International Journal of Early Childhood Environmental Education

ISSN: 2331-0464 (online)

"We won't hurt you butterfly!" Second-graders become environmental stewards from experiences in a school garden

Carley Fisher-Maltese
George Mason University

Submitted October 13, 2015; accepted May 24, 2016

Abstract

This is an important time to catalyze hope about the environment instead of fear and despair. One such opportunity for hope lies in school garden programs. Most of the scant studies on these settings investigate the health/nutritional impacts, science learning potential, or emotional dispositions of students. However, few studies examine the shifts in environmental attitudes that occur for students as a result of experiences in school gardens. This paper provides an example of how a school garden can improve student's environmental attitudes and help them to develop as environmental stewards. A study of second graders experiencing a garden-based science curriculum on insects is described. I argue that school gardens have the potential to help children develop a more empathic view of nature and become environmental stewards, but are often opportunities missed due to the challenges associated with their use.

Keywords: environmental attitudes, environmental stewardship garden-based learning, outdoor learning

We live in a time when our children are bombarded with messages that our Earth's climate and resources are in jeopardy. I hesitate to watch nature programs on television with my seven-year-old son because the last several we watched together ended with a sense of hopelessness that all will be lost unless something is done. This is an important time to catalyze hope instead of fear and despair. One such opportunity lies in school garden programs. I became interested in school gardens as an elementary school teacher over the course of seven years. I found that when I incorporated the garden into my teaching practice, my students learned the required curriculum, and more, in deep and meaningful ways (e.g., 2013; Blaire, 2009; Fisher-Maltese, 2013; Fisher-Maltese & Zimmerman, 2015; Klemmer, Waliczek, & Zajicek, 2005; Williams & Dixon, 2013). My students also seemed to learn about the importance of eating more fruits and vegetables (Nanney, Johnson, Elliot, & Haire-Joshu, 2006) and getting more physical exercise (Dillon, Rickinson, Teamey, Morris, Choi, Sanders & Benefield, 2006). I have been exploring school gardens ever since with the hope of better understanding their potential impacts.

This paper provides an example of how a school garden can instill a sense of hope and help them to become environmental stewards. First I will describe a study I conducted as a doctoral candidate on a garden-based science curriculum and its findings and then discuss the implications and challenges associated with using a garden-based approach. In the study, second graders' (n=71) experiences participating in a garden-based science curriculum led to improvements in their environmental attitudes (Fisher-Maltese, 2013; Fisher-Maltese & Zimmerman, 2015). Environmental attitudes are defined as "a psychological tendency expressed by evaluating the natural environment with some degree of favor or disfavor" (Milfont & Duckit, 2009, p. 81). Specifically, students developed a more empathic view of nature, in this case insects, and became interested in protecting the insects from adverse environmental factors, such as habitat loss and pesticide use.

Similarly, Project GREEN (Garden Resources for Environmental Education Now) is a program that uses a garden to teach about the environment and sustainability (Skelly & Zajicek, 1998). Two research studies, both employing the Project GREEN curriculum, have investigated environmental attitude change in conjunction with school gardens. Skelly & Zajicek (1998) surveyed second- and fourth-grade students (n=153) from four elementary schools in Texas who participated in the garden program and compared them to a control group (n=84) that did not participate in the garden program. Using the Children's Environmental Response Inventory, Skelly & Zajicek (1998) found garden program students demonstrated more positive environmental attitudes. For example, they noted higher scores in pastoralism, or "enjoyment of the natural environment in an intellectual and aesthetic fashion," than those students without the garden experience (Skelly & Zajicek, 1998, p. 579).

Similarly, Waliczek and Zajicek (1999), studied 589 second- through eighth-grade students from seven schools in Texas and Kansas, finding that environmental attitudes changed in a positive direction on a project-specific environmental attitudes scale called The School Garden Program Environmental Attitude Inventory after experiencing Project GREEN gardening activities. Mittelstaedt, Sanker, and Vanerveer's (1999) study of 46 U.S. children attending a five-day environmental summer program found that "although students arrived with a positive attitude toward the environment, they left the program with an even stronger environmental attitude" (p. 147). More broadly, Dillon et al. (2006) reviewed research conducted in Europe, Australia, and the United States on the value of outdoor learning experiences. They found that outdoor learning opportunities improve students' attitudes about the environment, along with other positive impacts.

