.), *Ecological literacy: Education our children for a sustainable world*. (pp. 56-66). San Francisco, CA: Sierra Club Books.

Hormann, B. L., & Lind, A. W. (1996). *Ethnic sources in Hawai'i*. New York, N.Y.: McGraw-Hill, Inc.

Illich, I. (1996). Deschooling society. In M. Hern (Ed.), *Deschooling our lives* (pp. 23 – 26). Gabriola Island, BC: New Society Publishers.

Järvenoja, H., & Järvelä, S. (2009). Emotion control in collaborative learning situations: Do students regulate emotions evoked by social challenges? *British Journal of Educational Psycholog,y 79*, 463-481.

Johnson, R. T., & Johnson, D. W. (1986). Action research: Cooperative learning in the science classroom. *Science and Children*, *24*, 31-32.

Juvik, S. P., & Juvik, J. O. (Eds.) (1998). *Atlas of Hawai'i* (3rd ed.). Honolulu, HI: University of Hawai'i Press.

Kahakalau, K. (2003). *Kanu oka 'Aina–natives of the land from generations back: A pedagogy of Hawaiian liberation* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No.3081954)

Kahn, P. H. (2002). Children's affiliations with nature: Structure, development, and the problem with environmental generational amnesia. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 93-116). Cambridge, MA: MIT Press.

Kaiser, M. (1976). Alternative to therapy: Garden program. *Journal of Clinical Child Psychology*, *5*(2), 21-24.

Kaplan, S. (1995). The restorative benefits of nature: toward an integrative framework. *Journal of Environmental Psychology*, *16*, 169-182.

Kawai'ae'a, K. (2010). *Kohala Kuamo'o: Nae'ole's race to save a king*. Honolulu, HI: Kamehameha Publishing.

Kellert, S. R. (1996). *The value of life: Biological diversity and human society*. Washington, DC: Island Press/Shearwater Books.

Kellert, S. R. (2002). Experiencing nature: Affective, cognitive, and evaluative development in children. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 117-152). Cambridge, MA: MIT Press.

Kirschenmann, F. L. (2008). Food as relationship. *Journal of Hunger and Environmental Nutrition, 3*(2/3), 106-121.

Klemmer, C. D. (2002). *Growing minds: The effect of school gardening program on the science achievement of elementary students.* (Unpublished doctoral dissertation). Texas A&M University, College Station, TX.

Klemmer, C. D., Waliczek, T. M., & Zajicek, J. M. (2005a). Development of a science achievement evaluation instrument for school garden program. *HortTechnology, 15*(3), 433-438.

Klemmer, C. D., Walizcek, T. M., & Zajicek, J. M. (2005b). Growing minds: The effect of a school gardening program on the science achievement of elementary students. *HortTechnology, 15*(3), 448-452.

Knowles, M. (1975). *Self-directed learning: A guide for learners and teachers.* New York, NY: Association Press.

Koh, M. W. (2011). Discovery Garden Kohala Elementary School newsletter. [Web log]. Retrieved from http://kohalacenter.org/schoolgardensblog/?cat=14.

Kohlberg, L. (1969). Stage and sequence: The cognitive-developmental approach to socialization. In D. A. Goslin (Ed.), *Handbook of socialization theory and research* (pp. 347-480). New York, NY: Rand McNally.

Kolb, D. A. (1984). *Experiential learning*, Englewood Cliffs, NJ: Prentice Hall.

Lather, P. (1986). Issues of validity in openly ideological research: Between a rock and a soft place. *Interchange, 17*(4), 63-84.

Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* New York, NY: Cambridge University Press.

Libman, K. (2007). Growing youth growing food: How vegetable gardening influences young people's food consciousness and eating habits. *Applied Environmental Education and Communication*, *6*(1) 87–95.

Lincoln, Y S. & Guba, E. G. (1985). *Naturalistic inquiry*. Newbury Park, CA: Sage Publications.

Lineberger, S. E., & Zajicek, J. M. (2000). School gardens: Can a hands-on teaching tool affect students' attitudes and behaviors regarding fruits and vegetables? *HortTechnology*, *10*, 593-597.

Louv, R. (2005). *Last child in the woods: Saving our children from nature-deficit disorder*. Chapel-Hill, NC: Algonquin Books.

Mabie, R., & Baker, M. (1996). The influence of experiential instruction on urban elementary students' knowledge of the food and fiber system. *Journal of Extension, 34(6),* 1-4.

Mahon, A., Glendinning, C., Clarke, K., & Craig, G. (1996). Researching children: Methods and ethics. *Children and Society, 10*, 145 – 154.

Marturano, A. (2000). Garden Variety Curriculum. *Science Scope, 23*(7) 34-35.

Mayer-Smith, J., Bartosh, O., & Peterat, L. (2007). Teaming Children and elders to grow food and environmental consciousness. *Applied Environmental Education and Communication* 6, 77 – 85.

McAleese, J. D., & Rankin, L. L. (2007). Garden-based nutrition education affects fruit and vegetable consumption in sixth-grade adolescents. *J Am Diet Assoc, 107*(4), 662-665.

McDonough, W., & Braungart, M. (2002). *Cradle to cradle: Remaking the way we make things*. New York, NY: Farrar, Strauss, & Giroux.

McGuinn, C., & Reff, P. D. (2001). An assessment of a vocational horticulture curriculum for juvenile offenders. *Hort Technology*, *11*(3), 427-468.

Md Nor, M., & Saeednia, Y. (2009). Exploring self-directed learning among children. *International Journal of Human and Social Sciences, 4*(9), 658-663.

Meadows, D., Randers, J. & Meadows, D. (2004). *Limits to growth: The 30-year update*. White River Junction, VT: Chelsea Green Publishing Co.

Mercogliano, C. (2001). Relational learning – say what? Retrieved from http://www.educationrevolution.org/relational.html

Meyer, M. A. (2003). *Ho'oulu: Our time of becoming*. Honolulu, HI: 'Ai Pohaku Press.

Mezirow, J. (1985). A critical theory of self-directed learning. In S, Brookfield (Ed.), *Self-directed learning: From theory to practice.* New Directions for Continuing Education (No. 25). San Francisco, CA: Jossey-Bass.

Mezirow, J., & Associates. (2000). *Learning as transformation*. San Francisco, CA: Jossey-Bass.

Miller, M. A. (2007). A rose by any other name: Environmental education through gardening. *Applied Environmental Education and Communication*, *6*(1), 15-17.

Mishler, E. G. (1986). *Research interviewing: Context and narrative*. Cambridge, MA: Harvard University Press.

Montessori, M. (1912). *The absorbent mind*. Translated from the Italian by Claude A. Claremont. New York, NY: Dell.

Moore, R. (1995). Growing foods for growing minds: Integrating gardening and nutrition education into the total curriculum. *Children's Environments, 12*(2), 134-142.

Morris J. L., Neustadter, A., & Zidenberg-Cherr, S. (2001). First-grade gardeners more likely to taste vegetables. *California Agriculture*, *55*(1), 43-46.

