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12 May 2015

Date

Wolf Ridge Environmental Learning Center Organic Farm: A Curriculum Evaluation

A THESIS
SUBMITTED TO THE FACULTY OF THE GRADUATE SCHOOL
OF THE UNIVERSITY OF MINNESOTA
BY

Melanie Jain Stewart

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
MASTER OR EDUCATION IN ENVIRONMENTAL EDUCATION

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May 2015

Acknowledgements

I would like to acknowledge my advisor and graduate committee, as well as faculty and fellow classmates within the Masters of Environmental Education program, for their unending support and guidance throughout this process. I would also like to extend a heartfelt thank you to the staff at Wolf Ridge Environmental Learning Center for the opportunity to work with their organization on this project, as well as all of their time and assistance that went into this study.

Abstract

Wolf Ridge Environmental Learning Center (WRELC), located in Finland, MN, recently developed a new curriculum for their on-site organic farm. Using a one group pre-test/post-test design, this evaluative study investigated the effectiveness of the WRELC Organic Farm curriculum at enhancing participants' knowledge of the food system. Mean knowledge scores collected from a quantitative survey significantly increased from pre- to post-test among all five knowledge domains measured. Additionally, there were few effects of demographic variables measured, indicating that this curriculum was generally effective for most participants. A qualitative interview with the instructor of the classes lent support to quantitative findings. Results from this study point toward an overall success of this curriculum at enhancing participants' knowledge of the food system. Recommendations for WRELC were provided, and areas for future research were noted.

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Chapter 1. Introduction

Background

As Hess & Trexler (2001) state, “modern agriculture poses ecological problems and opportunities which defy simple democratic reform without an educated citizenry” (p. 151). Tackling these important issues requires education of the public toward a better understanding of the food system. Environmental education (EE) has the potential to serve as a means toward this end.

The goals of environmental education include fostering awareness of economic, social, political, and ecological interdependence, providing opportunities to acquire knowledge, values, attitudes, commitment, and skills needed to address environmental issues, and creating new patterns of behavior toward the environment (UNESCO-UNEP, 1978). A relative of EE, education for sustainable development (ESD) has similar goals. These include integrating values of sustainability into everyday life, developing knowledge and skills to address common sustainability issues, achieving economic and social justice for all, and improving education to raise awareness for sustainability issues (Wals, 2009). The similar goals of EE and ESD offer a pathway toward a well-educated citizenry that can address environmental issues related to modern agriculture.

Garden-based education can be seen as one form of environmental education (Miller, 2007). While garden-based education is not a new phenomenon, it has been growing in popularity in the United States in recent years due to rising concerns for children’s health issues such as childhood obesity and type II diabetes, as well as rising concerns for what Richard Louv (2005) calls “nature deficit disorder” and a widespread movement to reconnect children with nature (Williams & Dixon, 2013).

Garden-based education has been used in a wide variety of formal and non-formal educational settings for audiences of all ages (for a review of youth garden-based education programs, see Blair, 2009 and Williams & Dixon, 2013). Educational gardens have the potential to improve learning in multiple areas. For example, garden-based education has been shown to improve students' environmental attitudes (Cammack, Waliczek, & Zajicek, 2002a; Skelly & Zajicek, 1998; Waliczek & Zajicek, 1999;), academic achievement (Dircks & Orvis, 2005; Klemmer, Waliczek, & Zajicek, 2005; Smith & Motsenbocker, 2005), psychosocial skills (Laaksoharju, Rappe, & Kaivola, 2012; Robinson & Zajicek, 2005; Ruiz-Gallardo, Verde, & Valdes, 2013), and nutrition (see Robinson-O'Brien, Story, & Heim, 2009 for a review of nutrition-related outcomes of garden-based education).

Quite surprisingly, given the prevalence of garden-based education and the importance of food and agriculture for all human life, very few studies have analyzed the effects of garden-based education on students' knowledge of the food system. Mabie and Baker (1996) found an increase in all measures of student knowledge of the food and fiber system after participating in a school garden program. However, this study is nearly two decades old and offered no statistical evidence to support the data. Thus, further inquiry into the impact of garden-based education on students' understanding of the food system is warranted.

In 1988, the National Academy of Science (NAS) released a report that underscored the importance of agricultural education for all K-12 students and proposed the concept of "agricultural literacy" (NAS, 1988). Since then, agricultural literacy has gained traction in education communities. A comprehensive set of K-12 agricultural education standards was published in 1998 (Leising, Igo, Heald, Hubert, & Yamamoto, 1998). Agricultural concepts have also been incorporated into science literacy benchmarks (American Association for the Advancement of Science, 2009) and the Next Generation Science Standards (Achieve, Inc., 2013). Despite the push for agricultural education by some, many of today's youth remain agriculturally illiterate (Brophy, Alleman, & O'Mahony, 2003; Pense & Leising, 2004; Hess & Trexler, 2011).

Some organizations are beginning to educate students about agriculture and the environment through garden-based education. One such organization is Wolf Ridge Environmental Learning Center (WRELC), located in Finland, Minnesota. Wolf Ridge was the first environmental learning center in the United States to become an accredited K-12 school (WRELC, 2013). Wolf Ridge currently serves approximately 13,000 students from over 160 visiting schools during the school year; field trips generally cater to middle school students, teachers, and parent chaperones from Minnesota, with a few school groups bringing younger students and some visiting from Wisconsin and North Dakota (WRELC, 2013).

In 2009, WRELC began developing an organic farm, with the mission to "establish an agricultural production system that will supply healthy, organic and affordable food for the center's meals and provide educational 'food' programs for Wolf Ridge" (WRELC, 2014). In the spring of 2014, WRELC developed an 8.5-hour food systems curriculum, consisting of three consecutive hands-on lessons: Introduction to Food Systems, Healthy Food and Community Cooking, and Plants and Pollination (WRELC, 2014). For more detail on the learning objectives of the farm curriculum, see the logic model in Appendix A. Six classes were conducted in the fall of 2014.

Purpose Statement

The purpose of this evaluative study was to investigate the effectiveness of the WRELC Organic Farm curriculum at enhancing participants' knowledge of the food system.

Evaluation Questions

This study was guided by the following evaluation questions:

1) Does participation in the WRELC Organic Farm curriculum increase participants' knowledge of the food system?
2) Is the WRELC Organic Farm curriculum equally effective at enhancing all participants' knowledge of the food system, regardless of age, gender, ethnicity, place of residence, or prior experience with gardens and/or farms?

Definition of Terms

This section highlights how important terms will be used in this study. A nominal definition as accepted in the literature is provided for each term. Where relevant, an operational definition is also provided, which specifies how the concept will be measured in this study.

Environmental Education

As stated in the Tbilisi Declaration, environmental education (EE) is defined as "a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address these challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action" (UNESCO-UNEP, 1978, p. 11).

While some have called for a distinction between EE and education for sustainable development (ESD), others have argued the two can be thought of as related entities (Monroe, 2012). For purposes of this study, the term EE will be used to incorporate both EE and ESD.

Garden- and Farm-Based Education

Garden-based learning is defined as "an instructional strategy that utilizes a garden as a teaching tool. The pedagogy is based on experiential education, which is applied in the living laboratory of the garden" (Desmond, Grieshop, & Subramaniam, 2004, p. 20). Farm-based education is defined as "a form of experiential interdisciplinary education that connects people to the environment, their community, and the role of agriculture in our lives" (Farm-Based Education Network, 2014, About section, para. 1).

As there is much overlap in these two definitions, the terms garden- and farm-based education will be used interchangeably throughout this study. Furthermore, these terms will be considered as one form or method of environmental education, due to the interconnectedness of garden-based education and EE (Miller, 2007).

The operational definition of garden- and farm-based education will be the implementation of the 8.5-hour curriculum at the WRELC Organic Farm.

Knowledge of the food system

A food system is defined as "comprising four sets of activities: those involved in food production, processing and packaging, distribution and retail, and consumption. All encompass social, economic, political, and environmental processes and dimensions" (Ericksen, 2008, p. 14).

The definition of environmental knowledge includes "knowledge of: physical and ecological systems; social, cultural, and political systems; environmental issues; multiple solutions to environmental issues; and citizen participation and action strategies" (Hollweg, et al., 2011, p. 3).

The term "knowledge of the food system" will therefore be defined as environmental knowledge as stated above, limited in scope with respect to the food system in particular. Participants' scores on the questionnaire will serve as the observable measure of this construct.

Agricultural literacy

Agricultural literacy is defined as "possessing knowledge and understanding of our food and fiber system. An individual possessing such knowledge would be able to synthesize, analyze, and communicate basic information about agriculture" (Frick, Kahler, & Miller, 1991, p. 52).

For purposes of this study, participants' knowledge of the food system, as observed through questionnaire scores, will be viewed as an important component to agricultural literacy.

Program Evaluation

Program evaluation is defined as the "systematic collection of information about the activities, characteristics, and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future programming" (Patton, 1997, p. 23). This study will operate through the lens of program evaluation.

Limitations

This evaluative study has several limitations. First, the evaluator has ties to Wolf Ridge ELC as well as a variety of experiences in teaching garden-based education and acknowledges the potential for evaluator bias throughout this study. Second, the study population is not representative of all school field trip visitors to Wolf Ridge; likewise, the lack of non-random selection or assignment within this study renders the results of this study not generalizable beyond the study participants. Third, there is the chance for testing effects within the study, particularly in that the pre-test may have cued participants' attention toward specific learning outcomes before their class even started. Similarly, each class experienced a different time interval between pre- and post-test, which may have also contributed to testing effects. Additional threats to internal validity for a one-group pre-test/post-test research design also include the lack of a control group with which to compare data (Campbell & Stanley, 1963).

Delimitations

Due to the evaluative nature of this study, purposeful, nonrandom sampling techniques were employed. Purposive sampling is "a type of nonprobability sampling in which the units to be observed are selected on the basis of the researcher's judgment about which ones will be the most useful or representative" (Babbie, 2011, p. 207). Creswell (2014) further states that purposeful selection of participants can be used to best help the researcher understand the problem and that it "does not necessarily suggest random sampling or selection of a large number of participants" (p. 189). As a result, the study population is delimited to participants of the WRELC Organic Farm curriculum. Findings from this study should not be generalized beyond the study population.

One potential limitation of the curriculum itself is the short length of time students will engage with the WRELC Organic Farm curriculum. Most garden-based education programs occur over longer periods of time (i.e. a school year or summer; see Blair, 2009 and Williams & Dixon, 2013 for a review); it is likely that a day-long curriculum is not enough to render students fully literate in all aspects of agriculture. However, Frick, Birkenholz, and Machtmes (1995) argue "functional [agricultural] literacy does not imply a perfect level of understanding about agriculture, but rather a minimum level." Hess & Trexler (2011) found that school field trips to farms were a common source of students' knowledge about the food system. Participation in the WRELC Organic Farm curriculum can be thought of, then, as one of many experiences that have the potential to contribute to a student's lifelong journey toward agricultural literacy. For this reason, the dependent variable in this study will be narrowed to knowledge of the food system rather than agricultural literacy as a whole.

Significance

The greatest significance of this study is that it will serve as an evaluation of a newly-developed curriculum at Wolf Ridge Environmental Learning Center. Results from this evaluative study were used to make recommendations to WRELC about any necessary adjustments to the farm curriculum. Results should also be used as a foundation for future program expansion at the WRELC Organic Farm.

Chapter 2. Review of Literature

Introduction

The purpose of this chapter is to provide a foundation for this study through a review of relevant literature related to the study objectives highlighted in the previous chapter. This chapter begins with a discussion of the tenets of Environmental Education and Education for Sustainable Development. It then moves into a discussion of garden- and farm-based education, providing a definition and historical context, examining the underlying pedagogy, and reviewing perceived and measured outcomes. A lack of understanding of the impact of garden-based education on students' knowledge of food systems is also noted. The chapter concludes with a review of agricultural literacy and its importance for, and absence among, today's youth.

Environmental Education and Education for Sustainable Development

While the origins of environmental education (EE) date back to the late 1800s and early 1900s, its formal history is somewhat more recent (Biedenweg, Monroe, & Wojcik, 2013). The Tbilisi Declaration, resulting from the first international EE conference held in Tbilisi, Georgia, USSR in 1977, defined environmental education as "a learning process that increases people's knowledge and awareness about the environment and associated challenges, develops the necessary skills and expertise to address these challenges, and fosters attitudes, motivations, and commitments to make informed decisions and take responsible action" (UNESCO-UNEP, 1978, p. 11). The Tbilisi Declaration further set out the following three goals of environmental education:

- "To foster clear awareness of, and concern about, economic, social, political and ecological interdependence in urban and rural areas;

- To provide every person with opportunities to acquire the knowledge, values, attitudes, commitment and skills needed to protect and improve the environment;
- To create new patterns of behavior of individuals, groups and society as a whole towards the environment" (UNESCO-UNEP, 1978, p. 26).

While the Tbilisi Declaration is still considered a foundational document in the history of EE, the field remains in constant flux. During the United States environmental movement of the 1970s, environmental and resource management concerns were at the forefront of EE programs. In the wake of conservative backlash against the environmental movement, EE became more closely aligned with formal science education, focusing on teaching concepts about ecosystems and conservation (Monroe, 2012). As a result of these social and political pressures, the interdisciplinary nature of environmental education intended by the Tbilisi Declaration was not fully realized in the United States.

Recently, education for sustainable development (ESD) has been receiving a lot of attention, as the United Nations is nearing the end of its international 2005-2014 Decade of Education for Sustainable Development. One of the most commonly cited definitions of ESD, as provided by the original Decade of ESD guidelines, reads:

> Education for Sustainable Development is a learning process (or approach to teaching) based on the ideals and principles that underlie sustainability and is concerned with all levels and types of education. ESD supports five fundamental types of learning to provide quality education and foster sustainable human

development – learning to know, learning to be, learning to live together, learning to do and learning to transform oneself and society (Wals, 2009, p. 26).

