

The Development of an Enhanced Extension Agent Training to Create Butterfly Gardens in Louisiana¹

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ABSTRACT An internally-funded innovation grant provided by the Louisiana State University AgCenter was awarded to host an extension agent training that addressed establishing butterfly gardens and using these gardens in educational programming. Information provided included basic butterfly anatomy, butterfly feeding habits, and selection of both host and nectar plants. Three lessons, matched with state educational benchmarks, addressing butterfly plant propagation, butterfly life-cycles, and butterfly and other insect-feeding mechanisms were provided to agents for use with school-aged children. All materials needed to construct, plant, and maintain a 1.2 m by 2.4 m raised butterfly garden, along with supplies to conduct the lesson plans were provided. Agents participated in pre- and post-workshop surveys as well as a post-one-year project survey. Knowledge of butterfly biology increased by 35.3% by the end of the workshop, and an additional 0.6% by the end of the year. This training resulted in the initiation of 15 butterfly gardens at 13 schools, one camp, and two agricultural field day (Ag Day) settings in St. James Parish, LA. A total of 2088 children participated in this butterfly project. Agents reported that the training and supplies enabled them to immediately begin new programming on this topic and that participation in this program lessened anxiety regarding working with students in garden situations.

KEY WORDS Butterfly garden, Children's activities, Extension training

Many school garden studies focus on vegetable crops. Using vegetable gardens as an educational focus emphasizes healthier eating habits and science skills related to growing edible plants (Graham et al. 2005, O'Brien & Shoemaker 2006, Koch et al. 2006, Lautenshlager & Smith 2007, Parmer et al. 2009). School-based vegetable gardens were found to increase student's science-based knowledge and environmental awareness (Smith & Motsenbocker 2005, Klemmer et al. 2005, Karsh et al. 2009). While vegetable and edible gardens are more common, garden program managers (such as county agents and teachers) often note that students tend to prefer lessons in which animals, insects, or other living and moving creatures (earthworms in composting activities or pollinator lessons) are

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integrated into activities [based on personal correspondences with Louisiana State University (LSU) AgCenter extension agents].

The LSU AgCenter's School Garden Initiative primarily focused on vegetable-related school garden programming from 2005 until 2012. To provide new programming and to encourage additional student participation, the LSU AgCenter developed an additional garden-based training for county agents that combined traditional school gardening information with an emphasis on butterfly gardens. This modification was important as literature suggests that butterfly gardens are relevant to enhancing a student's educational experience (Blair 2009). Butterfly garden programs, such as the South Carolina Butterfly Project, found that teams of teachers attending several butterfly garden workshops began to use butterfly gardens to provide students with an opportunity to plant flowers and use the venue to cover educational content such as butterfly lifecycles, soil characteristics and chemistry, and plant and flower structures. Students participating in the South Carolina Butterfly Project identify Lepidoptera species, collect census data on overall insect counts and flower numbers, and then use the collected data to make graphs, tables, and charts. Charting, graphing, and making tables help educators meet mathematics and science-based educational standards. Participating teachers reported that the South Carolina butterfly gardens were an effective use of outdoor space (Culin 2002). Not only are butterfly garden programs having a positive influence on mathematics and science-based education, but writing and language skills as well. The Journey North Project (Journey North 2009), a monarch educational program, provides North American students the opportunity to send paper monarch butterflies to students in Mexico who then mail paper butterflies back. Students write accompanying letters and must complete some language translation (Journey North 2009).