Morris J. L., & Zidenberg-Cherr, S. (2002). Garden-enhanced nutrition curriculum improves fourth-grade school children's knowledge of nutrition and preferences for some vegetables. *Journal of American Diet Association*, *102*, 91-93.

Moustakas, C. (1994). *Phenomenological research methods*. Thousand Oaks, CA: Sage Publications.

Murphy, M. (2003). Findings from the evaluation study of the edible schoolyard. In: *Writings online: Education for Sustainability.* Berkeley, CA: Center for Ecoliteracy. Retrieved December 3, 2010, from http://www.ecoliteracy.org/publications/index.html

Nabhan, G. P., & Trimble, S. (1994). *The geography of childhood*. Boston, MA: Beacon Press.

Neer, K. (1990). A children's garden. *The Herbarist*, *56*, 69-76.

Nelson, C. J. (1988). Harvesting a curriculum. *Science and Children*, *25*(7), 22-24.

North Kohala Community Development Plan. (2008). Hawai'i County Department of Planning. Retrieved September 18, 2010, from http://www.hawaiicountycdp.info/north-kohala-cdp/nkcdpfinal11.08.pdf/view

Occidental Arts and Ecology Center. (2000 – 2009). Retrieved December 11, 2011 from http://www.oaec.org/school-garden

Orr, D. W. (1992). *Ecological literacy: Education and the transition to a postmodern world.* Albany, NY: State University of New York.

Orr, D. W. (1994). *Earth in mind: On education, environment, and the human prospect.* Washington, DC: Island Press.

O'Sullivan, E. (1999). *Transformative learning: Educational vision for the 21st century*. London, UK: Zed Books.

Ozer, E. J. (2007). The Effects of school gardens on students and school: Conceptualization and considerations for maximizing healthy development. *Health Education & Behaviors, 34*(6), 846-863.

P21 Framework Definitions (2009). Retrieved April 11, 2011 from http://www.p21.org/overview/skills-framework

Page, C., Bony, L., & Schewel, L. (2007). *Island of Hawaii whole system project phase I report.* Rocky Mountain Institute. Retrieved November 15, 2010, from http://www.kohalacenter.org/pdf/hi_wsp_2.pdf

Parajuli, P., Dardis, G., & Hahn, T. (2008). *Curriculum development and teacher preparation in and for the learning gardens.* Report submitted to Gray Family Fund of Oregon Community Foundation. Portland, OR: Authors.

Parker, C. (1984). Interviewing children: Problems and promise. *Journal of Negro Education, 53*(1), 18-28.

Payne, P. G., & Wattchow, B. (2008). Slow pedagogy and placing education in post-traditional outdoor education. *Australian Journal of Outdoor Education*, *2*(1), 25-38. Retrieved April 6, 2011, from http://www.freepatentsonline.com/article/Australian-Journal-Outdoor-Education/181685153.html

Pellegrini, A. D., Van Ryzin, M. J., Roseth, C., Bohn-Gettler, C., Dupuis, D., Hickey, M., & Peshkam, A. (2011). Behavioral and social cognitive processes in preschool children's social dominance. *Aggressive Behavior*, *37*, 248-257.

Peterson, B., Gerhard, G., Hunter, K., Marek, L., Phillips, C., & Titcomb, A. (2001). *National 4-H impact study*. U.S. Dept. Agr., Washington D.C.

Peyser, M., & Weingarten, T. (1998, April 13). A growing experience: Spring is here and children's gardens are in bloom. *Newsweek, 65*, 69-76.

Phenix, P. (1961). *Education and the common good: A moral philosophy of the curriculum*. New York, NY: Harper & Brothers.

Phenix, P. (1964). *Realms of meaning: A philosophy of the curriculum for general education*. New York, NY: McGraw-Hill.

Phibbs, E. J., & Relf, D. (2005). Improving research on youth gardening. *HortTechnology, 15,* 425-428.

Piaget, J. (1954). *The construction of reality in the child.* New York, NY: Basic Books.

Piaget, J. (1978). *Success and understanding*. Cambridge, MA: Harvard University Press.

Piaget, J. (1983). Piaget's theory. In W. Kessen (Ed.), *Handbook of child psychology, Vol. 1, History, theory, and methods* (4th ed., pp. 103-128). New York, NY: Wiley.

Pivnick, J. (1994). Sowing a school garden: Reaping an environmental ethic. *HortTechnology*, *8*(3), 7–8.

Pollan, M. (2007). *The omnivore's dilemma: a natural history of four meals*. New York, NY: The Penguin Press.

Pomaikai McGregor, D. (2007). Hawaiian food sovereignty: Ho'ea ea. Retrieved November 25, 2011 from http://www.localharvest.org/newsletter/20070824/food-sovereignty.jsp

Poroshina, G. P. (1985). Organization and contents of labor training in boarding school for mentally retarded in summer time. *Defektologiya, 6*, 47-49.

Poston, S. A., Shoemaker, C. A., & Dzewaltowski, D. A. (2005). A comparison of a gardening and nutrition program with a Standard Nutrition program in an out-of-school setting. *HortTechnology, 15*(3), 463-467.

Pounder, S. (n.d.). *Gardening with children with special needs.* Retrieved December 8, 2010, from www.kidsgardening.com/Dig/digdetail.taf?Type=Art&id=2190

Presidents' Council of advisors on science and technology. (September 2010). *Report to the President: Prepare and Inspire K-12 education in Science, Technology, Engineering, and Math (STEM) for America's Future*, the. Retrieved January 10, 2011 from http://www.whitehouse.gov/sites/default/files/microsites/ostp/pcast-stemed-report.pdf.

Pukui, M. K. (1983). *'Olelo No'eau–Hawaiian proverbs and poetical sayings*. Honolulu, HI: Bishop Museum Press.

Pyle, R. M. (1993). *The thunder tree: Lesson from an urban wildland.* Boston, MA: Houghton Miffin.

Pyle, R. M. (2002). Eden in a vacant lot: Special places, species, and kids in the neighborhood of life. In P. H. Kahn & S. R. Kellert (Eds.), *Children and nature: Psychological, sociocultural, and evolutionary investigations* (pp. 305-327). Cambridge, MA: MIT Press.

Ratcliffe, M. M. (2007). *Garden-based education in school settings: The effects on children's vegetable consumption, vegetable preferences and ecoliteracy* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3283796)

Rauzon, S., Wang, M., Studer, N., & Crawford, P. (2010). *Changing students' knowledge, attitudes and behavior in relation to food: An evaluation of the school lunch initiative*. San Francisco, CA: The Chez Panisse Foundation.

Ravitch, D. (2000). *Left back: A century of failed school reforms*. New York, NY: Simon & Schuster.

Ravitch, D. (2010). *The death and life of the great American school system: How testing and choice are undermining education.* New York, NY: Basic Books.

Reason, P. (Ed.). (1988). *Human inquiry in action: Developments in new paradigm research.* London, UK: Sage Publications.