As I have found through my own work, experiences in school gardens not only have the potential to improve students' attitudes toward the environment, but provide opportunities for children to develop as environmental stewards (Fisher, Svendsen & Connolly, 2015). Fisher, Campbell, and Svendsen (2012) define environmental stewardship as, "conserving, managing, monitoring, advocating for, and educating local people about a wide range of quality-of-life issues related to public and private resources in their local areas" (p. 27). Through this garden-based curriculum, students explored whether they felt it was important to protect where insects live and how to protect insect habitats, which are so often ill affected by human behavior. Many of the students shifted from fearing insects to wanting to protect them. As I discuss in greater detail in the following sections of this paper, engagement with the school garden in this garden-based science curriculum encouraged the students to become environmental stewards. In the following sections, I will describe the study context, the curriculum that was implemented, the data sources, and results of the study.

A Garden Instills Hope and a Will to Protect Nature at Penn Valley Elementary School

At Penn Valley Elementary School (a pseudonym), in New Jersey, I created and evaluated a garden-based science curriculum on insects in four second-grade classrooms using multiple forms of complementary data. Sixty-six second graders participated in the study, along with four teachers, and one principal (n=71).

I had taught second grade at Penn Valley, a K-3 elementary school, and initiated a school garden in 2005. The school garden at this school consists of four large and two small raised beds surrounded by mulched paths and a deer- and rodent-proof fence. Teachers, students, and parents grow vegetables, herbs, fruit, and flowers, and maintain the garden. The fence is lined with an internal and external border of perennial plants. One section of the border contains perennial plants that are food sources for local butterflies. The garden is located on the school's property, although a distance from the building and across a parking lot. Students primarily use the garden during class time accompanied by a teacher. Students and their parents volunteer to help maintain the garden year-round, especially in the summer (see Figure 1).

Figure 1. Teachers, parents, and students volunteer on a garden work day.

Garden-based Curriculum

The second-grade science curriculum at Penn Valley Elementary School includes a unit on insects during the spring. Typically, specimens are ordered from a science supply company and raised in the classroom to demonstrate their life cycle changes. Painted lady butterflies are the most common insect observed in classrooms at the school. The year of the study, teachers from Penn Valley also chose to study ladybugs and praying mantises since they are beneficial to the garden and served as a practical means to connect the insect curriculum to the school garden. However, ladybugs pose a unique challenge to observing the different phases of the life cycle since most science supply companies typically ship adults, because larva are fragile and tend to die during transport. The garden provided a living laboratory where the different phases of the life cycle of ladybugs were observed (see Figure 2).

Figure 2. Ladybug adult and eggs found on the underside of a leaf of a Milkweed plant.

Following a co-design approach (Penuel, Roschelle, & Shechtman, 2007), I developed a four-week standards-based science curriculum on insects collaboratively with four participating teachers, utilizing the school garden (see Figure 3). The students participated in classroom and garden insect lessons every day during the curriculum. I facilitated lessons by supporting the teachers and co-teaching the lessons in the school garden. Lessons were focused around week-long themes including anatomy, life cycles, helpful and harmful insects, butterfly and larva identification, and designing a butterfly garden (see Table 1).

Table 1
Curriculum Overview

Lesson 1: Using the 5 senses to observe and explore the school garden	
Days	Key Questions and Activities
Day 1:	What's a garden? How do I use my 5 senses to observe and explore?
Day 2:	Exploration in the school garden
Lesson 2: Arthropods and insects – Basic anatomy and life cycle	
Day 1:	What's an insect? What's an arthropod? Conduct an observation of a praying mantis Using a rubric in the classroom
Day 2:	Catch and conduct an observation of an insect in the school garden
Day 3:	Helpful and harmful insects
Lesson 3: Butterflies – A type of insect	
Day 1:	How to identify butterflies
Day 2:	Conduct an observation of butterflies in the school garden
Day 3:	Identifying butterflies by their larva; Conduct an observation of caterpillars in the classroom
Lesson 4: Designing a butterfly garden	
Day 1:	What attracts butterflies to a specific habitat?
Day 2:	Butterfly life cycle
Day 3:	Plant nectar and host plants in the school garden