Yeh (2012) and Polus (2007) noted through interviews and research projects that a loss of butterfly habitats through over-exploitation of mountains, increased usage of pesticides, and fragmentation of grassland communities have contributed to a loss in number of butterfly populations. Combining natural habitat loss with the fact that many schools do not have butterfly gardens because of a lack of campus space, garden knowledge, or time, an Augmented Reality learning system was developed to teach students about butterflies (Tarng & Ou 2012). The researchers developed a six-week butterfly unit taught on smart phones. They discovered that students learned about many species of butterflies, how to breed virtual butterflies, and gained knowledge about butterfly lifecycles and host plants using fun-gaming technology. Augmented Reality is a wonderful use of technology to further extend educational experiences regarding the natural world. However, an argument remains for the need for "green space" in schools. Open landscape areas and natural playing areas including ornamental, edible, and butterfly gardens have been suggested to help reinforce a student's contact with nature, enabling students to receive psychological and physiological benefits (Townsend & Weerasuriya 2010). Taylor & Kuo (2009, 2011) found that daily exposure to natural environments helped children with Attention Deficit Hyperactivity Disorder (ADHD) display milder symptoms. Taylor (2002) found that children with exposure to free play in outdoor spaces tended to exhibit creativity, self-discipline, focus, and reduce aggression. It seems that a school butterfly garden can be the perfect opportunity to not only enhance a student's

Table 1. Knowledge based questions used on the pre- and post-workshop tests as well as on the post-one-year test.

Question number	General butterfly knowledge question
1	List two butterflies commonly found in Louisiana?
2	Do adult butterflies only feed on specific plants? Yes or No
3	Do butterfly larvae (caterpillars) only feed on specific plants? Yes or No
4	Name a butterfly host plant that grows well in Louisiana.
5	Name a butterfly nectar plant that grows well in Louisiana.
6	Do butterflies go through complete or incomplete metamorphosis?
7	What is the specific name for a butterfly's mouthpart or tongue?
8	Do butterflies form a cocoon or chrysalis?
9	List one other means of propagating plants other than by seed.
10	Are butterflies generally more active in the daytime or nighttime?
11	Do butterflies migrate? Yes or No
12	How many wings does a butterfly have?
13	What are butterfly wings covered with?

educational experience because it provides a real-world opportunity to interact with nature, but the garden may also positively influence a student's physical and mental well-being.

The LSU AgCenter School Garden Initiative provided internal funding to develop a butterfly garden training program and to provide associated garden supplies to county agents. The butterfly workshop focused on how to properly build raised beds, establish a butterfly garden, and use this garden for youth-based educational outreach. The first objective of this project was to increase participation numbers in university-based youth projects by providing county agents the knowledge, tools, and supplies needed to establish a butterfly garden and to conduct educational lessons associated with the garden. The second project objective was to evaluate the effectiveness of the butterfly workshop on agent's knowledge and self-confidence.

Materials and Methods

Fourteen county agents from 12 parishes throughout Louisiana participated in a one-day workshop held at Burden Botanical Gardens in Baton Rouge, LA. Agents were recruited by sending a statewide email to all agents with horticulture responsibilities notifying them of the upcoming workshop. Those that responded first were selected to participate.

During this workshop agents were given pre- and post-workshop tests (immediately before starting and after ending the workshop) to assess their overall butterfly knowledge and self-confidence working with students in a butterfly garden setting (Tables 1 and 2). Approximately one year after the workshop, at which time the agents had installed the garden and used the lesson plans, the agents were again surveyed with a post-one-year test to assess their overall knowledge of butterflies as well as their self-confidence in working with youth in butterfly garden settings. Agents also provided the state specialists who

Table 2. Questions used to assess agents self-confidence when working with students in butterfly gardens. Agents were asked to answer on a scale from 1–10.

Question number	Self-confidence question ^a
1	I am __ with working with elementary and middle school youth.
2	I am __ with recommending plants for a butterfly garden.
3	I am __ with building a raised bed.
4	I am __ with growing and maintaining a butterfly garden in a raised bed.
5	I am __ with teaching youth specifically about butterflies.
6	I am __ with teaching youth about insects.

^aScale provided to agents for answering these questions was from 1-10 (1 = Not comfortable with this activity; 5 = Comfortable with the activity; and 10 = Comfortable and excited to do this activity).

organized the training with short 5-minute PowerPoint® (Microsoft Corp., Redmond, WA) presentations to describe their efforts throughout the year.