However, despite the widespread acceptance of ESD, its precise definition remains up for debate. Many argue ESD ought to develop in locally relevant and culturally appropriate ways, with some emphasizing the 'education' component and others emphasizing the 'development' piece; regardless of the precise definition used, most views converge that ESD can be seen as:

- "A transformative and reflective process that seeks to integrate values and perceptions of sustainability into not only education systems but one's everyday personal and professional life;
- A means of empowering people with new knowledge and skills to help resolve common issues that challenge global society's collective life now and in the future;
- A holistic approach to achieve economic and social justice and respect for all life;
- A means to improve the quality of basic education, to reorient existing educational programmes and to raise awareness" (Wals, 2009, p. 26).

There remains yet another debate as to how, if at all, EE and ESD are related. Some argue that EE is a component of ESD, others argue that ESD is a component of EE; still others wonder whether the two ought to be thought of as completely separate fields, as the main focus of EE is seen as addressing environmental issues while the main focus of ESD includes social and economic, as well as environmental, issues related to development (Biedenweg, et al., 2013). Nevertheless, it is clear from the original definition and goals outlined in the Tbilisi Declaration that EE was intended to encompass the human side of environmental issues. Monroe argues, "perhaps it does not matter what we call it" (2012, p. 46), as both EE and ESD have the potential to prepare citizens to understand, devise solutions, and take action on environmental challenges. With this in mind, the term EE will henceforth be used to incorporate ESD throughout the remainder of this paper.

Modern agriculture is one area which poses many environmental challenges and opportunities for creative solutions (Hess & Trexler, 2011). Environmental education has the potential to address these challenges and opportunities through the use of educational gardens and/or farms. To better understand this potential, we turn now to a discussion of garden- and farm-based education.

Garden- and Farm-Based Education

Food gardens and farms are valuable tools for environmental learning that have been used for many years and in many educational settings. In a report for the Food and Agriculture Organization of the United Nations, Desmond, et al. (2004) defined garden-based learning as simply "an instructional strategy that utilizes a garden as a teaching tool" (p. 20). Often, garden-based learning takes place on educational farms. The Farm-Based Education Network (2014) defines farm-based education as "a form of experiential, interdisciplinary education that connects people to the environment, their community, and the role of agriculture in our lives" (About section, para. 1). As there is much overlap in these two definitions, the two terms garden- and farm-based education will be used interchangeably throughout the remainder of this paper.

There are some garden-based educators who do not perceive themselves as environmental educators, and conversely some environmental educators who may not view gardening as a form of EE. However, Miller (2007) argues the connections between the two are strong. Children's gardens and EE are intrinsically interdisciplinary: "[EE] requires understanding within economics, math, geography, ethics, language, politics, and other subjects. As nearly any subject can be taught in the integrated context of a children's garden, so can environmental education concepts be integrated throughout the entire curriculum" (Miller, 2007, p. 15). Garden-based education and EE advocate for the same basic tenets, offering "a real-life context for integrated learning, which provides a vehicle for higher order thinking, construction of knowledge, and the development of analytical and synthesis skills" (Miller, 2007, p. 15). Because of the interconnectedness of these two disciplines, garden-based education will be considered as one form or method of EE for purposes of this study.

History of Garden-Based Education in the United States

The concept of teaching through gardens is not a new one. As early as the sixth century BCE, King Cyrus of Persia had gardens in which the sons of noblemen were instructed (Miller, 2007). Although the idea of formal school gardens can be traced back to such early philosophers as Johann Comenius, Jean Jacques Rousseau, and Johann Pestalozzi, school gardens only became a phenomenon in the United States in the late 1800s to early 1900s, justified in part by their widespread use in European schools at the time (Kohlstedt, 2008). The initial push for school gardens at the turn of the century came from the Nature Study movement. Advocates of Nature Study sought to improve teaching and promote a connection to the earth by making learning more interactive through nature; gardens were seen as a compliment to nature areas, especially in urban schools where green space was less prevalent (Trelstad, 1997). The early school garden movement was, however, met with some skepticism; many argued gardens ought to be grown at home in order to allow schools to focus on academic skills (Kohlstedt, 2008).

In the early 1900s, progressive reformers began to advocate for school gardens as a means of achieving many social aims, with goals such as city beautification, reduction of juvenile delinquency, improved health and nutrition, and Americanization of immigrants (Trelstad, 1997). With time, school gardens began to look less like the living laboratories imagined by Nature Study advocates and more like a "good citizen factory" (Treslstad, 1997, p. 165). By 1906, an estimated 75,000 school gardens were in production (Kohlstedt, 2008).

In spite of the widespread usage of school gardens, the federal government had very little oversight until the country entered into World War I in 1918 and United States School Garden Army (USSGA) was created. Youth workers in school gardens were seen as vital to national security. As President Woodrow Wilson stated, "every boy and girl… would like to feel that they are in fact fighting in France by joining the home garden army" (Kohlstedt, 2008, p. 87). In total, over 1.5 million students took part in the USSGA, converting over 60,000 acres into production (Trelstad, 1997). In fact, school gardens were so productive that they actually suppressed local agriculture markets in some areas (Hayden-Smith, 2007).

Federal support for school gardens was significantly scaled back by war's end, at which time the school gardens had evolved drastically from their original intent. As Trelstad (1997) notes, by the end of the 1920s, "depression had gripped the country; the garden idea, except in the nation's largest cities, was dead" (p. 170). A smaller version of the USSGA, however, did resurface during World War II, though most efforts during this time were put into the highly successful campaign promoting the growing of home "Victory Gardens." Hayden-Smith (2007) speculates that the widespread success of the Victory Garden campaign may have been due in part to adults on the home-front having participated in the USSGA as children during World War I.

The modern resurgence of school and community gardens, while not directly connected, has much to learn from the past successes and failures of the school garden movement of the early 1900s. The current school garden movement is rooted in two national interest areas. The first is public health, as garden-based learning is seen as one way to address the rising rates of type II diabetes and childhood obesity plaguing the nation's children (Williams & Dixon, 2013). The second is the No Child Left Inside movement, as children are lacking in nature play spaces, suffering from what Richard Louv (2005) coined as "nature-deficit disorder." School gardens are seen as a way to offer children the outdoor spaces they need while simultaneously providing valuable learning experiences and potential health benefits (Williams & Dixon, 2013).

Pedagogy of Garden-Based Education

As Desmond, et al. (2004) explain, the pedagogy of garden-based learning "is based on experiential education, which is applied in the living laboratory of the garden" (p. 20). The Association for Experiential Education (AEE) defines experiential education as "a philosophy that informs many methodologies in which educators purposefully engage with learners in direct experience and focused reflection in order to increase knowledge, develop skills, clarify values, and develop people's capacity to contribute to their communities" (AEE, 2014, para. 1). A prominent progressive educator and philosopher of the early 20th century, John Dewey is widely considered the founder of experiential education. In his book *Experience and Education* (1938), Dewey lays the foundation for experiential learning. According to Dewey, an experience must be authentic rather than artificial, be planned and structured under the guidance of an instructor, elicit personal meaning from the student, and include a period of reflection (Dewey, 1938).

Drawing on the work of John Dewey, as well as philosopher Jean Piaget and psychologist Kurt Lewin, David Kolb (1984) expanded the theory of experiential education, developing an experiential learning cycle that is still widely used today. His experiential learning cycle includes the following four stages:

- The learner encounters *concrete experiences*,
- The learner takes time for *reflective observation*,
- The learner *conceptualizes and generalizes* new ideas, and
- The learner *applies* new concepts to the real world (Kolb, 1984).

For Kolb, learning was defined directly in terms of experiences, as "the process whereby knowledge is created through the transformation of experience" (Kolb, 1984, p. 38).

Experiential education has its roots in constructivism, a learning theory rather than a particular teaching strategy, which states learners construct new knowledge and meaning from current experiences coupled with past experiences and prior knowledge (Bransford, Brown, & Cocking, 1999). Constructivism, then, supports a student-centered approach to education. As Miller (2007) argues, "children's gardens serve as a natural context for experiential and project-based learning that is vital to learner-centered pedagogy" (p. 15).

Miller (2007) further notes that garden-based education can address Gardner's Theory of Multiple Intelligences regarding teaching and learning. Howard Gardner, a developmental psychologist, developed the theory of multiple intelligences in his 1983 book *Frames of Mind: The Theory of Multiple Intelligences*. According to this theory, there is no one single intellectual capacity, but multiple types of intelligence people can possess and utilize for problem-solving (Gardner, 1983). The original seven intelligences Gardener (1983) identified are: (a) linguistic, (b) musical, (c) logical-mathematical, (d) spatial, (e) bodily-kinesthetic, (f) interpersonal, and (g) intrapersonal. He later added naturalistic and existential/spiritual, to the list (Gardner, 1999). Because of its inter-disciplinary nature, garden-based education can appeal to these multiple intelligences of students and support learning in the process.

Perceptions of Garden-Based Education

Due to its roots in sound learning theory and pedagogy, it follows that educators' perceptions of garden-based learning are generally positive. In a survey of elementary teachers across the country, DeMarco, Relf, and McDaniel (1999) found that school gardens were incorporated into most core subjects, most commonly science, EE, math, and language arts, with goals for school gardens in both academic instruction and development of social skills. 96% of teachers surveyed viewed gardening with youth as a somewhat to very successful teaching tool (DeMarco, et al., 1999). As the researchers note, "gardening provides students with opportunities to interact with nature on a personal level that promotes positive behavior changes" (DeMarco, et al., 1999, p. 277).

In a similar survey of elementary school teachers in Florida, Skelly and Bradley (2000) found that the majority of teachers used school gardens for environmental education and for experiential learning. 84% of teachers perceived the garden as helping students learn better (Skelly & Bradley, 2000). However, the authors note the gardens in this study were used minimally, averaging only one hour per week in the garden (Skelly & Bradley, 2000). These findings indicate that perhaps even minimal exposure to garden-based education can have impacts on student learning.

Another survey of fourth grade teachers in California revealed similar findings. Teachers in this study used school gardens primarily for academic instruction, to teach subjects such as science, nutrition, environmental studies, language arts, and math (Graham & Zindenberg-Cherr, 2005). Teachers further perceived improvement in science learning, social skills, overall academic performance, physical activity, language, and healthy eating as a result of garden-based education; as one teacher noted, the garden provides "a valuable context for student learning" (Graham & Zindenberg-Cherr, 2005, p. 1798).

In addition to teachers, administrators and community members also perceive benefits of garden-based education. The majority of California public school principals also viewed garden-based learning as moderately to very effective at enhancing student learning (Graham, Beall, Lussier, McLaughlin, & Zindenberg-Cherr, 2005). In a study of school gardens in Las Vegas elementary schools, O'Callaghan (2005) found that the majority of community stakeholders viewed school gardens as highly important, linking it to community needs for youth, career information, and horticulture. Additionally, all of the responding elementary principals at schools with gardens perceived benefits to student learning (O'Callaghan, 2005).

From these studies summarized above, it is clear that teachers, principals, and community stakeholders perceive a wide range of benefits of garden-based learning. It is important to note, however, that each of these studies present only perceived benefits of garden-based learning. Garden-based educators instinctively know "that gardening is an ideal interdisciplinary method for children to connect with the natural world, understand their place in the web of life, and appreciate the role of plants in their everyday lives," but these claims are often unfortunately dismissed as anecdotal (Miller, 2007, p. 16). As DeMarco, et al. (1999) state, "it is imperative research be conducted that quantifies the student learning that occurs when gardening is used in the curriculum" (p. 280). To that end, the following section outlines research that has been conducted to assess the learning outcomes of garden-based education. For a more detailed review of the topic, see Blair (2009) and Williams & Dixon (2013).

EE Learning in Garden-Based Education

As a common tool for environmental education, many researchers have studied the effects of garden-based learning on students' environmental attitudes and other indicators of environmental literacy. The somewhat scant literature pool offers mixed, though generally positive, results. In one of the first studies of the modern school garden movement to assess students' environmental learning, second and fourth grade students in a school garden program reported significantly more positive environmental attitudes than a control group (Skelly & Zajicek, 1998). Neither gender nor ethnicity had an effect on environmental attitudes, though second grade students had more positive attitudes than fourth grade students; there was also an effect of the number of outdoor activities, in that students who participated in more outdoor garden activities exhibited more positive environmental attitudes (Skelly & Zajicek, 1998). Similarly, Waliczek and Zajicek (1999) found a significant increase in environmental attitudes among second-eighth grade students in Texas and Kansas after participating in school garden programs. However, this study found that girls had significantly more positive attitudes than boys, as did Caucasian students when compared with their Hispanic and African-American classmates (Waliczek & Zajicek, 1999).

A few researchers have gone beyond measurements of environmental attitudes as an indication of environmental learning. Cammack, et al. (2002a) sought to determine if participation in a horticulture-based intervention program for juvenile offenders in Texas improved participants' environmental attitudes and horticultural knowledge. Results showed significant improvements for both attitudes and knowledge for program participants, with no differences noted based on participant demographics (Cammack, et al., 2002a). Additionally, environmental attitudes were significantly more positive among those who had participated in at least 60% of the program sessions, indicating prolonged exposure may have stronger effects on environmental attitudes (Cammack, et al., 2002a). Aguilar, Waliczek, and Zajicek (2008) measured both environmental attitudes and environmental locus of control (belief in one's ability to make a difference and act responsibly regarding environmental issues) in third-fifth grade students in Texas. There were no significant differences between the experimental and control groups for either measure, though girls scored higher than boys, and Caucasians higher than Hispanic and African-American students, in both measures (Aguilar, et al., 2008). Interestingly, they also found that students with previous gardening experience in or out of school had significantly higher scores for both measures, indicating that "past [gardening] experiences appeared to have an effect on children's environmental attitudes and environmental locus of control" (Aguilar, et al., 2008, p. 247).