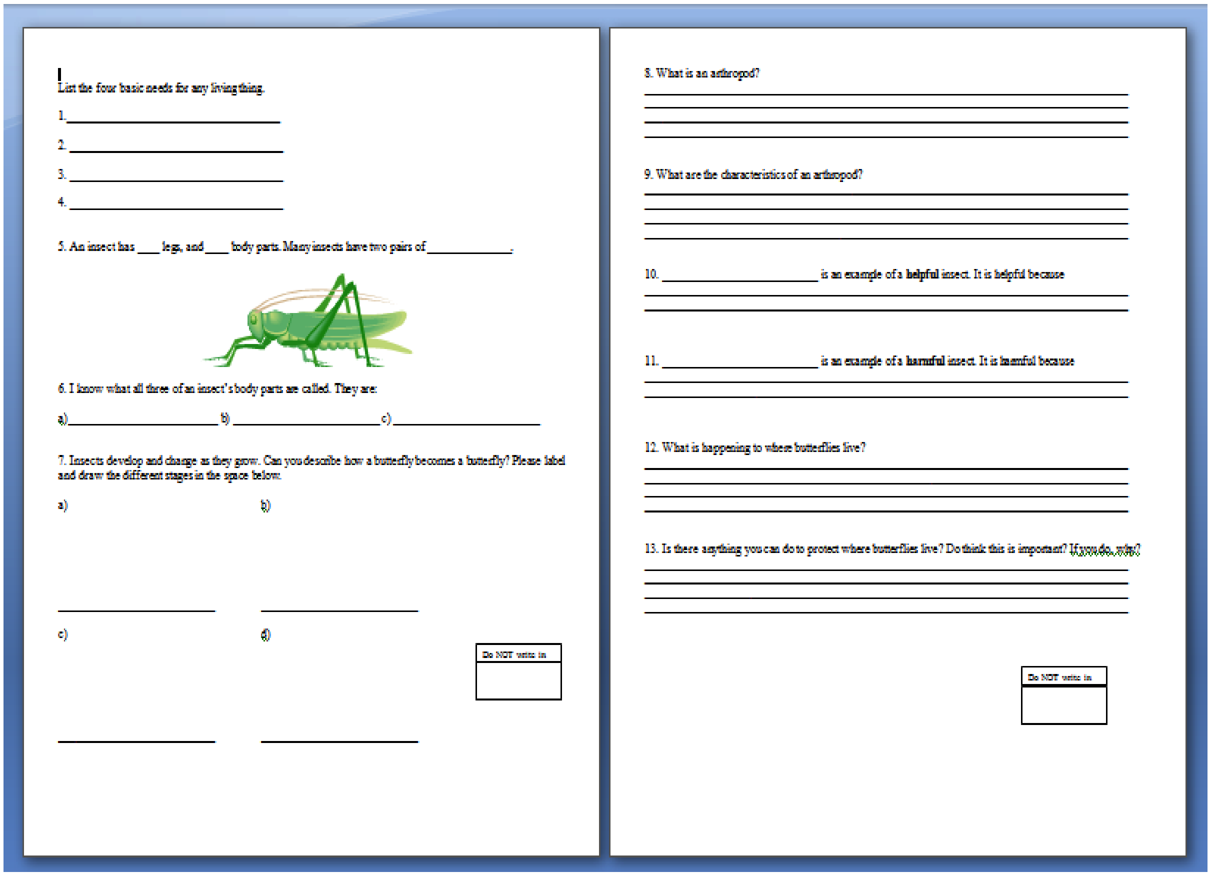
Figure 3. As part of the garden-based curriculum, second-grade teacher releases Painted Lady butterflies in the garden with her students.

Data Sources

Over the course of the four-week curriculum, I collected several forms of data related to attitudinal shifts by students. Complementary data sources included: (a) pre/post-tests, (b) pre/post environmental attitude surveys, (c) interviews, and (d) student conversations in the garden.

Pre/post-tests. I administered pre/post-tests to assess science content knowledge and student attitudes toward the environment. Pre-tests were administered the same week the curriculum was initiated and post-tests within one week of curriculum completion. Pre/post-tests included multiple choice and open-ended questions designed to elicit students' understanding of insect anatomy, life cycles, behavior, habitats, and attitudes toward insects and habitat loss.