Reason, P., & Rowan, J. (1981). Issues of validity in new paradigm research. In P. Reason & J. Rowan (Eds.), *Human inquiry: A sourcebook of new paradigm research* (pp. 239-262). New York, NY: John Wiley.

Resnick, L. B. (1987). *Education and learning to think*. Washington, DC: National Academy Press.

Richards, H.J . & Kefami, D. M. (1999). Impact of horticultural therapy on vulnerability and resistance to substance abuse among incarcerated individuals. *Journal of Offender Rehabilitation*, *29*(3/4), 183-193.

Rivero, L. (2003). *Self-directed home schooling*. Retrieved January 30, 2012, from http://www.homeschoolzone.com/unschooling/rivero.htm.

Robinson, C. W., & Zajicek, J. M. (2005). Growing minds: The Effects of a one-year school garden program on six constructs of life skills of elementary school children. *HortiTechnology, 15*(3) 453-457.

Robinson-O'Brien R., Story M., & Heim S. (2009). Impact of Garden-Based Youth Nutrition Intervention Programs: A Review. *Journal of the American Dietetic Association 109*, 273-280.

Rogers, S., & L. Renard. (1999). Relationship-driven teaching. *Educational Leadership 56(*1), 157–60.

Rothstein, P. D. (2010). Seeds for change: Creating alternative spaces for education in Taishō Japan (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3408591)

Royal Horticultural Society. (2010). *Growing together: Gardening with children and young people with special education needs.* Retrieved December 4, 2011, from http://www.sd42.ca/system/files/gardens%20and%20children%20with%20special%20needs.pdf

Sage, R. (2003). *Press release: Bad communication skills blamed television*. Retrieved from http://www.le.ac.uk/press/press/badcommunication.html

Sakofs, M. (1995). Piaget: A psychological rationale for experiential education. In K. Warren, M. Sakofs, & J. S. Hunt (Eds.), *The theory of experiential education*. (pp. 149-151). Dubuque, IO: Kendall/Hunt Publishing.

Salisbury, J. (1989). New alchemy's green classroom. *New Alchemy Quarterly*, *35,* 4-6.

Sandel, M. H. (2004). Therapeutic gardening in a long-term detention setting. *Journal for Juvenile Justice Services, 19*(1&2), 123-131.

Sarver, M. D. (1985). Agritherapy : Plants as learning partners. *Academic Therapy*, *20*(4), 389-396.

Say, R. (2004). *Managing with Aloha: Bringing Hawai'i's universal values to the art of business*. Waikoloa, HI: Ho'ohana Publishing.

Schumacher, E.F. (1973). *Small is beautiful: Economics as if people mattered*. New York, NY: Harper & Row.

Schumacher, E. F. (1977). *A guide for the perplexed.* New York, NY: Harper & Row.

Schweitzer, S. (2003). *Kohala 'Āina: A history of North Kohala*. Honolulu, HI: Mutual Publishing.

Scott, C. (2008). *A call to restructure restructuring: Lessons from the No Child Left Behind Act in five states,* Washington, DC: Center on Education Policy. Retrieved October 11, 2010, from www.cep-dc.org

Sebba, R. (1991). The landscapes of childhood: The reflections of childhood's environment in adult memories and in children's attitudes. *Environment and Behavior, 23,* 395-422.

Seidman, I. (2006). *Interviewing as qualitative research: A guide for researchers in education and the social sciences.* New York, NY: Teachers College Press.

Sheffield, B. K. (1992). The affective and cognitive effects of an interdisciplinary garden-based curriculum on underachieving elementary students (Unpublished doctoral dissertation). University of South Carolina, Columbia, SC.

Skelly, S. M. (2000). *The growing phenomenon of school gardens: Cultivating positive youth development*. (Unpublished doctoral dissertation). University of Florida, Gainesville, FL.

Skelly, S. M., & Bradley, J. C. (2007). The growing phenomenon of school gardens: Measuring their variation and their affect on students' sense of responsibility and attitudes towards science and the environment. *Applied Environmental Education and Communication, 6,* 97-104.

Skinner, E. A., Chi, U., & The Learning-Gardens Educational Assessment Group. (2011). *Intrinsic motivation and engagement as "active ingredients" in garden-based education:*

Examining models and measures derived from self-determination theory. Portland, OR: Portland State University Department of Psychology and Graduate School of Education, and Portland Public Schools/Lane Middle School.

Slavin, R. E. (1983). When does cooperative learning increase student achievement? *Psychological Bulletin*, *94*(3), 429-445.

Smith, M. L. (1981). Naturalistic research. *Personnel and Guidance Journal, 59*, 585 – 589.

Smith, B. L., & MacGregor, J. T. (1992). What is collaborative learning? In A. Goodsell, M. Maher, V. Tinto, B. L. Smith, & J. T. MacGregor (Eds.), *Collaborative learning: A sourcebook for higher education*. University Park, PA: Pennsylvania State University: National Center on Postsecondary Teaching, Learning, and Assessment.

Smith, L. L., & Motsenbocker, C. E. (2005). Impact of hands-on science through school gardening in Louisiana Public Elementary Schools. *HortTechnology, 15*(3), 439-443.

Sobel, D. (1993). *Children's special places: Exploring the role of forts, dens, and bush houses in middle childhood*. Tucson, AZ: Zephyr Press.

Sobel, D. (1996). *Beyond ecophobia: Reclaiming the heart in nature education*. Great Barrington, MA: The Orion Society.

Sobel, D. (2004). *Place-based education: Connecting classrooms and communities*. Great Barrington, MA: The Orion Society.

Sobel, D. (2008). *Childhood and nature: Design principles for educators*. Portland, ME: Stenhouse Publishers.

Stake, R. E. (1977). The countenance of educational evaluation. In A. A. Bellack & H. M. Kliebard (Eds.), *Curriculum and evaluation* (pp. 372- 390) Berkeley, CA: McCutchan.

Stanton, K. (July 16, 2010). Smart by nature: School garden teachers gather in Waimea. *Hawaii 24/7*. Retrieved from http://www.kohalacenter.org/HISGN/pdf/SmartbyNature247.pdf

State of Hawaii Department of Education. (n.d.a). *The Hawaii standards system.* Retrieved from http://standardstoolkit.k12.hi.us/index.html

State of Hawaii Department of Education. (n.d.b). *Instructional guides*. Retrieved from http://standardstoolkit.k12.hi.us/index.html

State of Hawaii Department of Education. (n.d.c). *Strategic plan, 2011-2018: Transforming Hawai'i's public schools.* . Retrieved from http://doe.k12.hi.us/curriculum/ strategicplan2011-2018/strategicplan.pdf

State of Hawaii Department of Education, Office of Curriculum, Instruction and Student Support Instructional Services Branch. (2007). *Program guide for gifted and talented*. Retrieved from http://gt.k12.hi.us/files/GT_Guide.pdf

State of Hawaii Department of Education, Systems Accountability Office. (2010). *Continuous improvement: Building for the future, 2009 superintendent's 20th annual report*. Retrieved from http://arch.k12.hi.us/state/superintendent_report/sar2009.html

Steiner, R. (1926). *The essentials of education.* London, UK: Anthroposophical Publishing Co.