Each of these studies measured slightly different populations in different educational settings, each using different tools to measure environmental learning, so it follows that results are somewhat mixed. However, taken together it appears that there is an overall positive effect of garden-based learning on students' environmental attitudes. As Skelly and Bradley (2000) conclude, "school gardens offer an ideal place to teach environmental education and to inform students about the environment and related issues" (p. 103).

Academic Achievement through Garden-Based Education

One of the virtues of garden-based education is that its teachings are multifaceted, transcending environmental education into other academic disciplines. A handful of studies have been conducted to assess the effects of garden-based education on science knowledge and achievement. In a post-test only measure of third-fifth grade students in Texas, Klemmer, et al. (2005) found that students involved in the school garden achieved significantly higher science test scores than their non-gardening peers. There was no effect of gender on science achievement; however, fifth grade students made significantly stronger gains than third or fourth grade students, indicating the garden-based learning was more effective for the older students (Klemmer, et al., 2005). Dircks and Orvis (2005) also measured science knowledge, as well as attitudes toward science, horticulture, and the environment among third grade students in Indiana school gardens.

Both knowledge and attitude scores significantly improved after the garden curriculum was implemented, and there was no effect of gender, age, race, or place of residence, indicating the curriculum was equally beneficial to all students; however, a significant difference was noted based on individual classroom differences (Dircks & Orvis, 2005).

In another measure of science achievement among fifth grade students in Louisiana, Smith and Motsenbocker (2005) found science scores once again improved significantly after participating in the garden curriculum. There was, again, no effect of gender (Smith & Motsenbocker, 2005). One interesting difference between this and other studies was the study population. As the authors note:

> Our study focused on a predominantly African-American student population in low-income, inner-city public schools, with some of the students being from disadvantaged backgrounds. These are the students who truly need educators to find new ways of engaging their students in science learning activities. (Smith & Motsenbocker, 2005, p. 442)

While many studies report the use of school gardens for multiple academic disciplines (i.e. DeMarco, et al., 1999; Graham & Zindenberg-Cherr, 2005), few studies have measured the effects on learning in academic disciplines beyond science.

It is important to move beyond knowledge measurements and focus on which aspects of garden-based learning correlate with academic achievement. As Skinner and Chi (2011) note, “several decades of research have demonstrated that students’ engagement predicts their learning, grades, achievement, retention, and graduation” (p. 17). They therefore published the first study to measure student engagement in the garden and how that affects academic achievement. In this study of sixth-seventh grade students in the Pacific Northwest, student engagement in the garden significantly and positively correlated with, among other things, students' perceived learning, students' actual grades in core subjects, and students' academic engagement in school (Skinner & Chi, 2011). Knowing what motivates a student in the garden is the first step to building better curricula to address academic learning.

Development of Psychosocial Skill through Garden-Based Education

In addition to fostering the development of academic knowledge and positive environmental attitudes, educational gardens may offer a place for youth to develop important psychosocial skills. While Waliczek, Bradley, and Zajicek (2001) found no overall differences between school garden and control groups with respect to interpersonal relationships or attitudes toward school among second-eighth grade students in Texas and Kansas, some demographic differences were noted. Female garden students exhibited significantly more positive attitudes toward school than did their male counterparts, older garden students developed significantly more positive interpersonal relationships than their younger counterparts, and students in schools allowing for more individual participation in the garden reported significantly higher attitudes toward school (Waliczek, et al. 2001). These findings indicate that, for some, garden-based education may impact psychological factors of children (Waliczek, et al., 2001). In another study of third-fifth grade students in Texas, Robinson and Zajicek (2005) measured the effects of a school garden on six life skills: working with groups, self-understanding, leadership, decision-making, communication, and volunteerism. There was a significant increase in overall life skills among students participating in the garden, whereas the control group did not experience an increase (Robinson & Zajicek, 2005). Additionally, no effect of grade, gender, or ethnicity was found, indicating the garden was successful at improving life skills for all students; as the authors mention, “these skills are extremely important to ensure socially responsible and productive citizens” (Robinson & Zajicek, 2005, p. 456).

Because of the potential for developing critical life skills, educational gardens are often used in high needs populations. Cammack, Waliczek, and Zajicek (2002b) studied the effects of a horticultural program for juvenile delinquents on participants’ self-esteem, attitude toward school, locus of control, and interpersonal relationships. There was no overall improvement in any of the variables measured from pre- to post-test; however, since the program was a “short-term probationary program, it may not have been long enough to influence complex psychological variables” (Cammack, et al., 2002b, p. 86). More recently, Ruiz-Gallardo, et al. (2013) examined the impact of garden-based learning on disruptive and low-performing secondary school students in Spain. After the garden program was implemented, participating students passed significantly more subjects in schools and improved all measures of disruptive behavior (Ruiz-Gallardo, et al., 2013). Additionally, qualitative observations found participants’ attitudes toward school, responsibility, self-esteem, and confidence all improved after the program, and participants developed both practical (i.e. gardening) and life (i.e. critical thinking) skills (Ruiz-Gallardo, et al., 2013). As the authors note:

> Explanations for these changes are neither singular nor simplistic. The reality is that [garden-based learning] provides these types of young people with opportunities to demonstrate their competence, overcoming a continuous sense of failure that has been generated in the traditional school system (Ruiz-Gallardo, et al., 2013, p. 264).

One study has moved beyond examining which life skills are developed in educational gardens to examine what aspects of garden-based learning allow for these life skills to be developed. In a qualitative study of a summer garden camp for 7-12 year olds in Finland, Laaksoharju, et al. (2012) found that garden-based learning allowed students to develop such life skills as social manners, affection, trust, and work ethic, and these skills were developed through opportunities for peer-gardening and access to natural materials, wildlife, and open spaces. The authors concluded, "gardening in a naturally rich environment can have a positive influence on the learning of social skills, work ethics and engagement with nature" (Laaksoharju, et al., 2012, p. 202). The multi-faceted nature of youth gardens, then, has the potential to instill life skills through many avenues.

Nutrition Outcomes of Garden-Based Education

Overwhelmingly, and perhaps unsurprisingly given the current state of childhood obesity, the most widely researched topic with respect to learning outcomes of garden-based education is in the field of nutrition. In 2009, Robinson-O'Brien, et al. published a review of eleven articles evaluating nutrition impacts of garden-based education. These studies showed mixed, but generally positive, results, leading the authors to conclude:

> The evidence for the effectiveness of garden-based nutrition education is promising. 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).

However, the authors called for additional well-designed, peer-reviewed studies before any definitive conclusions could be made (Robinson-O'Brien, et al., 2009).

Several researchers have since taken the charge of continued research. Heim, Stang, and Ireland (2009) studied a garden program at a YMCA summer camp for students entering fourth-sixth grades in Minnesota and found a significant increase in reported consumption of fruits and vegetables, vegetable preferences, and asking behavior for fruits and vegetables. However, snack preferences, self-efficacy relating to fruit and vegetable consumption, and home availability of fresh fruits and vegetables did not significantly improve (Heim, et al., 2009). In a study of second grade students in the Southeastern United States, Parmer, Salisbury-Glennon, Shannon, and Struempler (2009) compared nutrition education groups both with and without a gardening component with a control group. The gardening group significantly increased their ability to identify certain fruits and vegetables, taste ratings of fruits and vegetables, and consumption of vegetables at school, leading to the conclusion that, "although nutrition education alone does seem to improve fruit and vegetable knowledge and preference in children, adding the gardening component appears to strengthen the likelihood that children will increase vegetable intake" (Parmer, et al., 2009, p. 216). Among fifth and sixth grade students in Australia, Morgan, Warren, Lubans, Saunders, Quick, and Collins (2010) found, among other things, that gardening students with the lowest pre-test scores made the most significant gains in vegetable knowledge and ability to identify vegetables. These results may indicate that the school garden is most effective for those most in need of a nutrition intervention (Morgan, et al., 2010). Through an in-school taste test, Ratcliffe, Merrigan, Rogers, and Goldberg (2011) found significant improvements in vegetable identification and at-school vegetable consumption among sixth grade gardening students in low-income schools in California. An additional self-report survey indicated a significant increase in preferences for, willingness to taste, and at-home consumption of fruits and vegetables, though these effects were not observed during the taste test (Ratcliffe, et al., 2011).

Consistent with the Robinson-O'Brien, et al. (2009) review, these studies exhibit mixed, though overall positive, results on the impacts on children's nutrition through garden-based education. As Morgan, et al. (2010) concluded, "increasing vegetable intake is difficult due to the complex nature of children's eating behavior, which is also substantially influenced by adults, and can be particularly difficult to change in short-term interventions" (p. 1937). More research is needed into the factors that affect children's healthy eating behaviors.

One study by Heim, Bauer, Stang, and Ireland (2011) sought to observe the impact of a children's garden program on the students' parents and their home food environments. Among fourth-sixth grade students in a summer garden program in Minnesota, parents' reported a significant increase in fruit and vegetable asking behavior, at-home availability of fruits and vegetables, and parental value of fruit and vegetable consumption; parental encouragement of fruits and vegetables also increased, though not significantly (Heim, et al., 2011). These findings indicate home food environments became increasingly supportive of fruits and vegetables through the program's "ability to reach and engage parents through a child-focused intervention" (Heim, et al., 2011, p. 133).

Understanding of Food Systems through Garden-Based Education

Surprisingly, very few studies have been conducted on the effects of garden-based education on students' understanding of the food system. Frick, et al. (1995) set out to measure the knowledge and perceptions of agriculture among 4-H members. 4-H members, while not necessarily participants of garden-based education per se, are traditionally involved in agriculture-related projects. Overall, level of knowledge and perceptions of agriculture were high, but varied widely (Frick, et al., 1995). Natural resources was among the highest scoring concepts for both knowledge and perceptions, while knowledge of plant concepts was very low, indicating a need for targeted education (Frick, et al., 1995). Interestingly, those members who indicated living on farms, experience raising crops, and/or enrollment in high school agriculture courses had significantly lower levels of knowledge than others (Frick, et al., 1995).

Mabie and Baker (1996) measured the food and fiber system knowledge of fifth and sixth grade students in urban California participating in either school gardening or short in-class projects. At pre-test, students in general knew very little about the food & fiber system; however, many students did know the origin of common products such as tortillas, bacon, and wool (Mabie & Baker, 1996). On all measures, knowledge among both gardening and in-class projects groups increased, while there was little to no change in knowledge among a control group (Mabie & Baker, 1996). However, no statistical tests were run on the data, so it is therefore impossible to deduce the extent of which the gardening and/or in-class projects had an effect on students' knowledge of the food and fiber system (Mabie & Baker, 1996).

Summary of Learning Outcomes of Garden-Based Education

From the studies discussed above, garden-based education has been shown to be an overall effective interdisciplinary learning tool. The use of educational gardens has the potential to positively impact students' environmental attitudes, academic achievement, social skills, and nutrition. Moreover, garden-based education has been shown to be effective for a wide range of students and in a variety of formal and non-formal education settings.

Given this versatility of garden-based education, it is surprising that few studies have analyzed its effects on students' understanding of food and agriculture. After all, food and agriculture are essential to all human life. As Mabie & Baker (1996) state, "it is critical to ensure that today's youth grow up with a basic understanding of the food and fiber system" (p. 4). To better understand this importance, we turn now to a discussion of agricultural literacy.

Agricultural Literacy

In 1988, the National Academy of Science released an agriculture education report entitled *Understanding Agriculture – New Directions for Education*. This report highlighted the importance of agricultural education, claiming that "agriculture – broadly defined – is too important a topic to be taught only to the relatively small percentage of students considering careers in agriculture and pursuing vocational agriculture studies" (NAS, 1988, p. 8). The report recommended that "all students should receive at least some systematic instruction about agriculture beginning in kindergarten or first grade and continuing through twelfth grade" (p. 10); it then went on to outline goals for agricultural education and propose the concept of "agricultural literacy" (NAS, 1988).

From this guiding document, Frick, et al. (1991) set out to develop a working definition of agricultural literacy by surveying experts in the field. The consensus definition stated, "agricultural literacy can be defined as possessing knowledge and understanding of our food and fiber system. An individual possessing such knowledge would be able to synthesize, analyze, and communicate basic information about agriculture" (Frick, et al., 1991, p. 52). The definition includes the following eleven subject areas, each with their own subareas: (a) the production of plant products, (b) the production of animal products, (c) the economic impact of agriculture, (d) the societal significance of agriculture, (e) agriculture's important relationship with natural resources, (f) agriculture's important relationship with the environment, (g) the marketing of agricultural products, (h) the processing of agricultural products, (i) public agricultural policies, (j) the global significance of agriculture, and (k) the distribution of agricultural products (Frick, et al., 1991).

There have been a few modifications since this definition of agricultural literacy was put forth. A 1999 report from the National Council for Agricultural Education entitled *Reinventing Agricultural Education for the Year 2020* highlighted the importance of "conversational" agricultural literacy. Meischen and Trexler (2003) further posed an updated definition that included science- and technology-related concepts and stressed the importance of understanding beliefs and values inherent in agriculture.