Pre/post surveys. To capture shifts in students' environmental attitudes over the course of the curriculum, I used a pre-existing survey instrument designed by Ratcliffe (2007). Ratcliffe's (2007) survey was selected because it was previously used to measure changes in environmental attitudes as a result of a school garden experience and was most-closely age-appropriate (although some language had to be simplified since it was designed for sixth-grade students). An abbreviated version of Ratcliffe's (2007) Ecoliteracy Survey included statements about students' ecological attitudes toward extinction, organic produce, water pollution, land conservation and littering, and energy and water conservation. Sample survey items are found in Figure 5. Ratcliffe (2007) explains, "These eco-attitudes were identified as 'things environmental people cared about' and are conceptualizations of environmentally responsible behaviors found in the literature (Bunting & Cousins, 1983; Jaus, 1982)" (p. 78). In Ratcliffe's Ecoliteracy Survey (2007) there were a total of seven attitudinal statements, which included a 5-point Likert scale (e.g., 1 = strongly agree, 5 = strongly disagree). For example, one statement from the survey was, "Trying to protect the environment is my responsibility," with response options ranging from "agree" to "disagree" across a 5 point Likert scale. Another statement was, "I think people should build more parks for animals." For all but two of the statements (2 and 8), a 1, or strongly agree, was the most desirable response. For example, statement 1 read "I am worried about animals that are going extinct." For statements 2 and 8, the inverse was the most desirable response so the responses were re-coded for consistency (i.e., a 1 became a 5, a 2 became a 4, etc.).



List the four basic needs for any living thing.

1.________________

2. ________________

3. ________________

4. ________________

5. An insect has ___ legs, and ___ body parts. Many insects have two pairs of __________.

6. I know what all three of an insect's body parts are called. They are:

a)____________ b) ____________ c) ____________

7. Insects develop and change as they grow. Can you describe how a butterfly becomes a butterfly? Please label and draw the different stages in the space below.

a) b)

c) d)

Do NOT write in

8. What is an arthropod?

9. What are the characteristics of an arthropod?

10. ____________ is an example of a **helpful** insect. It is helpful because

11. ____________ is an example of a **harmful** insect. It is harmful because

12. What is happening to where butterflies live?

13. Is there anything you can do to protect where butterflies live? Do think this is important? If you do, why?

Do NOT write in

Figure 4. Pre/Post Test Sample Items.

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I am worried about animals that are going extinct.	**1**	**2**	**3**	**4**	**5**
Trying to protect the environment is my responsibility.	**1**	**2**	**3**	**4**	**5**
I would come to school on a Saturday to plant flowers.	**1**	**2**	**3**	**4**	**5**

Figure 5: Pre/Post Environmental Attitudes Sample Items.

Interviews. I conducted semi-structured pre-/post-curriculum interviews with four students in each classroom (n = 16). Interviews were audio recorded and videotaped for accuracy and later transcribed.

Student conversations. I digitally audio-recorded student conversations during lessons in the school garden to capture in situ learning and attitudinal shifts. I placed small digital recorders in students' pockets and lapel microphones on their shirts to capture their conversations (see Figure 6).

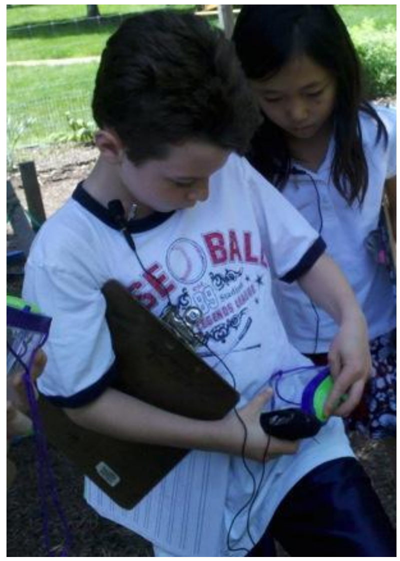


Figure 6. Students with parental permission wore digital recorders with lapel microphones to capture in situ conversations.

Data Analysis

Data analysis followed a multi-step process; quantitative and qualitative data were analyzed separately and then examined for triangulation purposes.

Pre/post-tests. Pre/post-tests primarily assessed science content knowledge, but also contained one question which measured attitudes toward the environment. Pre/post test data were analyzed using a rubric I developed. Inter-rater reliability was conducted and yielded 94% reliability. Paired sample t-tests were conducted using the statistical software, SPSS, on the pre/post-tests.

Pre/post surveys. I used Ratcliffe's (2007) Ecoliteracy Survey described above. Students' responses were entered into an Excel spreadsheet. Responses were then added together to create an index (Index A = pre-test, Index B = post-test). Indices provided a general measure of environmental attitudes over time (i.e., from pre- to post-test). Statistical analysis involved paired sample t-tests using SPSS.