Butterfly garden workshop format. The butterfly workshop began with a welcome and introduction of each participating agent followed by all agents taking a pre-workshop test. Three presentations followed the introduction and pre-workshop test. The first presentation was conducted by the state entomology specialist and covered information related to butterflies, their habitats, anatomy, migration patterns, life cycles, and behaviors. The second presentation was provided by the state ornamentals specialist and included information related to selection of host and nectar plants suitable for use throughout Louisiana, proper plant spacing, planting dates, and proper planting techniques. A working lunch followed the second presentation. During lunch, agents toured a model school butterfly garden on the grounds of Burden Botanical Gardens. The tour allowed agents to visualize what their gardens would look like once established. Agents were also able to obtain ideas on plant signage and children art projects to potentially use or modify for their own butterfly gardens.

Following lunch, the third presentation was made by the state school garden specialist. This presentation covered three basic butterfly-related horticulture lessons that agents could use with school-aged children. The lessons were tied to specific components of the Louisiana state educational standards at the fourth and fifth grade levels. Lesson titles, sources, and related state-based educational standards are listed in Table 3. Lesson topics included butterfly life cycles and how their body functions during each stage, propagation of butterfly plants, and various butterfly and insect mouthparts that help gardeners determine if plant damage was caused by a pest or a beneficial insect, such as an adult butterfly. In order to demonstrate how these lessons would function with students, each presentation was taught as if the agents were the students. Each agent was provided the materials needed to conduct each of the three lessons with 20 students. Agents were provided with the lumber, plants, fertilizer, irrigation supplies, and small tools (trowels, shovels, hoes rakes) needed to construct the raised-bed butterfly garden.

After the conclusion of the three main presentations, demonstrations on building raised beds and irrigation set up were provided agents, who also were

Table 3. Butterfly project lesson titles, related educational standards, and sources.

Lesson title	Grade level	Louisiana grade level expectation associated with lesson	Source of lesson	Link to lesson at the LSU AgCenter website
The functions of butterflies body parts throughout its life cycle	4th	Characteristics of organisms. 4: GLE-41. Describe how parts of animals' bodies are related to their functions and survival (e.g., wings/flying, webbed feet/swimming) (LS-E-A3)	A portion of this lesson (the paper plate lifecycle model) can be found in many educational resource books. The remaining portions of the lesson were developed by K. Fontenot.	https://www.lsuagcenter.com/NR/rdonlyres/1BEBDF2C-0938-4316-A04D-713DEC669336/89316/TheFunctionsOfButterflyBodyPartsinallStagesofTheir.pdf
Propagating butterfly plants	4th	Life cycles of organisms. 4: GLE-46. Describe how some plants can be grown from a plant part instead of a seed. (LS-E-B1)	Lesson adapted from the Texas Junior Master Gardener curriculum and from Carly Gillett's LSU Masters' thesis project titled "Creating horticulture curriculum addressing environmental concerns."	http://cms.lsuagcenter.net/mcms/relatedfiles/%7BA2F94184-5066-4ED3-9663-35C7D27ABE61%7D/butterfly.pdf
Garden friends and foes	5th	Populations and ecosystems. 5: GLE-28. Explain and give examples of predator/prey relationships (LS-M-C4).	Lesson adapted from the Texas Junior Master Gardener curriculum and from Carly Gillett's LSU Masters' thesis project titled "Creating horticulture curriculum addressing environmental concerns."	http://cms.lsuagcenter.net/mcms/relatedfiles/%7BA2F94184-5066-4ED3-9663-35C7D27ABE61%7D/Friends.pdf

reminded of the expectations of participating in this workshop. Expectations included establishing a garden in a public area within their parish, maintaining the garden for at least one year, and conducting each lesson at least one time with a group of students. In order to accommodate agent's schedules and perspective audiences, parameters on participant's age were not given. Agents could choose who they would use the garden and related activities with; examples of participants included schools, youth groups, and church organizations. At the conclusion of the workshop, agents were given a post-workshop survey. The post workshop survey included the same questions as the pre-workshop survey. An identical survey also was provided to agents for feedback at the end of the one-year period.