In 1998, *A Guide to Food and Fiber Systems Literacy* was published, highlighting the standards of what K-12 students ought to know regarding agricultural systems (Leising, et al., 1998). These guidelines stressed the importance of infusing agriculture into existing curricula and laid out grade-appropriate standards for each of five dimensions: (a) understanding food and fiber systems, (b) history, geography, and culture, (c) science, technology, and environment, (d) business and economics, and (e) food, nutrition, and health (Leising, et al., 1998). Agricultural concepts have also been incorporated into the American Association for the Advancement of Science's

Benchmarks for Science Literacy (i.e. “In agriculture, as in all technologies, there are always trade-offs to be made….” [8A/M3acd]; AAAS, 2009) and the Next Generation Science Standards (i.e. “Human Impacts on Earth Systems: Human activities in agriculture, industry, and everyday life have had major effects on the land, vegetation, streams, ocean, air, and even outer space.…” [ESS3.C]; Achieve, Inc., 2013).

In spite of the connection of agricultural concepts to academic standards, many youth remain agriculturally illiterate. In a review of two decades of agricultural literacy research, Kovar & Ball (2013) examined 23 studies with the goal of assessing levels of agricultural literacy and found a majority of populations assessed were agriculturally illiterate. Some of these studies specifically measured agricultural literacy among school-aged youth. For example, Brophy, et al. (2003) found that K-3 students in a Midwestern suburb lacked an overall awareness of the “land-to-hand” process, the essential nature of food products (i.e. how cheese is made), or the factors that affect food prices. Most students conceptualized agriculture as small family farms rather than an industrial food system (Brophy, et al., 2003). Pense and Leising (2004) compared the agricultural knowledge of high school seniors in general education course with those enrolled in agricultural education courses. They found no overall difference in agricultural knowledge between general and agricultural education students, and the study population as a whole did not meet benchmarks for agricultural literacy (Pense & Leising 2004). Hess and Trexler (2011) assessed the agricultural knowledge of fourth-sixth grade students in California. Students reported school field trips to farms and visiting relatives’ gardens as the most common sources of knowledge, though students in general lacked a background that would support the construction of agricultural knowledge (Hess &

Trexler, 2011). These students failed to convey an understanding of types of farms, purposes of farms, or local agriculture, providing only partially correct answers at best (Hess & Trexler, 2011). Given that humans are dependent on agriculture for many of our basic needs, the low level of agricultural literacy among youth is unnerving.

Summary of Literature Review

This chapter began with an overview of the foundation of environmental education and education for sustainable development, making a case for the intrinsic connection between the two. Garden-based education, one method of environmental education, was then examined. Educational gardens have been used with a variety of audiences and settings, with positive impacts on a wide range of interdisciplinary student learning outcomes. However, a lack of understanding of the impact of garden-based education on student knowledge and understanding of the food system was also noted. Next came a discussion of agricultural literacy, its importance, and its noteworthy absence among today's youth. The literature reviewed in this chapter points to a need for better understanding how garden-based education can impact students' knowledge of the food system.

This evaluative study will address a significant gap in the literature by examining the effects of one garden-based education curriculum on students' knowledge of the food system. This information will have important implications, given the importance of agricultural literacy for today's youth and the versatility and growing popularity of garden-based education across the country.

Chapter 3. Methodology

Introduction

The purpose of this evaluative study was to investigate the effectiveness of the WRELC Organic Farm curriculum at enhancing participants' knowledge of the food system. This study investigated the following evaluation questions:

1) Does participation in the WRELC Organic Farm curriculum increase participants' knowledge of the food system?
2) Is the WRELC Organic Farm curriculum equally effective at enhancing all participants' knowledge of the food system, regardless of age, gender, ethnicity, place of residence, or prior experience with food gardens and/or farms?

Results from this study will be used by WRELC staff to better understand how curriculum objectives are being met, to make improvements to the Organic Farm curriculum, as needed, and to serve as a foundation for future program expansion.

Design

As the scope of this study is limited to the WRELC Organic Farm curriculum, this study operated under the paradigm of program evaluation. Program evaluation can be defined as the "systematic collection of information about the activities, characteristics, and outcomes of programs to make judgments about the program, improve program effectiveness, and/or inform decisions about future programming" (Patton, 1997, p. 23). A Logic Model (Appendix A) and Evaluation Planning Matrix (Appendix B) were created to guide the evaluation process. Data gathered throughout this study was primarily quantitative in nature, which allows for an examination of relationships among variables using statistical analysis (Creswell, 2014). As this study sought to understand the immediate impacts of the WRELC Organic Farm curriculum, a cross-sectional approach was used through the administration of a pre- and post-test to program participants.

Population and Sample

The study population was confined to participants enrolled in the WRELC Organic Farm curriculum during the fall of 2014. Enrollment in the Organic Farm curriculum happened one of two ways: individual teachers could request to enroll students in the farm curriculum or some classes were automatically signed up by the Wolf Ridge Program Coordinator (B. Mead, personal communication, September 8, 2014). Classes were approximately 8.5 hours in length (rather than the standard three-hours typical of most WRELC classes) and occurred at the on-site organic farm which is located away from the main part of the WRELC campus.

Purposive sampling was employed, as the goal of this study was to understand the affects specifically of the WRELC Organic Farm curriculum on participants and not to make generalizations beyond this curriculum. This study evaluated six classes which took place in the fall of 2014, equating to 94 participants. Of these, a total of 59 matching sets of pre- and post-tests were returned from five classes. The variation in total participants and questionnaires returned can be attributed to a few factors. For logistical reasons, WRELC staff was unable to administer questionnaires to one class of 18 students; thus, no data is available for this class. Additionally, a total of two pre- and four post-tests were returned without a corresponding match. These questionnaires were excluded from data analysis. Finally, as participation was voluntary, some students may have opted out of participation in this study, and no questionnaires from adult participants were returned.

Instrumentation

The instrument that was used for data collection was developed specifically for this study (see Appendix C for the instrument). The first of two major sections of the instrument gathered data on participant demographics, including grade level, gender, ethnicity, place of residence, and prior experience with food gardens and/or farms. This information was only collected during the pre-test. The second section measured knowledge of the food system in five domains which reflect the knowledge-based learning objectives of the written farm curriculum (Table 1). Additional curriculum outcomes which are not knowledge based excluded from the instrument. A final section of two open-ended questions, intended to gather a broad sense of the overall learning that took place at the farm, was included on the post-test only. Throughout the questionnaire, questions were asked in the form of matching, order-the-steps, multiple choice, fill-in-the-blank, and short answer.

Table 1
Knowledge Domains of Instrument

Domain	Learning Outcome	Questions	Total
Soils	1. Distinguish between "soil" and "dirt"	14-15, 17-25, 37	12
Plants	2. Understand plant nutrient cycles and reproduction methods	26-30, 35-36	7
Pollinators	4. Explore the role of pollinators in the production of food	10-12, 38	4
Energy & choices	6. Explain food miles, energy in agriculture, and food system choices	13, 16, 31-34, 42-43	8
Procedural knowledge	7. Learn how to identify, harvest, clean, and prepare vegetables	1-9, 39-41	12

Note. Five domains, taken from five knowledge-based learning outcomes of the curriculum, were measured on the instrument.

Prior to implementation, the instrument was reviewed by the evaluator's graduate committee members for face validity and by WRELC staff for content validity. The instrument was then pilot tested amongst a group of educators to monitor for clarity and assess total time needed for completion, after which the instrument was modified accordingly.

Data Collection Procedures

The participant questionnaires were self-administered to program participants at two stages: upon arrival at WRELC (pre-test) and immediately following participation in the farm class (post-test). The time between pre- and post-test was anywhere between eight hours to three days, depending upon the group's arrival date and date of participation in the farm class. The evaluator relied on WRELC staff to administer both pre- and post-test questionnaires. Pre- and post-test questionnaires for all six classes were printed ahead of time, placed in labeled envelopes, and stored in an easily accessible location in the WRELC main office. WRELC staff was briefed on the evaluation process prior to any data collection. An administration script (see Appendix D) was included with every envelope of questionnaires to guide the questionnaire administration process and maintain as much consistency as possible during the data collection process.

Because this study operated as program evaluation and does not aim to contribute generalizable knowledge to the field, it fell outside the definition of human subjects research per guidelines at the time this study was initiated and therefore did not require approval from the Institutional Review Board. However, attempts were made to collect both parent consent and participant assent. A parent consent form (Appendix E) was sent to Wolf Ridge staff with instruction to share with lead teachers of groups scheduled to visit the farm, who were in turn instructed to forward this letter to all class parents or guardians. Parent consent was gathered in an opt-out format. Because the evaluator did not receive back any forms indicating otherwise, it was assumed that all parents were properly notified and consented to their child participating in this study. Students themselves were also given the opportunity to assent to study participation. During the questionnaire administration process, students were given the option to opt out of the study at any point in time (see the administration script in Appendix D).

To help contribute additional perspective to the quantitative questionnaire data, an interview was conducted with the instructor of the classes. The interview took place in person at the WRELC main office, two weeks after the final class was taught. The interview lasted approximately 45 minutes. The interview was recorded using “Audio Recorder”, a free Android cell phone application. Notes were also taken by hand during the interview. The audio recording was transcribed using the free online application “Transcribe” (https://transcribe.wreally.com/ app#). A set of interview questions (see Appendix F) were used to guide the interview.

Data Analysis

Data collected in this study was analyzed using SPSS Statistics software. Data was first coded by hand and then subsequently entered into SPSS software. Demographics were coded categorically, with prior garden experience falling on a 1-4 Likert scale. All questions were coded with a 1 for a correct answer and a 0 for an incorrect, partially correct, or blank answer. The exception was for questions 39-41, which measured students’ perceived abilities to harvest, clean, and prepare vegetables, were scored on a 1-3 Likert scale.

For each participant, a total score was calculated for both pre- and post-test in each of the domains. To calculate a total score for the fifth domain, procedural knowledge, questions 39-41 were recoded from a 1-3 Likert scale to a 0-1 Likert scale; then, these recoded scores were added with scores from questions 1-9 (vegetable identification) for a total procedural knowledge domain score.

Descriptive statistics were calculated for participant demographics. Paired-samples t tests were run for each of the domain levels to compare pre- and post-test scores. Two-way split-plot ANOVAs were run to measure the change in each domain score based on class, grade, gender, ethnicity, school, town of residence, residence in the city vs. in the country, and prior garden experience. Because there was so little variation between residence within the city vs. in the country, ANOVAs were not run for any domain across this demographic. Additionally, because ethnicity and town of residence had such little variation, data was regrouped into white/non-white and urban/suburban, respectively. The level of significance used in this study was $p=0.05$. For confidentiality, school names have been given generic names (i.e. School A, etc.) throughout this document.

Finally, the transcribed interview data was analyzed. The transcription was first read through for a general sense of the broad themes of the interview. Then, significant statements were noted; they were then categorized into similar codes using ATLAS.ti qualitative data analysis software. Emergent themes that were unrelated to the evaluation questions were discarded.

Chapter 4: Results

Introduction

This chapter presents the results of this evaluative study, which investigated the effectiveness of the WRELC Organic Farm curriculum at enhancing participants' knowledge of the food system. This study investigated the following evaluation questions:

1) Does participation in the WRELC Organic Farm curriculum increase participants' knowledge of the food system?
2) Is the WRELC Organic Farm curriculum equally effective at enhancing all participants' knowledge of the food system, regardless of age, gender, ethnicity, place of residence, or prior experience with food gardens and/or farms?

Information presented in this chapter is organized as follows. First, descriptive statistics of demographics will be presented. Next, the results of how participants' knowledge of the food system changed throughout this study are presented, followed by the results of effect of demographic variables on the change in knowledge of the food system. The chapter will conclude with results from open-ended questions and a list of emergent themes from the interview with the class instructor.

Demographics

Six classes from a total of four schools were taught at the WRELC Organic Farm during the fall of 2014. By chance, each of the four schools were private, religiously-affiliated schools located in the Twin Cities, MN metro area. All four schools arrived at WRELC on a Monday and departed on a Friday; however, the day of each groups' participation in the farm classes varied, as did the time interval between pre- and post-test administration. 59 matching pre- and post-tests were returned from five of six classes.

The specific demographic variables measured in this study included grade, gender, ethnicity, school, city/town of residence, residence within the city/in the country, and prior gardening experience. A demographic breakdown of the five classes is provided in Table 2. Responses for certain demographic variables (ethnicity, city/town of residence) exhibited little variation; therefore, responses were regrouped into white/non-white and urban/suburban, respectively, for data analysis. These regroupings are also reflected in Table 2.