Steiner, R. (1928). *The new art of education.* London, UK: Anthroposophical Publishing Co.

Steiner, R. (1982). *Balance in teaching*. Spring Valley, NY: Mercury Press.

Steiner, R. (1993). *Understanding the human being: Selected writings of Rudolf Steiner*. Bristol, UK: Rudolf Steiner Press.

Steiner, R. (1996a). *The child's changing consciousness as the basis of pedagogical practice*. Hudson, NY: Anthroposophic Press.

Steiner, R. (1996b). *The foundations of human experience*. Great Barrington, MA: Anthroposophic Press.

Steiner, R. (1997). *Education as a force for social change*. Hudson, N.Y.: Anthroposophic Press.

Steiner, R. (1998). *Rhythms of learning*. Hudson, N.Y.: Anthroposophic Press.

Steiner, R. (2000). *Practical advice to teachers*. Great Barrington, MA: Anthroposophic Press.

Sterling, S. (2001). *Sustainable education: Re-visioning learning and change*. Devon, UK: Green Books Ltd.

Stetson, E. (1991). The big green schoolhouse. *Educational Leadership*, *18*(1), 34–35.

Stone, M. K. (2009). *Smart by nature: Schooling for sustainability*. Healdsburg, CA: Watershed Media.

Stone, M. K., & Barlow, Z. (Eds.). (2005). *Ecological literacy: Education our children for a sustainable world.* San Francisco, CA: Sierra Club Books.

Subramaniam, A. (2002). *Garden-based learning in basic education: A historical review* (University of California 4-H Center for Youth Development Monograph). Davis, CA: University of CA, Department of Human and Community Development.

Subramaniam, A. (2003). *Garden-based learning: Considering assessment from a learner-centered approach* (University of California 4-H Center for Youth Development

Monograph). Davis, CA: University of CA, Department of Human and Community Development.

Superville, D. (2010, January 12). Michelle Obama's White House garden is a growing success. *Associated Press*. Retrieved January 3, 2011, from http://www.csmonitor.com/The-Culture/Gardening/2010/0113/Michelle-Obama-s-White-House-garden-is-a-growing-success.

Taosaka, S. (2002). *Let's talk story: Professional development in the Pacific.* Honolulu, HI: Pacific Resources for Education and Learning. Retrieved October 24, 2011 from http://www.prel.org/products/re_/talkstory.pdf

Taylor, F. A., Kuo, F. E., & Sullivan, W. C. (2001). Coping with ADD: The surprising connection to green play settings. *Environment and Behavior*, *33*(1), 54-77.

Teisl, M., Rogosch F. A., Oshri, A., & Cicchetti, D. (2011). Differential expression of social dominance as a function of age and maltreatment experience. *Developmental Psychology*, *48*(2), 575-588.

Telstad, B. (1997). Little machines in their gardens: A History of school gardens in America, 1891 to 1920. *Landscape Journal, 16*,161-173.

Texas Agricultural Extension Services. (1999a). *Junior Master Gardener handbook, level 1: Agr. Commun.* College Station, TX: Texas A & M University.

Texas Agricultural Extension Services. (1999b). *Junior Master Gardener teacher/leader guide, level 1: Agr. Commun*. College Station, TX: Texas A & M University.

Thibault, N (1994). Multicultural gardening. *Green Teacher, 38,* 14-15.

Thorp, L. G. (2001). *The pull of the Earth: An ethnographic study of an elementary school garden behaviors* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 3020122)

Thorp, L. G., & Townsend, C. (2001, December 12). *Agricultural education in an elementary school: An ethnographic study of a school garden*. Proceedings of the 28th Annual National Agricultural Education Research Conference in New Orleans, LA . Retrieved from http://www.aaaeonline.org/conference_files/758901

Totten, S., Sills, T., Digby, A., & Russ, P. (1991). *Cooperative learning: A guide to research*. New York, NY: Garland.

Townsend, C. D., & Carter, R. I. (1983). The relationship of participation in FFA activities and leadership, citizenship, and cooperation. *Journal of American Association Teacher Education in Agriculture, 24*(1), 20 – 25.

Tyler, R. (1949). *Basic principles of curriculum and instruction*. Chicago, IL: University of Chicago Press.

U.S. Department of Commerce, U.S. Department of Education, U.S. Department of Labor, National Institute of Literacy, & the Small Business Administration. (1999). *21st century skills for 21st century jobs.* Retrieved April 2, 2011, from http://www.p21.org/documents/report2003/21stCenturySkillsJobs.pdf

U.S. Department of Agriculture Economic Research Services. (2006). *Rural America at a glance* (Economic Information Bulletin No, 18_. Retrieved October 2, 2010, from http://www.ers.usda.gov/publications/eib18/eib18.pdf

U.S. Department of Health and Human Services, Maternal and Child Health Bureau (MCHB) of the Health Resources and Services Administration (HRSA). (2009). *National survey of children's health.* Retrieved April 2, 2011, from http://mchb.hrsa.gov/nsch/07main/index.html

Van Dexter, K. (2008). Designing school gardens. *SchoolArts: The Art Education Magazine for Teachers*, *108(2),* 32-33.

Van Manen, M. (1990). *Researching lived experience: Human Science for an Action Sensitive Pedagogy*. New York, NY: SUNY Press.

Vosniadou, S. (2001). *How children learn*. Bellegrade, France: International Academy of Education.

Walizcek, T. M. (1997). *The effect of school gardens on self-esteem, interpersonal relationships, attitude towards school, and environmental attitude in populations of children behaviors* (Doctoral dissertation). Available from ProQuest Dissertations and Theses database. (UMI No. 9815857)

Warren, K. (1995). The student-directed classroom: A model for teaching experiential education theory. In K. Warren, M. Sakofs, & J. S. Hunt (Eds.), *The theory of experiential education*. (pp. 249-258). Dubuque, IO: Kendall/Hunt Publishing.

Warren, K., Sakofs, M., & Jasper, S. H. (Eds.). (1995). *The theory of experiential education*. Dubuque, IO: Kendall/Hunt Publishing Company.

Waters, A. (2005). Fast-food values and slow food values. In M. K. Stone & Z. Barlow (Eds.), *Ecological literacy: Educating our children for a sustainable world* (pp. 49-55). San Francisco, CA: Sierra Club Books.

Wells, N. M. (2000). At home with nature: The effects of nearby nature on children's cognitive functioning. *Environment and Behavior, 32,* 775-795.

Wiggins, G. P. (1998). *Educative assessment: Designing assessments to inform and improve student performance*. San Francisco, CA: Jossey-Bass.

Williams, D. R., & Brown, J. D. (2010). *Living soil and sustainability education: Linking pedagogy and pedology*. Portland, OR: Portland State University.

Williams, D. R., & Brown, J. D. (2012). *Learning gardens and sustainability education: Bringing life to schools and schools to life.* New York, NY: Routledge.