Interviews and student conversations. Interview and student conversation data were first transcribed and organized by data source. Next the data set was described with several rounds of coding. The first round of coding involved looking for evidence of environmental attitude shifts. For subsequent passes of data coding, sub-codes were created both deductively from the literature and inductively from the data, following recommended qualitative data analysis protocols (Creswell, 2007). Table 2 describes the coding scheme we used, including the code, criteria, and examples. Codes for environmental attitudes included "protect habitat," "fear of insects," and "desire to protect insects/compassion towards."

Table 2
Coding Table

Code	**Criteria**	**Example**
Protect habitat	Demonstrated a desire to protect insects' habitat	"Yes, because they didn't harm you or anything and they didn't do anything to your place and now you should do something to help them because they need to have a habitat to survive."
Fear of insects	Demonstrated a fear of insects	"Yeah, because then like bees, if you ruin their home, they'll chase after you. But beware of killer bees because they might like, I think they might kill you because they're called killer bees."
Want to protect insects	Demonstrated compassion towards insects	"What? No! Don't hurt nature!"

Results

Several forms of data were used to assess if students' attitudes toward the environment changed throughout their use of the school garden. In this section, the following results are discussed: responses to a specific question on the pre/post-test, pre/post environmental attitudes survey, interviews, and student conversations in the garden.

Quantitative Results

Pre/post-test. Of the 88 students who took the pre-test, 63 also took the post-test. Therefore, a total of 63 paired pre/post tests were collected. Only one question assessed students' environmental attitudes on the pre/post-test. Question 13 read: "Is there anything you can do to protect where butterflies live? Do you think this is important? If you do, why?" However, this one question was separated into the separate sections, each coded independently. For the first part of this question, among answers coded as "correct" were responses such as plant seedlings for nectar plants (i.e., those with flowers from which butterflies obtain nectar), don't pull important plants thought to be weeds, and don't harm habitats (see Figure 7).

Figure 7. Students plant nectar plants for butterflies.

These responses also can be coded as pro-environmental responses and thus relate to students' attitudes toward the environment. If students provided some "other" response, it was considered incorrect. While many students answered, "I don't know" (n = 53) to question 13 on the pre-test, post-test answers included a variety of responses. Many students had ideas for things they could do to protect where butterflies live (question 13: n = 36 answered "1" for a positive behavior), such as "plant food for the butterflies to eat" and "ask my parents to stop spraying our lawn [with pesticides]." On this part of the question, students' pro-environmental responses increased by 32% and the number of students having no opinion decreased by 17% (see Table 3).

Table 3
Responses to "Do you think it is important to protect where butterflies live?"

Response	Pre-Test	Post-test
Yes	17	25
No	1	1
I don't know	48	40

For the third part of the question, 36% more students provided a "good reason" for why it is important to protect butterflies. Good reasons included: "butterflies are helpful insects because they pollinate flowers," "help plants grow," and "are living things." ("Not a good reason" usually was an unrelated response, e.g., "butterflies have three body parts," "butterflies are different colors.") 21% fewer children had no opinion on the post-test compared to the pre-test (see Table 4).

Table 4
Responses to "If you do [think it's important to protect where butterflies live], why?"

Response	Pre-Test	Post-test
Good Reason	16	25
Not a Good Reason	7	7
I don't know	43	34

Pre/Post environmental attitudes survey. Sixty-three students completed both the pre- and post-survey; only these repeated measures were analyzed. Analysis of these pre/post surveys did not result in a statistically significant pre-post change.

Qualitative Results

Interviews. Sixteen students (four in each of the second-grade classes) were interviewed before and after the curriculum. Pre/post curriculum student interviews included the questions, "Do you think it's important to protect where insects live? If yes, why? How can you protect where insects live? Is there anything you can do?" In total, 6 out of 16 students' interview responses showed a positive shift in environmental attitudes from pre to post curriculum (see Table 5); the other 10 students had a positive attitude toward the environment at the start of the curriculum which remained positive at the end of the curriculum (i.e., there was no change in their attitudes toward the environment).

Table 5
Student Interview Responses to "Do You Think It's Important to Protect Where Insects Live?"