Table 2

Demographics of Study Participants

Variable	Responses	Class 1		Class 2		Class 3		Class 4		Class 5		**Total**	
		Freq.	Perc.	Freq.	Perc.	Freq	Perc.	Freq.	Perc.	Freq.	Perc.	**Freq.**	**Perc.**
Grade	6th Grade					8	100.0	7	100.0	12	100.0	**27**	**45.8**
	7th Grade	6	40.0	9	52.9							**15**	**25.4**
	8th Grade	9	60.0	8	47.1							**17**	**28.8**
	Total	15	100.0	17	100.0	8	100.0	7	100.0	12	100.0	**59**	**100.0**
Gender	Male	7	46.7	9	52.9	2	25.0	4	57.1	6	50.0	**28**	**47.5**
	Female	8	53.3	8	47.1	6	75.0	3	42.9	6	50.0	**31**	**52.5**
	Total	15	100.0	17	100.0	8	100.0	7	100.0	12	100.0	**59**	**100.0**
Ethnicity	Caucasian (White)	11	73.3	9	52.9	8	100.0	5	71.4	10	83.3	**43**	**72.9**
	African-American			1	5.9							**1**	**1.7**
	Asian	2	13.3	3	17.6					1	8.3	**6**	**10.2**
	Hispanic	1	6.7	1	5.9							**2**	**3.4**
	Native American											**0**	**0.0**
	Other	1	6.7	3	17.6			2	28.6	1	8.3	**7**	**11.9**
	[Non-white]	4	26.7	8	47.1			2	28.6	2	16.7	**16**	**27.1**
	Total	15	100.0	17	100.0	8	100.0	7	100.0	12	100.0	**59**	**100.0**
School	School A	15	100.0	17	100.0							**32**	**54.2**
	School B					8	100.0	7	100.0			**15**	**25.4**
	School C									12	100.0	**12**	**20.3**
	Total	15	100.0	17	100.0	8	100.0	7	100.0	12	100.0	**59**	**100.0**
City/Town of Residence	St. Paul	10	66.7	7	41.2	7	87.5	5	71.4			**29**	**49.2**
	Minneapolis	4	26.7	5	29.4							**9**	**15.3**
	Plymouth			1	5.9					5	41.7	**6**	**10.2**
	Maple Grove									3	25.0	**3**	**5.1**
	Medina									2	16.7	**2**	**3.4**
	Eagan			1	5.9							**1**	**1.7**
	Falcon Heights			1	5.9							**1**	**1.7**
	Long Lake									1	8.3	**1**	**1.7**
	New Brighton			1	5.9							**1**	**1.7**
	Richfield			1	5.9							**1**	**1.7**
	Roseville							1	14.3			**1**	**1.7**
	Wayzata									1	8.3	**1**	**1.7**
	[Urban]	14	93.3	12	70.6	7	87.5	5	71.4			**38**	**64.4**
	[Suburban]			5	29.5			1	14.3	12	100.0	**18**	**30.5**
	No Response	1	6.7			1	12.5	1	14.3			**3**	**5.1**
	Total	15	100.0	17	100.0	8	100.0	7	100.0	12	100.0	**59**	**100.0**
Residence	Town/City	15	100.0	16	94.1	8	100.0	6	85.7	10	83.3	**55**	**93.2**
	Country									2	16.7	**2**	**3.4**
	No Response			1	5.9			1	14.3			**2**	**3.4**
	Total	15	100.0	17	100.0	8	100.0	7	100.0	12	100.0	**59**	**100.0**
Prior Gardening Experience	No experience	3	20.0	3	17.6	1	12.5	1	14.3			**8**	**13.6**
	Little experience	7	46.7	9	52.9	3	37.5	3	42.9	6	50.0	**28**	**47.5**
	Some experience	4	26.7	4	23.5	2	25.0	3	42.9	4	33.3	**17**	**28.8**
	A lot of experience	1	6.7	1	5.9	2	25.0			2	16.7	**6**	**10.2**
	Total	15	100.0	17	100.0	8	100.0	7	100.0	12	100.0	**59**	**100.0**

Note. Classes are listed in order of occurrence, from left to right. Due to lack of variation within responses, ethnicity was grouped into white/non-white and city/town of residence was grouped into urban/ suburban for two-way ANOVA comparisons.

Participants' Knowledge of Food System

To determine the overall effectiveness of the curriculum at enhancing knowledge of the food system, paired-samples t tests were run to compare the pre- and post-test scores for each of the five knowledge domains across all participants combined. The results of the paired-samples t tests are shown in Table 3. For all five domains, the mean score increased significantly from pre- to post-test ($p<0.01$).

Table 3
Results of Paired-Samples T Tests

		Pre		Post				
Domain	Max	M (%)	SD	M (%)	SD	t	df	p
Soils	12	4.98 (41.5)	2.96	6.88 (57.3)	2.63	6.10	58	<0.001*
Plants	7	2.85 (40.7)	1.86	3.85 (55.0)	1.67	3.86	58	<0.001*
Pollinators	4	2.03 (50.8)	0.85	3.22 (80.5)	0.83	8.89	58	<0.001*
Energy & Choices	8	5.86 (73.3)	1.68	6.64 (83.0)	1.28	3.26	58	0.002*
Procedural Knowledge	12	7.61 (63.4)	2.32	9.91 (82.6)	2.32	11.48	58	<0.001*

Note. Max = highest possible score within domain. N = 59.
*p<0.01.

Effects of Demographics on Increase in Knowledge of Food System

To determine the effectiveness of the WRELC Organic Farm curriculum for all participant demographic variables, a series of two-way split-plot ANOVAs were run for each demographic variable across each of the five domains. The results of the two-way split-plot ANOVAs can be found in Tables 4-10.

Among all of the split-plot ANOVAs calculated, only the four significant interaction effects were found: the effect between the soils domain and class ($p=0.004$), the effect between the soils domain and school ($p=0.001$), the effect between the soils domain and residence ($p=0.003$), and the effect between the energy & choices domain and previous gardening experience ($p=0.009$), suggesting the treatment is working differently across these demographic groups for the respective domains. These four interactions are plotted in Figure 1. No other significant interaction effects were found.

Table 4

Results of Split-Plot ANOVA Tests by Class

Domain		N	Pre M	Pre SD	Post M	Post SD	df	Mean Sq.	F	p
Soils	Class 1	15	6.73	3.06	8.20	2.08	4	10.148	4.380	0.004*
	Class 2	17	5.47	2.48	7.82	2.58				
	Class 3	8	3.25	1.98	6.38	2.00				
	Class 4	7	2.43	1.90	6.00	2.08				
	Class 5	12	4.75	3.14	4.75	2.67				
Plants	Class 1	15	3.60	1.72	4.33	1.84	4	2.712	1.406	0.244
	Class 2	17	2.65	1.90	4.35	1.66				
	Class 3	8	2.63	1.69	2.88	1.36				
	Class 4	7	1.14	2.04	2.86	1.77				
	Class 5	12	3.33	1.44	3.75	1.22				
Pollinators	Class 1	15	2.33	0.62	3.00	0.38	4	0.824	1.636	0.178
	Class 2	17	2.12	0.93	3.59	0.62				
	Class 3	8	1.75	0.89	3.13	0.99				
	Class 4	7	1.57	0.79	2.57	1.13				
	Class 5	12	2.00	0.95	3.42	1.00				
Energy & Choices	Class 1	15	5.93	1.87	6.60	1.06	4	1.409	0.823	0.516
	Class 2	17	6.65	0.93	7.00	1.12				
	Class 3	8	6.00	1.41	6.63	1.19				
	Class 4	7	4.71	2.43	5.57	1.51				
	Class 5	12	5.25	1.54	6.83	1.53				
Procedural Knowledge	Class 1	15	8.33	2.78	9.93	2.68	4	2.098	1.892	0.125
	Class 2	17	7.18	2.62	10.09	1.94				
	Class 3	8	7.82	1.85	10.63	0.92				
	Class 4	7	7.93	1.51	10.07	1.06				
	Class 5	12	7.00	1.93	9.04	1.66				

Pre and Post columns are Pre/Post M and SD; df, Mean Sq., F and p are Within-Subjects Effects.

Note: $p<0.05$.
$*p<0.01$.

Table 5

Results of Split-Plot ANOVA Tests by Grade

Domain		N	Pre M	Pre SD	Post M	Post SD	df	Mean Sq.	F	p
Soils	6th Grade	27	3.70	2.66	5.56	2.38	2	0.5135	0.175	0.840
	7th Grade	15	4.80	2.73	7.00	2.42				
	8th Grade	17	7.18	2.40	8.88	1.90				
Plants	6th Grade	27	2.56	1.85	3.26	1.43	2	1.110	0.551	0.579
	7th Grade	15	3.87	1.81	3.87	1.81				
	8th Grade	17	3.47	1.77	4.76	1.56				
Pollinators	6th Grade	27	1.81	0.88	3.11	1.05	2	0.230	0.429	0.653
	7th Grade	15	2.13	0.83	3.33	0.72				
	8th Grade	17	2.29	0.77	3.29	0.47				
Energy & Choices	6th Grade	27	5.33	1.78	6.44	1.48	2	1.438	0.737	0.483
	7th Grade	15	6.33	1.80	6.73	1.16				
	8th Grade	17	6.29	1.16	6.88	1.05				
Procedural Knowledge	6th Grade	27	7.48	1.79	9.78	1.46	2	0.374	0.310	0.735
	7th Grade	15	7.83	2.43	9.90	2.12				
	8th Grade	17	7.62	3.01	10.12	2.47				

Note: $p<0.05$.

Table 6
Results of Split-Plot ANOVA Tests by Gender

Domain		N	Pre M	Pre SD	Post M	Post SD	Within-Subjects Effects df	Mean Sq.	F	p
Soils	Male	28	4.79	2.82	6.61	2.54	1	0.158	0.54	0.817
	Female	31	5.16	3.11	7.13	2.73				
Plants	Male	28	2.64	1.95	3.96	1.43	1	2.753	1.398	0.242
	Female	31	3.03	1.78	3.74	1.88				
Pollinators	Male	28	2.11	0.79	3.29	0.81	1	0.002	0.003	0.956
	Female	31	1.97	0.91	3.16	0.86				
Energy & Choices	Male	28	5.71	1.90	6.18	1.44	1	2.650	1.583	0.213
	Female	31	6.00	1.46	7.06	0.96				
Procedural Knowledge	Male	28	6.93	2.57	9.32	2.37	1	0.247	0.207	0.651
	Female	31	8.23	1.92	10.44	1.26				

Note: p<0.05.

Table 7
Results of Split-Plot ANOVA Tests by Ethnicity

Domain		N	Pre M	Pre SD	Post M	Post SD	Within-Subjects Effects df	Mean Sq.	F	p
Soils	White	43	5.28	2.99	7.23	2.61	1	0.242	0.083	0.774
	Non-white	16	4.19	2.81	5.94	2.54				
Plants	White	43	3.02	1.86	4.14	1.49	1	1.072	0.536	0.467
	Non-white	16	2.38	1.82	3.06	1.91				
Pollinators	White	43	2.14	0.89	3.26	0.82	1	0.391	0.739	0.393
	Non-white	16	1.75	0.68	3.13	0.89				
Energy & Choices	White	43	6.05	1.56	6.67	1.23	1	1.826	1.081	0.303
	Non-white	16	5.38	1.93	6.56	1.46				
Procedural Knowledge	White	43	7.79	2.31	9.98	1.92	1	0.969	0.821	0.369
	Non-white	16	7.13	2.36	9.72	2.03				

Note: p<0.05.

Table 8
Results of Split-Plot ANOVA Tests by Residence

Domain		N	Pre M	Pre SD	Post M	Post SD	Within-Subjects Effects df	Mean Sq.	F	p
Soils	Urban	38	5.47	3.00	7.97	2.14	1	24.429	9.490	0.003*
	Suburban	18	4.33	2.87	4.83	2.48				
Plants	Urban	38	2.95	1.84	4.08	1.67	1	1.320	0.659	0.420
	Suburban	18	2.89	1.81	3.56	1.54				
Pollinators	Urban	38	2.13	0.84	3.18	0.80	1	0.9375	1.863	0.178
	Suburban	18	1.83	0.86	3.28	0.96				
Energy & Choices	Urban	38	6.05	1.75	6.79	1.02	1	0.621	0.367	0.547
	Suburban	18	5.50	1.38	6.56	1.72				
Procedural Knowledge	Urban	38	8.20	2.15	10.43	1.85	1	0.263	0.211	0.648
	Suburban	18	6.31	2.33	8.75	1.73				

Note: p<0.05.
**p<0.01.*

Table 9

Results of Split-Plot ANOVA Tests by School

Domain		N	Pre M	Pre SD	Post M	Post SD	Within-Subjects Effects df	Mean Sq.	F	p
Soils	School A	32	6.06	2.79	8.00	2.33	2	18.546	8.075	0.001*
	School B	15	2.87	1.92	6.20	1.97				
	School C	12	4.75	3.14	4.75	2.67				
Plants	School A	32	3.09	1.86	4.34	1.72	2	1.578	0.769	0.468
	School B	15	1.93	1.94	2.87	1.51				
	School C	12	3.33	1.44	3.75	1.22				
Pollinators	School A	32	2.22	0.79	3.13	0.59	2	0.229	0.426	0.655
	School B	15	1.67	0.82	2.87	1.06				
	School C	12	2.00	0.95	3.42	1.00				
Energy & Choices	School A	32	6.31	1.47	6.81	1.09	2	2.572	1.550	0.221
	School B	15	5.40	1.99	6.13	1.41				
	School C	12	5.25	1.54	6.83	1.53				
Procedural Knowledge	School A	32	7.72	2.71	10.02	2.28	2	0.350	0.290	0.749
	School B	15	7.87	1.64	10.37	0.99				
	School C	12	7.00	1.93	9.04	1.66				

Note: p<0.05.
**p<0.01.*

Table 10

Results of Split-Plot ANOVA Tests by Prior Gardening Experience.