Williams, D. R., & Dixon, P. S. (in review). *Impact of garden-based learning on academic outcomes: Synthesis of research between 1990 and 2010.*

Wilson, E. O. (1984). *Biophilia*. Cambridge, MA: Harvard University Press.

Wilson, E. O. (1992). *The diversity of life.* Cambridge, MA: Harvard University Press.

Wilson, L. (1995). When we want to empower as well as teach. In K. Warren, M. Sakofs, & J. S. Hunt (Eds.), *The theory of experiential education*. (pp. 275-283). Dubuque, IO: Kendall/Hunt Publishing.

Wise, B. (2008). *Raising the grade: How high school reform can save our youth and our nation*. San Francisco, CA: Jossey-Bass.

Woodbridge, R. (2004). *Next world war: Tribes, cities, nations and ecological decline*. Toronto, Ontario: University of Toronto Press.

Wuest, J. (2009). Negotiating with helping systems: An example of grounded theory evolving through emergent fit. *Qualitative Health Research, 10*(1), 51-70.

Yee, A. (2012). Growing your own to feed the future. *Green Hawaii Sustainable Living Magazine, 2*(3). Retrieved from http://www.greenmagazinehawaii.com/food_v2-3.html

APPENDIX A

CONSENT FORMS

Parental Consent Form

I understand that the Prescott College PhD. Program supports the practice of protection for human subjects participating in research. The following is provided for me to decide whether I wish to allow my child to participate in the present study.
I understand that:

- My child will be taking part in a study of the effects of the school garden on student learning and academic achievement that is being conducted by Prescott College and Kohala Elementary School.
- This study is being conducted to determine the educational outcomes of garden-based curriculum and to improve our understanding of student learning and academic achievement.
- The Leadership Team of Kohala Elementary School, under the guidance of the school principal, selects the student participants of the Gifted and Talented program.
- Participation in this study is completely voluntary and I may withdraw my child and their data from the study at any time.
- My child can continue in the Kohala Elementary School Gifted and Talented program and gardening classes whether or not they participate in this study.
- Whether or not my child participates in this study will not impact their grades.
- My child's identity will be kept completely anonymous; his/her answers will be coded so that responses cannot be identified with names.
- My child's name will not be used in any write-up or report if this study.
- My child's Edison Learning Test scores and Hawaii State Assessment test score will be analyzed for academic achievement measurement.
- My child will be asked to answer a few questions about what they have learned from the garden-based classes (Science, Technology, Engineering and Math concepts), how they think they learn, and their overall experience with the garden.
- The interview questions should take no longer than one-half hour each and my child will not miss any class time to participate in this interview.
- If my child choses not to be interviews he/she will not be penalized in any way.
- My child will fill out self-evaluation surveys once a quarter.
- The number of subjects involved in this study will be at least 10 students and at least 6 teachers.
- I have been given a copy of this consent form.
- If at any time during the study I would like additional information I am free to contact the researcher, Koh Ming Wei at (808) 443-9231 or her Advisor Dr. Joan Clingan at:

  Prescott College PhD. Program
  220 Grove Avenue
  Prescott, AZ 86301
  (928) 350-3222

- This study has been reviewed and approved by the Institutional Review Board at Prescott College. For research related problems or questions regarding subject's rights please contact Dr. Pramod Parajuli (information above).

I have read and understand the explanation provided to me. I have had al my questions answered to my satisfaction and voluntarily agree to have my child participate in this study.

Print child's name:_____
Parent/Guardian Signature:_____ Date:_____
Principal Investigator:_____ Date:_____

Student Assent Form

I understand that:

- My school and Gifted and Talented Program (GT) have been chosen to be in a study about our school garden.
- The Leadership Team of my school has chosen the GT students.
- I do not have to take part in this study if I do not want to.
- I am volunteering to be in this study, and I may leave the study at any time.
- I will still get to do the GT class and garden activities even if I do not want to take part in the study.
- Taking part in this study will not change my grades in class.
- I will be asked some questions about what my class and I did in the garden.
- There is no wrong or right answer to these questions.
- If there is a question that I do not want to answer, I do not have to answer it.
- I will have self-evaluation survey to fill out.
- This will happen once every quarter.
- My answers will be given a secret code so that only the researcher will know it is mine.
- At least 10 other students and 6 teachers will participate in this study.
- If I have any questions about this study I can ask, the principal, my homeroom teacher, or Ms. Ming Wei.
- I have read this form and understand what is going to happen.
- I do not have any more questions and would like to take part in this study.
- At any time during the study, I may call the researcher Ms. Ming Wei at (808) 443-9231 with questions or her Advisor Dr. Joan Clingan at:

  Prescott College PhD. Program
  220 Grove Avenue
  Prescott, AZ 86301
  (928) 350-3208

- This study has been reviewed and approved by the Institutional Review Board at Prescott College. For research related problems or questions regarding subject's rights please contact Dr. Joan Clingan (information above).

Print student name:_____

Student's Signature:_____ Date:_____

Principal Investigator:_____Date:_____

APPENDIX B

GENERAL LEARNER OUTCOMES RUBRIC FOR GRADES 1 TO 6
STATE OF HAWAI'I
DEPARTMENT OF EDUCATION

GLO #1: Self-Directed Learner
(The ability to be responsible for one's own learning)

Indicators	**4** **Descriptors for *Consistently Demonstrates***	**3** **Descriptors for *Usually Demonstrates***	**2** **Descriptors for *Sometimes Demonstrates***	**1** **Descriptors for *Rarely Demonstrates***
Sets priorities and establishes achievable goals and personal plans for learning	• Consistently sets challenging, achievable goals and personal plans for learning • Consistently sets priorities to achieve goals • *Develops a thorough action plan for short and long range learning goals (in pursuit of career choices)* *Descriptor for Grades 5 & 6.*	• Usually sets achievable goals and personal plans for learning • Usually sets priorities to achieve goals • *Develops an adequate action plan for short and long range learning goals (in pursuit of career choices)* *Descriptor for Grades 5 & 6.*	• Sets achievable goals and personal plans for learning with moderate assistance • Sets priorities to achieve goals with moderate assistance • *Develops an incomplete action plan for short and long range learning goals (in pursuit career choices)* *Descriptor for Grades 5 & 6.*	• Sets achievable goals and personal plans for learning with ongoing assistance • Sets priorities to achieve goals with ongoing assistance • *Unable to develop short and long range learning goals (in pursuit of career choices)* *Descriptor for Grades 5 & 6.*
Plans and manages time and resources to achieve goals	• Consistently manages time and resources in an efficient manner to achieve goals • Consistently uses a variety of credible and relevant resources	• Usually manages time and resources in an efficient manner to achieve goals • Usually uses a variety of credible and relevant resources	• Manages time and resources with moderate assistance to achieve goals • Sometimes uses a variety of credible and relevant resources	• Manages time and resources with ongoing assistance to achieve goals • Rarely uses a variety of credible and relevant resources
Monitors progress and evaluates learning experiences	• Consistently checks on progress and learning experiences to resolve problems that may be interfering with learning	• Usually checks on progress and learning experiences to resolve problems that may be interfering with learning	• Checks on progress and learning experiences with moderate assistance to resolve problems that may be interfering with learning	• Checks on progress and learning experiences with ongoing assistance to resolve problems that may be interfering with learning