Student	Pre/Post	Response
Pamela	Pre	*No. Because they eat our plants.*
	Post	*Some places like we don't need to protect where ants live. And other critters, but we do need to protect some of, ones that eat other insects and that don't do any harm to us.*
Carson	Pre	*Yeah, because then like bees, if you ruin their home, they'll chase after you. But beware of killer bees because they might like, I think they might kill you because they're called killer bees.*
	Post	*Yeah, because some are helpful so, like the ones that are helpful you would keep safe and then the ones that are not very helpful, you wouldn't.*
Margaret	Pre	*No.*
	Post	*Yeah, because insects are important to the world. You can't live without insects because some are helpful. For example, a dragonfly. Because mosquitoes bother people, but dragonflies eat mosquitoes and then there are less mosquitoes. And an example of a harmful insect is a killer bee.*
Kyle	Pre	*Yes, because if you hurt an insect, they'll hurt you back. Like if you hurt a bee, it will sting you.*
	Post	*Yes, because they didn't harm you or anything and they didn't do anything to your place and now you should do something to help them because they need to have a habitat to survive.*
Isaac	Pre	*Yes, otherwise you have another animal to add to the endangered species list. There are so many.*
	Post	*Yes, since most butterflies now are dying…because people are killing like, they're putting bug spray…and then they're well, they're searching for the habitat and [people are] building cities there.*
Noah	Pre	*Mm-hmm. Because they could become endangered and maybe even extinct. We need insects…I mean if we didn't have honeybees, there would be no such thing as honey, which never spoils.*
	Post	*Yes. Well, because not all of them are pests or harmful. They're helpful because they want to protect, and they help pollinate flowers.*

Table 5 demonstrates the six students' shifts in attitudes from pre to post curriculum. In summary, Pamela[1] and Margaret exemplify students who had a complete attitude change. They changed their attitude from "no, you should not protect where insects live" in the pre-curriculum interview to "yes, because some insects are actually helpful, and not all are harmful." Similarly, Pamela, Carson, Margaret, and Noah seemed to regard insects favorably in the post interview because some insects are helpful. Isaac and Noah did not change their opinion that insects' habitats should be protected, but their reasoning in the post-interview was much more sophisticated. During the pre-interview, both explained that you should protect insects because you do not want more animals added to the endangered animals list. However, in the post-interview, Isaac explained how people are responsible for the butterflies dying due to spraying pesticides and habitat destruction and Noah explained how insects are important for pollination. Carson and Kyle explained that you should protect where insects live because insects will hurt you if you don't protect their habitat. In the post-curriculum interview, Carson expressed that you should protect the insects' habitats that are helpful. Kyle seems to have developed some compassion towards insects. He thinks he should help them since they need a habitat to survive.

At least four students communicated a fear of insects in the pre-interview. Clearly, students had either been taught or learned through personal experience that insects are frightening. For example, Darren explained in an interview, "I don't like insects. Like I can draw an insect, but when people talk about them a lot, I start to shiver and then I feel like I have bugs and insects crawling on me." Darren refused to touch the plastic creatures I asked him to sort into two groups during the interview: insects and non-insects. He felt more comfortable pointing as I moved them for him into two different piles. Interestingly, Darren seemed to overcome or forget about his fear during the lesson in the garden which involved catching insects with tweezers and nets and observing them in bug boxes. In the audio-recorded conversation between him and his partner, Darren does not once express fear and seems engaged in the activity.

Figure 8. Students caught insects in the garden, which they later identified and observed.

Student conversations in the garden. Student conversation data also provided support that students had a positive shift in attitude toward the environment. Students' comments fell into two categories: expressing concern for insects and wanting to protect them and expressing excitement about catching insects as part of the curriculum (see Table 6).

[1] All names are pseudonyms.

Table 6
Student Voices from the Garden

Concern for Insects/Desire to Protect Them
We won't hurt you butterfly! (chasing a Cabbage White)
Robert, let it go. Let him go! There he goes. He jumped! There's Larry, the grasshopper. Don't touch him!
You have to learn to be gentle with that! (to others with nets)
Dude, don't do that. You're going to kill it.
Student 1: *Look, there's a wood ant! Right there. Kill it!* **Student 2**: *What? No! Don't hurt nature!* **Student 1**: *I'm not. I'm just kidding.*

Excitement About Catching Insects as Part of the Curriculum
Teacher: *Group 1, you're going to look for insects.* **Students**: *Yes!* (squeals)
I saw a really cool insect, Rohan. Somewhere…here. Get over here! Look at that one. Get it!
Student: Mrs. F-*M can you come next week and we can try to catch more butterflies*? **Researcher**: *Yes, we're going to do that.* **Student***: YAY!!!*
Teacher: *Would you like to help me break the lumps?* (in the soil before planting flowers) **Student**: *Sure, I'd love to!*

Figure 9. Two students run to catch butterflies by the garden.