Domain		N	Pre M	Pre SD	Post M	Post SD	Within-Subjects Effects df	Mean Sq.	F	p
Soils	No	8	4.88	3.00	7.00	2.93	3	1.924	0.675	0.571
	Little	28	4.93	3.23	7.21	2.90				
	Some	17	5.12	2.80	6.41	2.32				
	A lot	6	5.00	2.68	6.50	2.07				
Plants	No	8	3.75	1.28	3.75	1.83	3	2.043	1.032	0.386
	Little	28	3.00	1.89	4.21	1.60				
	Some	17	2.12	1.93	3.41	1.87				
	A lot	6	3.00	1.79	3.50	1.05				
Pollinators	No	8	1.63	0.52	3.00	0.76	3	0.654	1.262	0.296
	Little	28	2.00	0.94	3.39	0.74				
	Some	17	2.18	0.88	3.00	1.06				
	A lot	6	2.33	0.52	3.33	0.52				
Energy & Choices	No	8	5.75	1.67	5.75	1.39	3	6.150	4.248	0.009*
	Little	28	5.93	1.88	6.96	1.07				
	Some	17	6.12	1.41	6.18	1.38				
	A lot	6	5.00	1.41	7.67	0.52				
Procedural Knowledge	No	8	6.38	2.23	3.00	3.24	3	2.824	2.597	0.062
	Little	28	7.11	2.13	9.86	1.57				
	Some	17	8.50	2.42	10.09	1.87				
	A lot	6	9.08	1.80	10.83	1.33				

Note: p<0.05.
**p<0.01.*

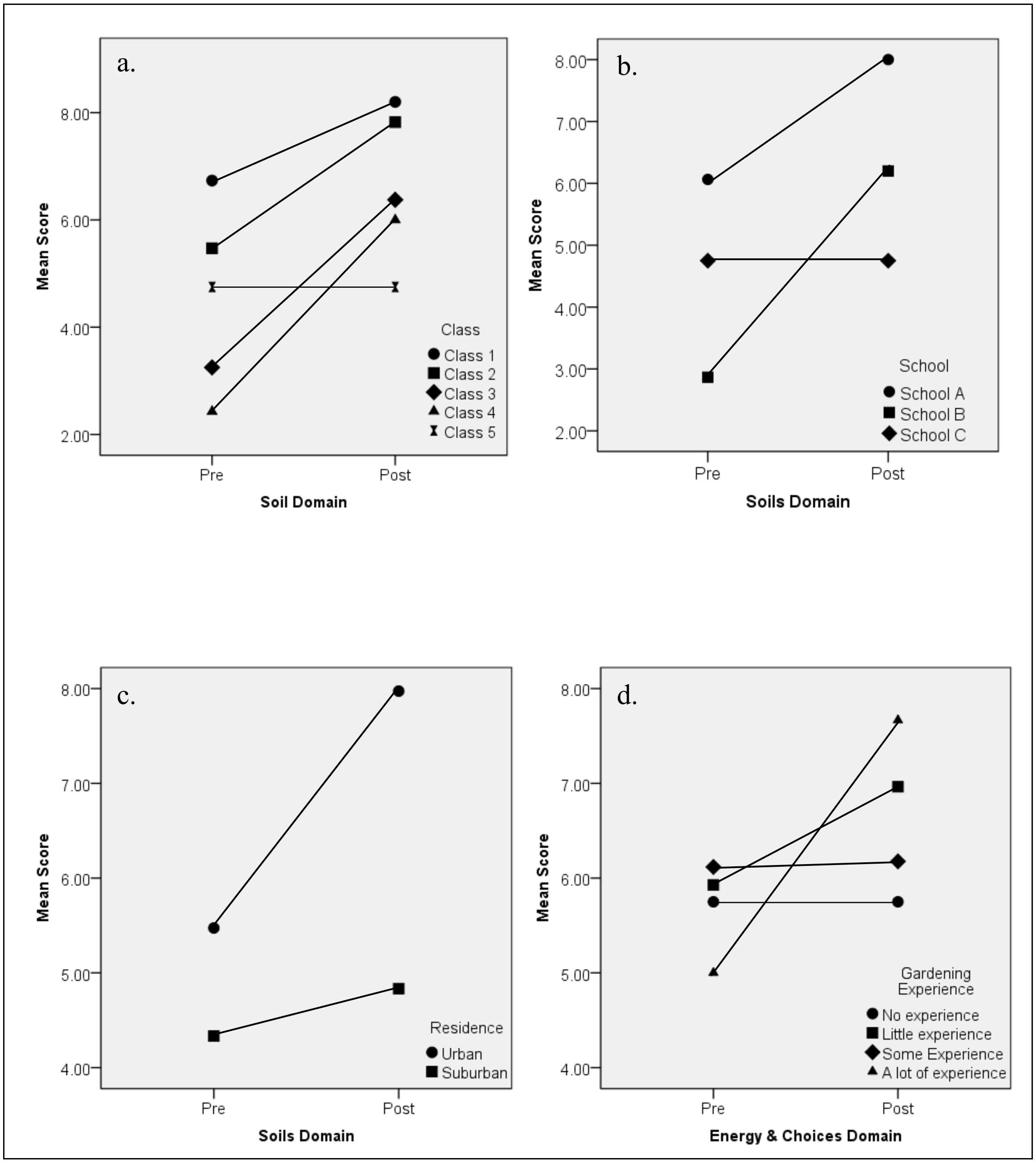

Figure 1. Profile Plots of Significant Interaction Effects. Soils domain by class (a), soils domain by school (b), soils domain by residence (c), and energy & choices domain by prior gardening experience (d). $p<0.01$ for each case.

Participants' Perceptions of Learning

Participants were asked two open-ended questions on the post-test, "What did you learn today at the Wolf Ridge Organic Farm?" and "What do you think you will remember about your time at the Wolf Ridge Organic Farm?" These questions were intended to provide participants with an opportunity to voice their perceptions of the WRELC Organic Farm curriculum. The majority of the responses to the first open-ended question reflected themes within the five knowledge domains used to guide instrument development. Example statements are displayed in Table 11. Responses to the second open-ended question also fell into several distinct categories (knowledge, skills, specific activities, social/fun aspects, and WRELC). Example statements are displayed in Table 12. Some participants listed more than one response to each question, hence N>59.

Table 11
Categories of Responses to "What did you learn today at the Wolf Ridge Organic Farm?"

Domain	N	Example Statement
Soils	11	"That there are a lot of types of soil"
Plants	11	"That plants need sun, water, and carbon dioxide"
Pollinators	21	"That honeybees are not native to MN"
Energy & Choices	10	"I learned that food usually takes 1500 miles to get to me."
Procedural Knowledge	14	"I learned how to identify vegetables and how to pick and clean them. I had some background knowledge of this, but it helped a lot."
Non-specific	7	"Many things" / "I didn't learn anything, I think"

Note. N=number of responses that fell within each domain. Spelling and grammar have been corrected in quotations, where necessary.

Table 12
Categories of Responses to "What do you think you will remember about your time at the Wolf Ridge Organic Farm?"

Category	N	Example Statement
Knowledge	13	"That the soil has to have a certain pH for plants to grow."
Skills	7	"How to make a salad"
Specific Activities	31	"When a boy in my group dressed up as a bee"
Social/Fun Aspects	7	"I will remember working hard, having fun, and being with friends."
WRELC	4	"The greenhouse and the teacher"

Note. N=number of responses that fell within each category. Spelling and grammar have been corrected in quotations, where necessary.

Interview Themes

An interview was conducted with the instructor of the classes to capture an additional perspective and help explain the results from the quantitative data. The interview lasted for approximately 45 minutes, during which time the instructor gave his overall impressions of the classes and a detailed account of what took place during each class.

Many themes emerged from the interview and are displayed in Table 13. The most commonly mentioned theme which influenced student learning focused on access, or lack thereof, to materials. For example, "We need to improve the dress up kit of the bee." Another common theme related to the specific activities that occurred during the classes. For example, "I added some initiative games to help things along the way." Examples of students' reactions to various aspects of the class were also gained from the interview. For example, "Harvesting the vegetables was very, very exciting to them." Significant statements gleaned from this interview will be used to support results in the following chapter.

Table 13
Emergent Themes from Interview

Theme	Freq.
Activities	15
Adult Dynamics	4
Materials (Equipment, Facilities, etc.)	20
Safety Issues	4
Site Location	3
Student Reactions	18
Teacher's Performance	8
Timing/Sequence	6
Written Curriculum	12

Conclusion

This chapter presented the results of the questionnaire data as well as themes that emerged from the interview conducted with the instructor of the WRELC Organic Farm curriculum. Overall, there was a significantly positive change in all five domain scores from pre- to post-test. Additionally, only four significant interaction effects between domain scores and demographic variables were noted: soils domain by class, soils domain by school, soils domain by residence, and energy & choices domain by prior gardening experience. The following chapter will interpret and discuss these findings.

Chapter 5. Discussion

Introduction

This chapter presents interpretations of the results of this evaluative study, which are analyzed in the context of the relevant literature. Interpretation of results includes a discussion of demographics, the overall increase in participants' knowledge of the food system, the effects of demographics on the increase in knowledge of the food system, responses to open-ended questions, and significant statements from the interview. The chapter concludes with a discussion of possible implications of these results and a set of recommendations for the future.

Demographics

Participants of this study were relatively evenly split within grade level and gender. All participants fell in the middle school range (6^{th}-8^{th} grade), which is in line with the general age for school field trips at Wolf Ridge (WRELC, 2013). Additionally, all participants were from schools in Minnesota, in particular the Twin Cities metro area, which is a common area for visiting schools (WRELC, 2013). However, participants varied little among certain other demographic variables, such as ethnicity and residence. Almost three-quarters of participants identified as Caucasian/white. About two-thirds of participants indicated living in Minneapolis or St. Paul, with the remainder residing in Twin Cities suburbs. Additionally, only two participants indicated living in the country; this was too low of a response rate against which to run statistical tests with any power. Finally, all participants attended private, religiously-affiliated schools. Taken together, combined with a lack of random selection or assignment with the study design, this information indicates that the sample population was not indicative of all visiting school groups to Wolf Ridge ELC and therefore results should not be generalized beyond the study population.

A final note of interest pertaining participant demographics relates to participants' prior gardening experience. Only 14% of participants indicated having "no" prior experience with gardens or farms. In their study, Aguilar, et al. (2008) found that about 20% of 3^{rd}-5^{th} grade participants indicated having no prior gardening experience. Similarly, Skelly & Zajicek (1998) found that about 16% of 2^{nd} and 4^{th} grade participants indicated having no prior gardening experience. While these studies' sample sizes are from much larger and younger populations, the percentage of participants with "no" prior gardening experience found in the present study is similar, though slightly lower. This may indicate a trend toward an increase in gardening experiences among youth throughout the years.

In spite of a relatively low percentage of participants indicating no prior gardening experience, only 10% indicated having "a lot" of prior gardening experience in this study, which indicates opportunities for increased access to youth gardening experiences. More research needs to be done to better quantify the amount and frequency of youth garden experiences and to understand how access to these experiences can be improved among all youth.

Participants' Knowledge of Food System

Results from the paired-samples t tests showed a significantly positive change in all five domain scores from pre- to post-test among all participants ($p<0.01$ for all domains). This statistic indicates that, on average, participants' knowledge in each of these five knowledge domains increased following participation in the WRELC Organic

Farm curriculum. It further indicates that Wolf Ridge met its knowledge-based learning objectives for the curriculum over the course of this evaluative study.

Information gleaned from the interview with the instructor of the classes supports the results found through the paired-samples t tests. When asked whether or not it seemed that the learning objectives of the curriculum were met, overall, the instructor said, "I think the bigger concepts of the curriculum were met." The instructor went on to explain that a focus in teaching was on the broader ideas rather than on specific facts and figures, as evidenced in the statement, "I'm less concerned whether they know what phosphorous does for the plant than that phosphorous is there and it's part of this web." From the instructors' observations, as well as the quantitative data from the questionnaires, it appears that the WRELC Organic Farm curriculum was successful in meeting its knowledge-based learning objectives.

While some studies on student learning through farm- and garden-based education have shown no significant knowledge gains (Pigg, Waliczek, & Zajicek, 2006), the majority of studies on the subject have found that garden- and farm-based educational programs for youth are effective ways of increasing knowledge of the food system and related science and environmental concepts (Dircks & Orvis, 2005; Klemmer, et al., 2005; Mabie & Baker, 1996; Skinner & Chi, 2011; Smith & Motsenbocker, 2005). Of these studies, Skinner & Chi (2011) was the only one conducted on middle school participants, with the remainder focusing on the elementary-level.

Interestingly, very few studies have looked at the effects of these types of educational programs specifically on knowledge of the food system. One such study found an increase in student knowledge of the food and fiber system after participating in school gardening (Mabie & Baker, 1996). However, this study offered no statistical to substantiate their claims. Results from the present study indicate that farm-based education could be an effective means for improving students' knowledge of the food system. More research is needed before conclusions can be drawn.

Hess & Trexler (2011) found that school field trips to educational farms were among the most common sources of students' knowledge of the food system. Results from this study further indicate that even a one-day program can increase participants' knowledge of the food system. More research is needed to determine how participants retain knowledge gained through one-day or short-term programs and whether it is comparable to longer-term programs.

Another consideration is the level of participants' knowledge in conjunction with the concept of agricultural literacy. In a review of the literature, Kovar & Ball (2013) found many studies have shown that youth are agriculturally illiterate. While participants of this study made significantly positive gains in all five knowledge domains from pre- to post-test, their knowledge of the food system may still need improvement. At post-test, mean scores varied widely, with the highest being the energy & choices domain (83%) and lowest being soils (57%) and plants (55%). This study did not aim to measure agricultural literacy as a whole; however, it seems evident that there is still room for growth in this area. More research is needed to measure the full scope of agricultural literacy among youth and to better understand what types of educational programming help develop agricultural literacy.

Effects of Demographics on Increase in Knowledge of Food System

Results from the two-way split-plot ANOVAs showed that all but four interaction effects between pre- and post-test domain scores and demographic variables were insignificant ($p>0.05$). Any insignificant results from the ANOVA tests would indicate that participants performed relatively equally in a particular domain, regardless of differences in demographic variables. Because the majority of interactions tested (31 out of a total 35, or roughly 90%) were not significant, these results may indicate that, overall, the WRELC Organic Farm curriculum was equally effective at enhancing all participants' knowledge of the food system regardless of differences in demographics. This is especially true for participants of varying gender, grade level, and ethnicity, as none of these demographics exhibited any significant interaction effects for any of the five knowledge domains.