GLO #2: Community Contributor
(The understanding that it is essential for human beings to work together)

Indicators	4 Descriptors for *Consistently Demonstrates*	3 Descriptors for *Usually Demonstrates*	2 Descriptors for *Sometimes Demonstrates*	1 Descriptors *for Rarely Demonstrates*
Respects people's feelings, ideas, abilities and cultural diversity	• Consistently listens and considers other points of view and asks appropriate questions for clarification and understanding • Consistently uses appropriate voice level and tone appropriate to the message and audience in formal and informal settings • Consistently uses appropriate nonverbal responses including eye contact, attentive posture and facial expression to indicate respect and interest	• Usually listens and considers other points of view and asks appropriate questions for clarification and understanding • Usually uses appropriate voice level and tone appropriate to the message and audience in formal and informal settings • Usually uses appropriate nonverbal responses including eye contact, attentive posture and facial expression to indicate respect and interest	• Sometimes listens and considers other points of view and asks appropriate questions for clarification and understanding • Sometimes uses appropriate voice level and tone appropriate to the message and audience in formal and informal settings • Sometimes uses appropriate nonverbal responses including eye contact, attentive posture and facial expression to indicate respect and interest	• Rarely listens or considers other points of view; makes inappropriate comments • Seldom uses appropriate voice level and tone appropriate to the message or audience in formal and informal settings • Seldom uses appropriate nonverbal responses including eye contact, attentive posture and facial expression to indicate respect and interest
Cooperates with and helps and encourages others in group situations	• Consistently makes positive contributions toward achievement of the group's goals (stays on task, shares materials and ideas, helps others to focus on the task) • Consistently helps assess group progress toward the goal and improve efforts on an ongoing basis	• Usually makes positive contributions toward achievement of the group's goals (stays on task, shares materials and ideas, helps others to focus on the task) • Usually helps assess group progress toward the goal and improve efforts on an ongoing basis	• Makes positive contributions toward achievement of the group's goals (stays on task, shares materials and ideas, helps others to focus on the task) with moderate assistance • Sometimes helps assess group progress toward the goal	• Makes positive contributions toward achievement of the group's goals (stays on task, shares materials and ideas, helps others to focus on the task) with ongoing assistance • Rarely helps assess group progress toward the goal
Understands and follows rules of conduct	• Consistently follows class/school rules	• Usually follows class/school rules	• Follows class/school rules with moderate guidance	• Follows class/school rules with ongoing guidance
Analyzes conflict and applies	• Consistently recognizes the	• Usually recognizes the problem, makes	• Sometimes recognizes the problem, makes	• Rarely recognizes the problem, makes

methods of cooperative resolution	problem, makes appropriate input and helps group resolve conflicts and overcome difficulties	appropriate input and helps group resolve conflicts and overcome difficulties	appropriate input and helps group resolve conflicts and overcome difficulties	appropriate input or helps group resolve conflicts and overcome difficulties
Demonstrates responsible and ethical behavior in decision making	• Consistently demonstrates self control, moral and ethical behavior and acts with integrity in decision making	• Usually demonstrates self control, moral and ethical behavior and acts with integrity in decision making	• Demonstrates self control, moral and ethical behavior and acts with integrity in decision making with moderate guidance	• Demonstrates self control, moral and ethical behavior and acts with integrity in decision making with ongoing guidance
Responsibly implements a solution	• Consistently fulfills one's responsibility in implementing a solution	• Usually fulfills one's responsibility in implementing a solution	• Fulfills one's responsibility in implementing a solution with moderate assistance	• Fulfills one's responsibility in implementing a solution with ongoing assistance

GLO 3: Complex Thinker
(The ability to demonstrate critical thinking and problem solving)

Indicators	**4** **Descriptors for *Consistently Demonstrates***	**3** **Descriptors for *Usually Demonstrates***	**2** **Descriptors for *Sometimes Demonstrates***	**1** **Descriptors for *Rarely Demonstrates***
Applies prior learning experiences to new situations	• Consistently demonstrates use of prior knowledge to acquire new knowledge or develop new skills	• Usually demonstrates use of prior knowledge to acquire new knowledge or develop new skills	• Demonstrates use of prior knowledge to acquire new knowledge or develop new skills with moderate assistance	• Demonstrates use of prior knowledge to acquire new knowledge or develop new skills with ongoing assistance
Considers multiple perspectives in analyzing and solving a variety of problems	• Consistently demonstrates thorough analysis and evaluation of major points of view in analyzing/solving problems	• Usually offers adequate analysis and evaluation of major points of view in analyzing/solving problems	• Offers superficial analysis of a few alternative points of view in analyzing/solving problems	• Ignores alternative points of view in analyzing/solving problems
Generates new and creative ideas and approaches to developing solutions	• Consistently applies creative thinking to generate ideas and approaches to solving problems	• Usually applies creative thinking to generate ideas and approaches to solving problems	• Applies creative thinking to generate ideas and approaches to solving problems with moderate assistance	• Applies creative thinking to generate ideas and approaches to solving problems with ongoing assistance
Evaluates the effectiveness and ethical considerations to a solution and make adjustments as needed	• Consistently applies critical thinking to evaluate solutions based on solid information and change position when evidence and reasons are sufficient	• Usually applies critical thinking to evaluate solutions based on solid information and change position when evidence and reasons are sufficient	• Applies critical thinking to evaluate solutions based on solid information and change position when evidence and reasons are sufficient with moderate assistance	• Applies critical thinking to evaluate solutions based on solid information and change position when evidence and reasons are sufficient with ongoing assistance

GLO #4: Quality Producer
(The ability to recognize and produce quality performances and quality products)