Discussion

Findings from this study are in line with conclusions from Blair's (2009) review that found students' environmental attitudes do not consistently improve with gardening. I attempted to use triangulation to corroborate my results, but instead found interesting differences between the survey results and the pre/post-test, interview, and student conversation data. The quantitative survey data for this study show no statistically significant shifts in attitudes. However, in contrast to the survey data, data from the pre/post-test, interviews, and student conversations suggest an improvement in students' attitudes toward a more empathic view of nature, thus preparing to become environmental stewards.

Figure 10. Student observes a caterpillar she caught in the garden earlier that day.

Students' changing their opinion of insects as a result of studying them is not unique to this study. For example, Ratcliffe (2007) found that teachers from her study reported that students became "more insect friendly" and that "not all kids want to make their hands dirty, but…they got used to it and [then]…they wanted to touch the worms and insects" (Ratcliffe, 2007, p. 80). In addition, my pre/post-test, interview, and student conversation data are in-line with other research studies that show positive shifts in environmental attitudes for students as a result of outdoor education programs generally (Carrier, 2009; Fancovicova & Prokop, 2011; Farmer, Knapp & Benton, 2007) and experiences in school gardens, in particular (Skelly & Zajicek, 1998; Waliczek & Zajicek, 1999).

However, there are methodological challenges in generating classroom-based action. I encountered challenges with regards to an inconsistency in my results, which led me to question the survey tool I used and its reliability for this population and for this context. During my search for a valid, reliable instrument for measuring environmental attitudes, I found only three instruments that had strong measures. However, only one of these instruments had been modified for research with children (Manoli, Johnson & Dunlap, 2007). I ultimately chose the only instrument I could find that was developed for students participating in a gardening activity. I believe I saw no change from pre- to post-survey because of the limitations of the instrument and a possible ceiling effect. In hindsight, the questions from the survey I used were too general and did not match the specific curriculum content. For example, our students' shifts in environmental attitudes were often about insects specifically. Data suggest that perhaps another tool would have resulted in quantitative pre-post changes. For instance, a scale that included fear toward nature (or specifically insects) would have captured changes in the students' environmental attitudes. In addition, similar to interview responses in Mittelstaedt et al.'s (1996) study, a majority of our students (10 out of 16) began the curriculum with a positive attitude toward the environment, however, I was not able to demonstrate that they finished the curriculum with an even stronger environmental attitude. This indicates a possible ceiling effect, where the items on the instrument limit the possible answer choices in a way that constrains possible higher measures.

Conclusion

Environmental education produces environmentally literate and responsible citizens (Knapp, 2000). It also has the potential to develop young scientists who will potentially find the solutions to global environmental problems (International Social Science Council, 2014). In the U.S., The National Environmental Education Act of 1990 (NEEA) established an Office of Environmental Education in EPA's headquarters to provide leadership and support of educational programs (EPA, 2015). "Environmental education, with its emphasis on informed decision-making and stewardship, comes to the forefront as one of the most appropriate and effective tools for improving environmental quality" (EPA, 2015). School gardens are logical sites to teach about living things and environmental stewardship. Some states (e.g., California and Washington, D.C.) have passed policy that directly supports school gardens by providing funding for which schools can apply. For example, in August 2010, the Healthy Schools Act of 2010 was unanimously passed by the City Council of the District of Columbia to "improve the health, wellness, and nutrition of the students of the public and charter schools." Building on the momentum for urban agriculture, local foods, and school gardens, the Act formally establishes a school garden program for schools in the District, including the distribution of competitive grants that support the creation and maintenance of school gardens.

School gardens provide an opportunity for even our youngest students to learn science and ecological awareness. Unfortunately, in spite of some supportive policies, like the ones mentioned above, school gardens represent a critical tension in programming. In spite of evidence-based beliefs, such as children learn science or improve their environmental attitudes when out in a garden, teachers often report that they seldom use the school garden, if their school has one. Barriers, such as a lack of time and content knowledge in the areas of science and gardening, have been reported among teachers (Fisher-Maltese, 2013). These barriers are perhaps related to a policy context that requires teachers to administer high-stakes tests and adhere to curricula that exclude a thoughtful understanding of what kinds of environments might be most conducive to learning. Moreover, because students (and teachers) are expected to meet curriculum standards and test score benchmarks, indirect academic effects do not provide the hard assessment data that is required in a high stakes climate. This may explain why teachers and administrators may have difficulty justifying the time to work in the garden. This is unfortunate for *all* children, especially those who attend struggling schools and often already have little exposure to nature. There is a need for more school gardens and garden-based curricula, like the one described in this study. It is educational gardens like these that will help children develop a love of nature and become environmental stewards motivated to protect our Earth.