Research has yielded varying information on the effectiveness of garden- and farm-based education programs for all participants, regardless of demographics (Aguilar, et al., 2008; Dircks & Orvis, 2005; Klemmer, et al., 2005; Pigg, et al., 2006; Smith & Motsenbocker, 2005; Waliczek & Zajicek, 1999). Results from this study support the findings from other research (Dircks & Orvis, 2005; Smith & Motsenbocker, 2005) that reported no significant effect of participants' gender, age/grade level, and race/ethnicity on knowledge gains through farm- or garden-based education. More research is needed to determine what factors influence student learning and how garden- and farm-based educational programs can be designed to improve effectiveness for all participants.

Interaction effects tested in this study that were found to be significant ($p<0.01$ for all cases) were the soils domain by class, soils domain by school, soils domain by residence, and energy & choices domain by prior gardening experience. The graphs in

Figure 1 illustrate the differences in performance from pre- to post-test among demographic variables for each of the four cases with significant interaction effects.

Within the soils domain, class 5, School C, and participants from the Twin Cities suburbs made little to no gain in knowledge, while their peers in other demographic categories did. Referring back to Table 3, class 5 was made up entirely of students from School C, and the majority of students living in the suburbs were also in class 5. Because of this overlap, it is difficult to determine a causal relationship between these variables. It is possible that there is something inherent about students at this school or youth who live in the suburbs that could cause this result. However, because no significant interaction effects for class, school, or residence were found among any of the other four domains, this seems unlikely. Another possible explanation could be that this class was the last in the season and occurred on a cold, rainy day; thus, personal comfort issues could have been affecting learning during soil investigations (D. Abazs, personal communication, April 13, 2014).

Again, information gleaned from the interview with the instructor may help explain some of the results found through the quantitative data analysis of these variables. When asked whether or not the individual classes differed, the instructor said,

> The second lesson went better than the first in terms of my performance. I paced the class more balanced as I went through. Because you have 8 hours. And so, the first two classes, it was kind of, “I don't know the time, I don't know what's gonna happen.”

From the quantitative data, it appears that the change in timing/pacing of the class did not affect participants’ knowledge gain. The only domain in which the class showed a significant interaction effect was the soils domain, and here it was class 5 that made little to no knowledge gain, while classes 1 and 2 did increase in mean scores.

When asked if the content or activities within the classes changed over time, the instructor said, “Well, we changed work. What I wanted to do is make sure the work activities were related to real needs, so students felt part of its success.…Content was virtually the same the whole way through.” This observation helps explain the overall finding that the WRELC Organic Farm curriculum was equally effective for all classes, with the exception of class 5 in the soils domain.

Finally, the instructor was asked if the curriculum seemed more successful for any group of participants in particular. The instructor responded, “I don’t really think so.…I think the greater determinant was whether I was successful or not.…I wouldn’t say it was specific on age or even [prior] knowledge.” Again, this observation supports the overall finding that, in general, the WRELC Organic Farm curriculum was equally effective at increasing participants’ knowledge across demographic variables.

An interesting finding was the significant interaction between the energy & choices domain and participants’ prior gardening experience. Those indicating “no” or “some” gardening experience made little to no change in their domain scores from pre- to post-test. However, those who indicated having “a lot” of prior gardening experience made the largest gain in energy & choices domain score, jumping from the lowest pre-test score (5.00) to the highest post-test score (7.67). This is an unusual finding, as the literature would suggest that participants’ with prior gardening experience would come in with higher pre-test scores than their peers without prior experience (Aguilar, et al., 2008; Skelly & Zajicek, 1998). However, participants with “a lot” of prior gardening experience had the highest or second-highest mean pre-test scores for each of the other four domains. Perhaps given that the energy & choices domain encompassed broad picture aspects of the food system, rather than specific knowledge and skills used in gardening, prior gardening experience may not be a significant predicting factor of knowledge within this domain. It is also possible that the relatively low sample size (just six of fifty-nine participants indicated “a lot” of prior experience) doesn’t yield enough statistical power. More research should be done to determine how the amount and type of prior gardening experience affects youths’ knowledge of the food system.

Participants’ Perceptions of Learning

The majority of participants’ responses to the question “What did you learn today at the Wolf Ridge Organic Farm?” could be categorized among the five knowledge-based learning outcomes of the curriculum, with a few being non-specific (i.e. “many things”) or altogether blank. This is an interesting finding because if students were able to recall knowledge in these domains without prompting, it may indicate that Wolf Ridge was successful at aligning its curriculum to its stated learning outcomes and that, in accordance with the first evaluation question, the curriculum increased participants’ knowledge of the food system. However, because this question came at the end of the post-test, after answering many previous questions within the knowledge domains, the actual taking of the test may have skewed their responses toward these domains. Therefore, testing effects could partially account for this finding.

The most common domain to be mentioned was pollinators (N=21), while the least common domain to be mentioned was energy & choices (N=10). These findings align with overall changes in mean domain scores from pre- to post-test. The pollinators domain score increased the most (from a 50.6% to 80.5%) while the energy & choices domain made the least amount of change, with a post-test score of 83%. This may indicate that the curriculum did a thorough job teaching about pollinators or that this domain received proportionally more time and attention during the curriculum.

Participants' responses to the opened-ended question "What do you think you will remember about your time at the Wolf Ridge Organic Farm?" were grouped into one of five categories: knowledge, skills, specific activities within the lesson, social aspects of the class, and information specific to WRELC.

Overwhelmingly, participants indicated they will remember the various activities done throughout the class. Interview data corroborates this finding that overall participants enjoyed the activities. "When I had them reflect on the class, they worked backwards, and the first things they'd talk about were the physical things they did." When asked further what activities in particular were successful, the instructor responded,

> Well, the digging, the soil probes were successful at identifying the soil types. Harvesting the vegetables [was] very, very exciting for them. And using knives and cutting and being part of the prepping their lunch was very, very [well] received… They loved the dress up of the bee.

Taken together, these findings and observations indicate that Wolf Ridge has done well with incorporating experiential learning throughout this curriculum and should continue to include physical activities and experiential learning in the future. However, research suggests that while activities through environmental field trips may provide positive memories of the overall experience, these memories of activities do not necessarily translate to a retention of the knowledge gained through the activities (Knapp, 2000; Knapp & Poff, 2001). Perhaps more opportunities for reflection and application of the activities may be warranted to solidify the learning that is taking place.

It is also noteworthy that several participants listed more social and personal aspects of the class, both with their peers and with WRELC staff, as stand-out memories (see Table 12 above for example statements). In the interview, the instructor indicated the personal connections that were made with the groups and their importance to the overall success of the classes:

> A lot of the rapport that I built with the school groups was... they wanted to know about our family farm, you know, the whole picture on a personal, applied level for myself as the teacher, so having [the farm interns] teach it, um, it's a different class.

These findings indicate the importance of allowing for social interactions with peers throughout the curriculum and forming personal connections with Wolf Ridge staff. These are important aspects of the curriculum to continue to provide in the future.

Interview Themes

Many quotations from the interview with the class instructor were used in the preceding sections to give context to the quantitative questionnaire data. In addition to these select quotations, some additional emergent themes from the interview may help illustrate some aspects of the curriculum that may have contributed to its success. The following is a discussion of important themes and significant statements from the interview.

One of the common themes of the interview included adult dynamics during the classes. The instructor noted, "The adults, the parents and teachers, were very, very engaged in the class.…They're all probably even more engaged than the kids. And partly, I teach to them as well." However, the instructor emphasized that this engagement did not get in the way of student learning or participation in activities. While no adults elected to participate in this study, Wolf Ridge may consider evaluating the impact of this curriculum on adult participants in the future.

An additional theme that emerged related to the written curriculum, especially given a lack of access to some key materials.

> There [are] definitely gaps in the curriculum as it stands now. And, well, parts that only work with two classes, which is the ideal down there, eventually, is to have two classes going simultaneously. And part is we don't have the equipment or facilities yet.

Many examples of missing materials were given, including the human plow, the pizza oven, and a grassy running area. Other examples included improvements to the dress-up kit for the bee skit as well as the addition of some tactile objects during the explanation of soil nutrients. Because of the limited equipment and facilities, some changes were made in practice, including making salads for lunch instead of pizza and adding some initiative games. Because of this, the classes in this evaluative study do not mirror exactly the written curriculum. As the materials and activities within the curriculum continue to evolve, Wolf Ridge should continue to monitor student learning and engagement.

Another recurring issue related to materials was that of safety. Throughout the duration of the classes, the instructor states, “some safety things were evaluated.” These issues included the use of tools during some of the activities as well as the need for a grassy running area, as the only space currently available for running games was the gravel driveway. “The injuries were minor,” the instructor noted, “but the potential was great.” To ensure continued successful learning on the farm, steps should be made to address these safety issues in the future, and if necessary, activities should be altered until suitable equipment or spaces become available.

Two of the unexpected benefits of the curriculum were the location of the site and the length of time for each class. The farm is located about a mile and a half away from the main part of campus; as such, it tends to be more isolated from other groups. The farm class was an eight-hour class, as opposed to the normal three-hour class at Wolf Ridge, which allowed for deeper connections to be formed. This is evidenced in the following statement from the class instructor:

> I think being away from campus and having the whole eight hours was way bigger gift than I had thought about.…There's this whole kind of day of them being just them. And relaxing and, you know, getting to know everyone on a better level than a typical three-hour class. It was just a totally different experience and it was quite nice.… It was a really nice opportunity for them to be away from the hub and bub of running into other groups and stuff like that.

From these observations, the location and extended time period appear to have been contributing factors to the success of the WRELC Organic Farm curriculum.

Recommendations

Many recommendations arose from this study, in conjunction with the existing body of literature. A number of these recommendations were highlighted above. Below is a compilation of recommendations for Wolf Ridge ELC as well as for research in the broader academic field.

Recommendations for Wolf Ridge

Recommendations for Wolf Ridge fall under three broad categories: programming, evaluation, and sharing successes. Results from this evaluative study showed overall significantly positive increases in knowledge of the food system and suggest that the curriculum was generally successful in meeting its knowledge-based learning outcomes. These outcomes appear to be well-aligned with the curriculum in practice and should continue to be used as guiding principles as programming evolves. It may, however, be worthwhile to restructure some of the activities within the curriculum to ensure equal attention to all learning outcomes as well as to incorporate more reflection opportunities to help solidify the learning and skill development that is taking place. A continued emphasis on physical activities and experiential learning, as well as a focus on peer interactions and building personal connections to Wolf Ridge staff, are important factors to the continued success of programming. Additionally, to ensure quality learning, safety issues need to be addressed and alternatives put into place until proper equipment and facilities are secured. Finally, learning should not stop when students leave the farm; suggestions for connecting lessons learned on the farm back to school classes should be provided for teachers to expand upon this content.

This evaluative study has taken first steps into understanding the impacts of the Organic Farm curriculum on participants' knowledge of the food system. As materials and facilities evolve, student learning and engagement should continue to be regularly monitored to ensure success of programming. This evaluation can occur through questionnaires, interviews, or observations, should incorporate all participant demographics, and measure multiple areas of learning such as attitudes and behaviors related to food and farming. Additional areas to consider evaluating would be the impact of this curriculum on adult participants as well as the long-term retention by participants. Finally, a look into how this curriculum impacts participants' environmental literacy is warranted to better understand how this curriculum aligns with Wolf Ridge ELC's environmentally-driven mission statement. Linking this curriculum to other classes and activities at Wolf Ridge will be important for fostering a unified connection between the farm class and the Wolf Ridge field trip experience as a whole.

A final recommendation to Wolf Ridge would be to communicate its successes with regional schools and organizations working on garden- or farm-based education programs. The majority of research on garden-based education in the United States takes place in warm climates, such as Texas (Cammack, et al., 2002a/b; Klemmer, et al., 2005; Robinson & Zajicek, 2005) and California (Graham, et al., 2005; Hazzard, et al., 2011; Ratcliffe, et al., 2011), with relatively few coming from the more-difficult growing conditions of the Upper Midwest. It is the opinion of the evaluator that programming at Wolf Ridge can serve as a model for similar organizations and that collaboration should happen with local and regional partners through conferences, networking, and connection to academic research.

Recommendations for Research

The results of this evaluative study and an examination of related literature have pointed to many avenues for future research. Research is needed to quantify youth gardening experiences and how to improve access to these experiences. Research is also needed to understand how farm- and garden-based educational experiences affect knowledge of food systems, specifically among middle and high school students. It is also recommended that researchers investigate the effectiveness of one-day or short-term garden- and farm-based educational programs on knowledge of the food system and other learning outcomes, as well as the retention rates of knowledge gained through one-day programs in comparison with summer or year-long programs. Finally, more research is needed to understand what specific factors of garden- and farm-based education influence learning so that programs can be designed to be effective for all students, regardless of demographic differences.

Conclusion

Results from this evaluative study indicate that the Wolf Ridge Organic Farm curriculum was effective at improving participants' knowledge of the food system and was equally effective for the majority of participants, regardless of differences in demographic variables. The class instructor summed it up best with the following quote, "All of [the classes] were more successful than I had hoped.… Some kids said, oh, 'it was better than the ropes course!'" Results from this study can and should be used to improve existing programming and guide future programming at the WRELC Organic Farm. While more research is needed in the broader academic field, and continued evaluation is needed at Wolf Ridge specifically, it appears that the WRELC Organic Farm curriculum has promising impacts on participants' knowledge of the food system.

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Appendix A: Logic Model

Mission

WRELC – "To develop a citizenry that has the knowledge, skills, motivation and commitment to act together for a quality environment."

WRELC Organic Farm – "Establish an agricultural production system that will supply healthy, organic and affordable food for the center's meals and provide educational 'food' programs for Wolf Ridge."

Situation

Educational gardens and farms are an effective learning tool with demonstrated outcomes in increased environmental knowledge and attitude and improved academic achievement and engagement, social skills, and nutritional attitudes and behaviors. However, little is known about the effects of garden- and farm-based education on students' understanding of food systems. In a world where children are increasingly disconnected from their food and the environment, there is a need for effective, hands-on agricultural education.