Indicators	**4** **Descriptors for *Consistently Demonstrates***	**3** **Descriptors for *Usually Demonstrates***	**2** **Descriptors for *Sometimes Demonstrates***	**1** **Descriptors for *Rarely Demonstrates***
Recognizes and understands what quality performances and products are	• Consistently identifies and describes the criteria and performance standards of products and performances • Consistently demonstrates clear understanding of the learning goals and task requirements	• Usually identifies and describes the criteria and performance standards of products and performances • Usually demonstrates understanding of the learning goals and task requirements	• Identifies and describes the criteria and performance standards of products and performances with moderate assistance • Demonstrates understanding of the learning goals and task requirements with moderate assistance	• Identifies and describes the criteria and performance standards of products and performances with ongoing assistance • Demonstrates understanding of the learning goals and task requirements with ongoing assistance
Understands and sets criteria to meet or exceed Hawaii Content and Performance Standards	• Consistently sets criteria and clear goals to meet/exceed Hawaii Content and Performance Standards	• Usually sets criteria and goals to meet/exceed Hawaii Content and Performance Standards	• Sets criteria and goals to meet/exceed Hawaii Content and Performance Standards with moderate assistance	• Sets criteria and goals to meet/exceed Hawaii Content and Performance Standards with ongoing assistance
Produces evidence that meets or exceeds Hawaii Content and Performance Standards	• Consistently demonstrates in-depth understanding, knowledge and skills necessary for producing quality products and performances • Consistently monitors progress and uses feedback, criticisms and suggestions to improve work • Consistently remains on task and perseveres to the completion of quality work, performance or product	• Usually demonstrates clear understanding, knowledge and skills necessary for producing quality products and performances • Usually monitors progress and uses feedback, criticisms and suggestions to improve work • Usually remains on task and perseveres to the completion of quality work, performance or product	• Demonstrates understanding, knowledge and skills necessary for producing quality products and performances with moderate assistance • Monitors progress and uses feedback, criticisms and suggestions to improve work with moderate assistance • Remains on task and perseveres to the completion of quality work, performance or product with moderate assistance	• Demonstrates understanding, knowledge and skills necessary for producing quality products and performances with ongoing assistance • Monitors progress and uses feedback, criticisms and suggestions to improve work with ongoing assistance • Remains on task and perseveres to the completion of quality work, performance or product with ongoing assistance

GLO #5: Effective Communicator
(The ability to communicate effectively)

Indicators	4 **Descriptors for *Consistently Demonstrates***	3 **Descriptors for *Usually Demonstrates***	2 **Descriptors for *Sometimes Demonstrates***	1 **Descriptors for *Rarely Demonstrates***
Listens to, interprets, and uses information effectively	• Consistently solicits and actively listens to the ideas and opinions of others and demonstrates thorough understanding of the communication	• Usually solicits and actively listens to the ideas and opinions of others and demonstrates adequate understanding of the communication	• Listens to the ideas and opinions of others and demonstrates understanding of the communication with moderate assistance	• Listens to the ideas and opinions of others and demonstrates understanding of the communication with ongoing assistance
Communicates effectively and clearly through speaking, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes	• Consistently determines purpose for communicating, organizes and presents information to serve the purpose, context and audience • Consistently communicates information with logic and coherence. Intended purpose is explicit and all major points are fully elaborated	• Usually determines purpose for communicating, organizes and presents information to serve the purpose, context and audience • Usually communicates information with logic and coherence. Intended purpose is usually explicit and most major points are elaborated.	• Determines purpose for communicating, organizes and presents information to serve the purpose, context and audience with moderate assistance • Communicates with logic and coherence with moderate assistance	• Determines purpose for communicating, organizes and presents information to serve the purpose, context and audience with ongoing assistance • Communicates with logic or coherence with ongoing assistance
Reads with understanding various types of written materials and literature and uses information for a variety of purposes	• Consistently seeks information through reading various types of written materials • Consistently self corrects and takes risks • Consistently makes predictions and draws accurate inferences • Consistently demonstrates thorough understanding and meaning derived from print	• Usually seeks information through reading various types of written materials • Usually self corrects and takes risks • Usually makes predictions and draws accurate inferences • Usually demonstrates understanding and meaning derived from print	• Seeks information through reading various types of written materials with moderate support • Sometimes self corrects and takes risks • Makes predictions and draws inferences with moderate assistance • Demonstrates understanding and meaning derived from print with moderate assistance	• Seeks information through reading various types of written materials with ongoing support • Rarely self corrects and rakes risks • Makes predictions and draw influences with ongoing assistance • Demonstrates understanding and meaning derived from print with ongoing assistance

Communicates effectively and clearly through writing, using appropriate forms, conventions, and styles to convey ideas and information for a variety of audiences and purposes	• Consistently organizes sequence of ideas/events that moves reader smoothly through the writing from beginning to end	• Usually organizes sequence or ideas/events that moves reader smoothly through the writing from beginning to end	• Organizes sequence of ideas/events that moves reader through the writing from beginning to end with moderate assistance	• Organizes sequence of ideas/events that moves reader through the writing from beginning to end with ongoing assistance
Observes and makes sense of visual information	• Consistently observes and draws logical inferences and conclusions based on observations	• Usually observes and draws inferences and logical conclusions based on observations	• Observes and draws inferences and logical conclusions based on observations with moderate assistance	• Observes and draws inferences and logical conclusions based on observations with ongoing assistance

GENERAL LEARNER OUTCOMES

GLO #6: Effective and Ethical Users of Technology
(The ability to use a variety of technologies effectively and ethically.)

Indicators	**4** **Descriptors for *Consistently Demonstrates***	**3** **Descriptors for *Usually Demonstrates***	**2** **Descriptors for *Sometimes Demonstrates***	**1** **Descriptors for *Rarely Demonstrates***
Uses a variety of technologies in producing an idea or product	• Consistently uses a variety of productivity tools that displays excellence in presentation and content • *Consistently uses advanced capabilities of a variety of productivity tools (e.g., word processing, spreadsheet, database, graphics, digitized cameras) to produce quality work* *Descriptor for Grades 5 & 6*	• Usually uses a variety of productivity tools that demonstrate competency in displaying presentation and content • *Usually uses advanced capabilities of a variety of productivity tools (e.g., word processing, spreadsheet, database, graphics, digitized cameras) to produce quality work* *Descriptor for Grades 5 & 6*	• Uses a variety of productivity tools that demonstrate competency in displaying presentation and content with moderate assistance • *Uses advanced capabilities of limited productivity tools (e.g., word processing, spreadsheet, database, graphics, digitized cameras) to produce quality work with moderate assistance* *Descriptor for Grades 5 & 6*	• Uses a limited variety of productivity tools that demonstrate competency with ongoing assistance • *Uses advanced capabilities of limited productivity tools (e.g., word processing, spreadsheet, database, graphics, digitized cameras) to produce quality work with ongoing assistance ** *Descriptor for Grades 5 & 6*
Uses a variety of technologies to access and manage information and to generate new information	• Consistently and accurately uses a variety of technologies to access and manage information • *Consistently demonstrates mastery of variety of tools to collect data such as on-line surveys and interviews as well as tools to record, organize, and communicate the data using databases and spreadsheets* *Descriptor for Grades 5 & 6* • Consistently generates new information that demonstrates effective use of information	• Usually uses a variety of technologies to access and manage information • *Usually demonstrates mastery of variety of tools to collect data such as on-line surveys and interviews as well as tools to record, organize, and communicate the data using databases and spreadsheets* *Descriptor for Grades 5 & 6* • Usually generates new information that demonstrates effective use of information tools based on accessed information	• Uses a limited number of different technologies to access and manage information with moderate assistance • *Demonstrates a partial mastery of tools to collect data such as on-line surveys and interviews as well as tools to record, organize, and communicate the data using databases and spreadsheets with moderate assistance* *Descriptor for Grades 5 & 6* • Generates new information that demonstrates effective	• Uses a limited number of different technologies to access and manage information with ongoing assistance • *Demonstrates a partial mastery of tools to collect data such as on-line surveys and interviews as well as tools to record, organize, and communicate the data using databases and spreadsheets with ongoing assistance* *Descriptor for Grades 5 & 6* • Generates new information that demonstrates effective