References

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

Bunting, T.E., & Cousins, L.R. (1983). Development and application of the Children's Environmental Response Inventory. *Journal of Environmental Education*, 15(1), 3-10.

Carrier, S. (2009). Environmental education in the schoolyard: Learning styles and gender. *The Journal of Environmental Education*, 40(3), 2-12.

Creswell, J.W. (2007). *Qualitative inquiry & research design: Choosing among five approaches*. London, England: Sage Publications.

Dillon, J., Rickinson, M., Teamey, K., Morris, M., Choi, M.Y., Sanders, D., Benefield, P.

(2006). The value of outdoor learning: Evidence from research in the U.K. and elsewhere. *School Science Review*, 87(320), 107-111.

Farmer, J., Knapp, D., & Benton, G. M. (2007). An elementary school environmental education field trip: long-term effects on ecological and environmental knowledge and attitude development. *The Journal of Environmental Education*, *38*(3), 33-42.

Fisher, D.R., Svendsen, E.S., & Connolly, J.J.T. (2015). *Urban Environmental Stewardship and Civic Engagement: How Planting Trees Strengthens the Roots of Democracy*. New York, NY: Routledge Press.

Fisher, D.R., Campbell, L.K., & Svendsen, E.S. (2012). The organizational structure of urban environmental stewardship. *Environmental Politics*. 12(1), 26-48.

Fisher-Maltese, C. (2013). Fostering science literacy, environmental stewardship, and collaboration: Assessing a garden-based approach to teaching life science. Unpublished doctoral dissertation, Rutgers, The State University of New Jersey—New Brunswick.

Fisher-Maltese, C., & Zimmerman, T.D. (2015). A garden-based approach to teaching life science produces shifts in students' attitudes toward the environment. *International Journal of Environmental & Science Education*, 10(1), 51-66.

Fisher-Maltese, C., & Zimmerman, T.D. (April, 2014). Teaching science in an informal setting: Assessing a garden-*based approach to teaching the life cycle of insects.* Paper presented at the 2014 Annual American Educational Research Association Meeting, Philadelphia, PA.

Francovicova, J., & Prokop, J. (2011). Plants have a chance: Outdoor educational programmes alter students' knowledge and attitudes towards plants. *Environmental Education Research*, 17(4), 537-551.

Jaus, H. (1982). The development and retention of environmental attitudes in elementary school children. *Journal of Environmental Education*, 13(2), 12-18.

Klemmer, C.D., Waliczek, T.M., & Zajicek, J.M. (2005). The effect of a school gardening program on the science achievement of elementary students. *HortTechnology,* 15, 448-452.

Manoli, C., Johnson, B., & Dunlap, R. (2007). Assessing children's environmental world views: Modifying and validating the New Ecological Paradigm Scale for use with children. *Journal of Environmental Education*, 38(4), 3-13.

Milfont, T., & Duckit, J. (2009). The environmental attitudes inventory: A valid and reliable measure to assess the structure of environmental attitudes. *Journal of Environmental Psychology*, 30, 80-94.

Mittelstaedt, R., Sanker, L., & Vanderveer, B. (1999). Impact of a week-long experiential

Nanney, M., Johnson, S., Elliot, M., & Haire-Joshu, D. (2006). Frequency of eating home-grown produce is associated with higher intake among parents and their pre-school aged children in rural Missouri. *Journal of the American Dietetic Association*, 107(4), 577-584.

Ratcliffe, M. (2007). *Garden-based education in school settings: The effects on children's vegetable consumption, vegetable preferences, and ecoliteracy*. Unpublished doctoral thesis, Tufts University, Boston.

Skelly, S.M. & Zajiceck, J.M. (1998). The effect of an interdisciplinary garden program in the environmental attitudes of elementary school students*. HorTechnology*, 8(4). 579-583.

Waliczek, T.M., & Zajicek, J.M. (1999). School gardening: Improving environmental attitudes of children through hands-on learning. *Journal of Environmental Horticulture*, 17, 180-184.

Williams, D.R. & Dixon, P.S. (2013). Impact of garden-based learning on academic outcomes in schools: Synthesis of research 1990-2010. *Review of Educational Research*, 83, 211-235.

Carley Fisher-Maltese is an Assistant Professor of Education in the Early Childhood Education Department in the College of Education and Human Development at Goerge Mason University. She can be contacted at Cfisherm@gmu.edu.