Inputs

1. Human Resources: WRELC Board & Staff; Organic Farm Director; Student Naturalists
2. Financial Resources: Grants, program fees, contributions, value of produce credit
3. Farm/Space: Eventual 7 acre farm with 4 greenhouses and 3.5 acres of cropland, outdoor classroom and three-season oven, certified kitchen
4. Educational Materials
5. Media

Outputs

1. Food & Farming 101 class: An 8.5-hour, hands-on class for school and group field trip participants at WRELC. Students will explore food and farming through experiments, surveys, lab work, teaching circles, and working stations.
2. Vegetables & Fruits: Produce grown at the WRELC Organic farm will be cooked and consumed during class lunch time. When available, excess produce will be served in the dining hall to the whole campus.
3. Participation: Approximately 250 (primarily middle school) students and adult chaperones visiting from schools and groups across Minnesota, Wisconsin, and North Dakota.

Learning Outcomes

The following learning outcomes were taken directly from the farm lesson plan.

1. Distinguish between "soil" and "dirt."
2. Understand plant, nutrient cycles, and reproduction methods.
3. Experience the energy needs of growing food.
4. Explore the role of pollinators in the production of food.
5. Make personalized pizza to eat for lunch
6. Explain food miles, energy in agriculture, and food system choices
7. Learn how to identify, harvest, clean, and prepare vegetables
8. Share thoughts and ideas about food, farming, and farmers.

Action Outcomes

1. Eat more vegetables.
2. Support local food through farmers' markets or CSAs.
3. Plant pollinator plants at home.
4. Make food from scratch.
5. Help stop the use of pesticides in your home or school.

Impact

1. Agriculturally literate individuals.
2. Land stewardship ethics surrounding agriculture and food production.
3. Students possess the knowledge, skills, motivation and commitment to act on agricultural issues.
4. Healthy students and environment.

Appendix B: Evaluation Planning Matrix

Evaluation Questions:	Indicators:	Sources of Information:	Data Collection Tools:	Design and Sampling:
1. Does participation in the WRELC Organic Farm curriculum increase (youth and adult) participants' knowledge of the food system?	Increased ability to distinguish between 'dirt' and soil Increased ability to explain plant nutrient cycles and reproduction methods Increased ability to explain the role of pollinators in food production Increased ability to explain food miles, energy in agriculture, and food system choices Increased ability to identify, harvest, clean, and prepare vegetables	Participants (youth and adults)	Participant Questionnaire: Matching, order-the-steps, multiple choice, fill-in-the-blank, and short answer type questions	One group pretest/ posttest
2. Is the WRELC Organic Farm curriculum equally effective at enhancing all participants' knowledge of the food system, regardless of age, gender, ethnicity, place of residence, or prior experience with gardens and/ or farms?	Participants of certain demographics will exhibit different levels of competency in the above indicators	Participants (youth and adults)	Participant Questionnaire: Demographics section -- Grade level -- Gender -- Ethnicity -- Place of Residence -- Prior exp. with farms and/or gardens	One group pretest/ posttest

Appendix C: Participant Questionnaire

Food & Farming 101 – Questionnaire

You will be asked a series of questions about food and farming. This is not a test. Your answers will help us improve programs at the Wolf Ridge Organic Farm. Your answers will be totally anonymous, so please do not write your name on this paper.

The following questions will be used to link your pre- and post- answers without identifying you.

- Day of month you were born (i.e. if your birthday is February 9th, write "9"): ________
- Favorite color: ___________________
- Favorite sport: ___________________

Please tell us a little bit about yourself [PRE-TEST ONLY]:

- Grade: ______________________
  - ☐ N/A – adult
- Gender (please check one):
  - ☐ Male/Boy
  - ☐ Female/Girl
- Ethnicity (please check one):
  - ☐ Caucasian (White)
  - ☐ African-American
  - ☐ Asian
  - ☐ Hispanic
  - ☐ Native American
  - ☐ Other: ______________________
- School: ________________________
- What city/town do you live in: __________________________
- Home (please check one):
  - ☐ I live in town/in the city
  - ☐ I live in the country
- How much experience do you have with food gardening? (please check one):
  - ☐ I have no experience
  - ☐ I have a little experience
  - ☐ I have some experience
  - ☐ I have a lot of experience

Questions 1 - 9: Fill in the Blank – Name the vegetable growing in each of the following images.

1. ______________________

2. ______________________

3. ______________________

4. ______________________

5. ______________________

6. ______________________

7. ______________________

8. ______________________

9. ______________________

Questions 10 - 16: Multiple Choice – Circle the one (1) best answer.

10. Bee populations are:
    A. Increasing
    B. Staying the same
    C. Decreasing

11. Honeybees are:
    A. Native to Northern Minnesota
    B. Not native to Northern Minnesota
    C. Not found in Northern Minnesota

12. Without stable populations of pollinators, our food system would:
    A. Produce more food
    B. Stay the same
    C. Produce less food

13. The average meal travels _____ miles to get from farm to plate.
    A. 500
    B. 1,000
    C. 1,500
    D. 2,000

14. Nutrient-rich soils are _____ in color.
    A. Light
    B. Dark
    C. Both A and B
    D. Neither A nor B

15. Healthy soil requires a variety of:
    A. Plants
    B. Bugs
    C. Both
    D. Neither

16. Of the following choices, where can you find food with the least amount of food miles?
    A. Neighborhood restaurant
    B. Farmer's market
    C. Grocery store
    D. Backyard garden

Questions 17 - 25: Matching – Match the correct term from the word bank on the right to the description on the left. Each word will be used only once.

17. _____ The largest, gritty particles in soil; provides air space; does not hold water well; provides few nutrients
18. _____ The medium-sized, powdery particles in soil
19. _____ The smallest particles in soil; very compact with little air space; holds water; nutrient-rich
20. _____ The remains of dead plant and animal matter found in the soil, which is turned into nutrients by decomposers such as worms, bacteria, and fungi.
21. _____ An animal that lives in the soil; makes fertilizer for plants; creates air space within the soil as it burrows
22. _____ Microscopic organisms that decompose organic matter and turn it into nutrients
23. _____ Decomposed organic matter made from water and food scraps and/or animal waste; used as a plant fertilizer
24. _____ A soil nutrient that is essential for all living cells; helps plants in above-ground leafy growth; is often used in fertilizers, although some plants (such as legumes) can replenish the soil with this nutrient
25. _____ An essential soil nutrient that helps plants grow roots and blossoms; helps plants resist diseases; is often used in fertilizers

Word Bank:
A. Earthworm
B. Silt
C. Bacteria
D. Phosphorous
E. Clay
F. Organic Matter
G. Nitrogen
H. Sand
I. Compost

Questions 26 - 30: Order the Steps – Put the following steps of plant reproduction in order from first (1) to last (5).

26. _____ The flower is fertilized
27. _____ The seed is scattered
28. _____ The flower is pollinated
29. _____ The seed sprouts a new plant
30. _____ The seed is formed in the flower

Questions 31 – 34: In the following pairs, circle the food item that uses the <u>least</u> amount of energy to get to Wolf Ridge.

31. A. Tomatoes from Minnesota OR B. Tomatoes from California

32. A. Beef from Wisconsin OR B. Milk from Wisconsin

33. A. Lettuce from Iowa OR B. Eggs from Iowa

34. A. Food from a grocery store OR B. Food grown at the Wolf Ridge farm

Questions 35 - 38: Multiple Choice – Circle all of the correct answers. There may be more than one correct answer to each question.

35. Which of the following do plants need to photosynthesize? (circle all that apply):
    A. Sunlight
    B. Water
    C. Oxygen
    D. Carbon dioxide
    E. Sugar

36. Which of the following do plants produce during photosynthesis? (circle all that apply):
    A. Sunlight
    B. Water
    C. Oxygen
    D. Carbon dioxide
    E. Sugar

37. Invertebrates are important to soil because they can (circle all that apply):
    A. Keep the soil loose/aerated
    B. Sprout seeds
    C. Remove mold from the soil
    D. Fertilize the soil
    E. Water the soil
    F. Predate on (eat) pest species

38. Which of the following are plant pollinators? (circle all that apply):
    A. Squirrel
    B. Bee
    C. Moth
    D. Butterfly
    E. Worm
    F. Hummingbird
    G. Blue Jay

Question 39 – 41: Your garden has lettuce, tomatoes, and cucumbers that you want to use in a salad. Do you feel you would be able to… (select one):

	I wouldn't know how	I think I could	I definitely could
39. Harvest (pick) the vegetables?	☐	☐	☐
40. Clean the vegetables?	☐	☐	☐
41. Prepare the vegetables?	☐	☐	☐

Questions 42 – 43 Short Answer – Please briefly write in your answers to the following questions in the space provided.

42. What kinds of choices do people have when deciding what food to buy?

43. What are three things farmers/gardeners do to care for their crops?
    1.

    2.

    3.

44. [POST-TEST ONLY] What did you learn today at the Wolf Ridge Organic Farm?

45.[POST-TEST ONLY] What do you think you will remember about your time at the Wolf Ridge Organic Farm?

Appendix D: Questionnaire Administration and Assent Script

- Participation in this evaluation is **completely voluntary**. A parental permission form of non-consent should have been delivered to parents via the lead teacher. Any parent returning this signed form has NOT given their child permission to participate in this evaluation, and those students should not be given a questionnaire.

- Questionnaires should be given to each willing participant (both **youth** and **adult**) who will be taking the farm class. The questionnaire should take about 20 minutes to complete. Hand out the questionnaires in two sessions –
    - **Pre-test**: should be given as close to arrival time as is convenient (i.e. during group orientation/welcome, before/after first meal, etc.)
    - **Post-test**: should be given immediately following the farm class

WHAT TO SAY TO PARTICIPANTS ABOUT THIS QUESTIONNAIRE:

*"Melanie Stewart, a graduate student at the University of Minnesota Duluth, is helping Wolf Ridge to evaluate our new farm lesson. Because you are among the first to participate in our new farm lesson, we are asking you to help us learn more about your experience. Each of you will receive a questionnaire asking you about food and farming. This is **not** a test. This will not affect your time here at Wolf Ridge nor your grades back at school. Nobody will be able to trace your answers back to you, so please do **not** put your name on the questionnaire. Work quietly by yourself, and do the best that you can. If there is a question that you do not want to answer, you may leave it blank. This questionnaire should take about 20 minutes to complete. Please turn your questionnaire into me when you are done. Thank you for taking the time to help us evaluate our farm lesson. If you have any questions about this study, you may ask them now or later."*

<u>NOTE</u>: In order to maintain consistency, please do **not** read any questions aloud or help students define or explain a term or question.

- When all questionnaires are completed, please place them in the corresponding envelope. Please **label** that envelope with the following:
    - School/group name
    - Date the questionnaires were administered
    - Approximate time the questionnaires were administered

Again, thank you for your help with collecting data for this study. I am *very* grateful for your assistance! If at any time you have questions, or would like to refer a lead teacher/ chaperone to me for more information, please feel free to contact me at:

Melanie Stewart
stewa852@d.umn.edu
###-###-### (cell)

Appendix E: Parent Consent Form

Dear Parent/Guardian,

Your child will soon be taking a field trip to Wolf Ridge Environmental Learning Center. During this field trip, your child will be taking a new class at the Wolf Ridge organic farm. Wolf Ridge is working with graduate student from the University of Minnesota Duluth, Melanie Stewart, to evaluate this new lesson. The purpose of this evaluation is to investigate whether learning objectives of the farm class are being learned, and the results will be used to improve the class for future students. Because your child will be among the first to participate in this new class, your child has been selected as a possible participant in this evaluation. The evaluation process will consist of the following:

- S/he will be asked to fill out two questionnaires about food and farming, once upon arrival at Wolf Ridge, and again following the farm class. Your child's answers on these questionnaires will be **completely anonymous**, with no names or identifiers linking your child to his/her responses. Each questionnaire will take approximately 20 minutes to complete.

- Your child will also have the option to decide whether or not to participate in this evaluation, and will not have to answer any question s/he does not wish to answer. Should your child choose to **not** participate in this evaluation process, that decision will not affect his/her participation in the farm class or any other aspect of the Wolf Ridge experience.

- There are no foreseeable benefits to your child or his/her school for participating in this evaluation. However, data collected from participants in this evaluation process will benefit Wolf Ridge, as the results will be used to improve this class for future students and teachers.

<u>If you DO **NOT** want your child to participate in this study</u>, sign this form and return to your child's teacher prior to his/her field trip to Wolf Ridge. If no form is returned, we will assume parent consent.

If you have any questions about this evaluation, please feel free to contact:

Melanie Stewart
Graduate Student
University of Minnesota Duluth
stewa852@d.umn.edu

Again, only sign and submit this form to your child's teacher <u>if you **DO NOT** approve your child to participate in this evaluation</u>.

Your Name: ______________________________ Child's Name: _________________

Your Signature: ___________________________ Date: ___________

Appendix F: Interview Question Guide

1. Did you teach all Food and Farming classes this fall? Were other staff/naturalists involved in the teaching?

2. Overall, how did the lessons go?

3. Share an overview of how you taught the classes. What activities did you teach?

4. How closely did the activities align with the lesson plan?

5. Did the activities you taught change over the course of the season? If so, why?

6. Which activities did students appear to be most engaged in/learn the most from?

7. Which activities did students appear to be least engaged in/learn the least from?

8. Do you feel the learning objectives were successfully met? How do you know?

9. Do you feel each class was equally successful? If not, what factors led to certain classes being more successful than others?

10. Is there anything you would change/do differently the next time you teach the lesson (spring 2015) – i.e. specific items/activities, general sequencing, etc.?