	tools based on accessed information as well as the quality of the information sources	as well as the quality of the information sources	use of information tools based on accessed information as well as the quality of the information sources with moderate assistance	use of information tools based on accessed information as well as the quality of the information sources with moderate assistance
Understands the impact of technologies on individuals, family, society and the environment *Descriptor for Grades 5 & 6*	• *Appreciates and can accurately explain how the use of various technologies makes a difference in the lives of individuals, the family, society and the environment* • *Is able to illustrate with real life examples* *Descriptor for Grades 5 & 6*	• *Understands and can explain how the use of various technologies can make a difference in the lives of individuals, the family, society and the environment* *Descriptor for Grades 5 & 6*	• *Has an awareness of and can explain with prompts how the use of various technologies can make a difference in the lives of individuals, the family, society and the environment* *Descriptor for Grades 5 & 6*	• *Is not able to explain the impact of technology on individuals, family, society and the environment* *Descriptor for Grades 5 & 6*
Uses appropriate technologies for communication, collaboration, research, creativity and problem solving	• Consistently chooses the most appropriate technologies to complete assignments and can explain its appropriateness. • Uses multimedia, electronic devices, email, and/or Internet to expand beyond the barriers of a normal classroom	• Usually selects the most appropriate technologies to complete product and can explain its appropriateness	• Chooses appropriate technologies to complete product with moderate assistance	• Chooses appropriate technology tools to complete product with ongoing assistance
Understand and respects legal and ethical issues	• Consistently demonstrates knowledge of the legal and ethical issues regarding the use of technology and information (e.g., follows school rules covering language, privacy, copyright, citation of sources) • *Consistently all sources (information and graphics) are accurately documented in the desired format*	• Usually demonstrates knowledge of the legal and ethical issues regarding the use of technology and information (e.g., follows school rules covering language, privacy, copyright, citation of sources) • *Usually all sources (information and graphics) are accurately documented, in the desired format*	• Demonstrates knowledge of the legal and ethical issues regarding the use of technology and information (e.g., follows school rules covering language, privacy, copyright, citation of sources) with moderate guidance • *Sources (information and graphics) are accurately documented with moderate assistance*	• Demonstrates knowledge of the legal and ethical issues regarding the use of technology and information (e.g., follows school rules covering language, privacy, copyright, citation of sources) with ongoing guidance • *Sources (information and graphics) are accurately documented with ongoing assistance*

APPENDIX C

GENERAL LEARNER OUTCOMES PRE AND POST SURVEY

Kohala Elementary School
Discovery Garden
Gifted and Talented Program 2011 – 2012

GENERAL LEARNER OUTCOMES
or
HOW DO I KNOW I LEARNED SOMETHING
AND
THAT I CAN USE WHAT I LEARNED?
I can statements

GLO #1: As a **self-directed learner,** I can	**Consistently**	**Usually**	**Sometimes**	**Rarely**
• Set my own learning direction and specialty, eg., entomology (bugs), medicinal plants, soil science, Hawaiian plants etc.				
• Check on my own learning.				
• Make proper use of my time and materials.				
• Take on and carry out responsibilities.				

Comments:
_____

	I want to	**My teacher says I have to**	**Of my friends**	**My parents expect me to**
• I learn because…				

Comments:
_____

GLO #2: As a **community contributor,** I can:	**Consistently**	**Usually**	**Sometimes**	**Rarely**

• Listen to my classmates actively.				
• Cooperate and collaborate on garden tasks.				
• Make choices for the good of the whole group, not just for myself.				
• Grow healthy produce to share.				

Comments:

_____

	I want to	**My teacher says I have to**	**Of my friends**	**My parents expect me to**
• I work and play with the group because…				

Comments:

_____

GLO #3: As a **complex thinker,** I can:	**Consistently**	**Usually**	**Sometimes**	**Rarely**
• Use different tools such as drawing, writing, gardening, and music to help me think.				
• Make wise choices, using gathered facts and information.				
• Look beyond the problem and see a variety of solutions.				
• Be open to other viewpoints.				

Comments:

_____

	I want to	**My teacher says I have to**	**Of my friends**	**My parents expect me to**
• I use my thinking abilities because…				

Comments:

GLO #4: As a **quality producer,** I can:	**Consistently**	**Usually**	**Sometimes**	**Rarely**
• Tell what carefully and thoughtfully done work would look, sound, taste, or feel like.				
• Create carefully and thoughtfully done work.				
• Follow through and complete my work.				
• Choose to hold myself to high standards (PONO).				

Comments:

	I want to	**My teacher says I have to**	**Of my friends**	**My parents expect me to**
• I create carefully and thoughtfully done work, very nice and lasting products because…				

Comments:

GLO #5: As an **effective communicator,** I can:	**Consistently**	**Usually**	**Sometimes**	**Rarely**
• Listen actively for information.				
• Speak clearly, sequentially, and effectively.				
• Comprehend what I read and watch.				
• Write so that others can understand my thoughts				

and opinions.				
• Use a variety of formats such as posters, and PowerPoint presentations to communicate my ideas, knowledge, and research.				

Comments:

	I want to	**My teacher says I have to**	**Of my friends**	**My parents expect me to**
• I communicate so that others can understand me because…				

Comments:

GLO #6: As an **effective** and **ethical user** of **technology**, I can:	**Consistently**	**Usually**	**Sometimes**	**Rarely**
• Use tools (school, garden, etc) responsibly and correctly.				
• Use other tools and instruments such as magnifying glasses, weather station equipment, microscopes, and soil probes correctly and effectively.				
• Access information from the Internet responsibly and wisely.				
• Share knowledge and information with a variety of technologies.				

Comments:

	I want to	**My teacher says I have to**	**Of my friends**	**My parents expect me to**
• I use all kinds of technology because…				

Comments:

Please draw a picture to express your feelings and thoughts about how you are as a learner:

Mahalo!

APPENDIX D

PRESENTATION EVALUATION

Discovery Garden Kohala Elementary School
Gifted and Talented Program
Mini-STEM fair Presentation Evaluation
December 2011

Please rate the student's presentation. **Please rate each student individually**.

Student Name: _____ Date:_____

Grade YOU teach: _____

	Consistently	**Usually**	**Sometimes**	**Rarely**
1. Student demonstrated really knowing the topic/subject presented by being able to answer questions (self-directed learner).				
2. Student did not dominate the presentaiton and was group orientated (eg. listening when other student presented, did not interrupt, took turns speaking and answering questions).				
3. Student demonstrated critical and/or complex thinking with an ordered, logical, interesting and well-designed presentation (PPT, Poster, or Video).				
4. Student produced a high quality presentaiton – factual, logical, neat handwriting, and carefully composed pictures.				
5. Student communicated effectively – poised speech, eye contact, tone modulation, and comfortable, easy to understand speaking pace.				
6. Student demonstrated effective and ethical use of all kinds of technology – non-media and media.				

Comments: _____