Pre- and post-workshop tests and post-one-year test description. The pre-workshop test was developed to assess agents' general butterfly knowledge and self-confidence working with students in butterfly garden settings. This test included 13 questions related to butterflies and the plants needed to attract butterflies to the garden (Table 1) as well as six questions related to assessment of the agent's self-confidence when working with students in a butterfly garden (Table 2). Agents answered the general knowledge test questions (Table 1) with "Yes" or "No," or with one or two words. The self-confidence questions were answered on a scale of 1–10, with 1 being 'not comfortable with this activity'; 5 being 'comfortable with the activity'; and 10 being 'comfortable and excited to do this activity'. At the conclusion of the day-long workshop, agents were again provided with a post-workshop test with the same questions in the same format as the pre-workshop test. Participating agents were asked to complete this same test approximately one year after the conclusion of the workshop, which was referred to as the post-one-year test. The post-one-year survey was given to agents to assess if the general butterfly information provided to them during the workshop was retained in their long-term memory or perhaps even enhanced as a result of installing a butterfly garden. Assessing the self-confidence questions were very relevant following a year of participation in the butterfly garden as it would help determine if working with students in the garden setting helped boost or decline an agent's self-confidence.

The LSU AgCenter has a full Institutional Review Board (IRB) review process for any projects that ask participants to complete tests or questionnaires as a result of participation in a project. However, this butterfly project was exempt from a full IRB review because it a) did not contain test and control participants; b) did not jeopardize participant's health nor their mental well-being; c) did not assess participants less than 18 years of age; and d) stated that the purpose of the pre- and post-tests were to evaluate the programming and not necessarily to conduct research. In addition, this project was not completed in conjunction with graduate student research.

Analysis of pre-workshop, post-workshop, and post-one-year tests. Statistical analyses were not used to evaluate tests, primarily because of low participant numbers. Instead, questions from the general knowledge portion of the tests (Table 1) were scored giving each question equal weight of one point. If the question had two parts (e.g., "name two butterflies that are commonly found in Louisiana"), the agent received one point for each correct answer. If the agent got one butterfly correct but the other incorrect, he/she still received partial credit. Mean scores (correct or incorrect) were determined for individual knowledge

questions on each test (pre-, post- and post-one-year). Scores from the general knowledge questions (Table 1) were summed to determine a total score for each participant and an overall total score combining all agents' scores together.

Self-assessment questions were simply averaged using the (1-10 scale) across all six questions to determine if agents were more or less self-confident. Agents assessed themselves for each question and then those numbers were averaged for individual questions as well as total confidence level (combining all questions together).

Butterfly garden lesson plan descriptions. Three separate lessons were developed for this study. Lesson titles were: 1) The functions of butterfly body parts throughout its life cycle; 2) Propagating butterfly plants; and 3) Garden friends and foes. Each lesson was adapted from existing educational materials. Titles, correlating state educational benchmarks, and a website link to each lesson plan can be found in Table 3.

Lesson 1, "The functions of butterfly body parts throughout its life cycle" was included because it teaches complete metamorphosis and helps participants better understand how a butterfly's body changes during each stage of the lifecycle. Metamorphosis is a topic repeated in Louisiana's curriculum in elementary as well as middle school years. Because participant's ages varied widely and because certain age requirements were not mandated, lesson topics were chosen that would be relevant to various age levels.

Lesson 2, "Propagation of butterfly plants," was included so that students would begin to understand that particular plant habitats are needed in order to observe butterflies in the natural environment. Propagation is a basic horticulture practice and understanding that plants can be reproduced by seeding and asexual methods is important to being able to grow and manage a garden area. Propagation, like metamorphosis, is also a reoccurring theme in Louisiana's science curriculum at various ages.

Lesson 3, "Garden friends and foes," was chosen because children and adults often assume all insects are bad. Managing a butterfly garden can be difficult for beginning gardeners who do not understand a butterfly's life cycle. For instance, caterpillars eat plant foliage, whereas adult butterflies consume nectar from flowers. It was the intention of this lesson to help students understand that different mouth parts will result in damage or no damage to plants. This lesson was used to reinforce the idea to wait before you spray and to correctly identify an insect before labelling it as a pest or beneficial. These three lesson plans can be used by other educators and modified to meet various levels of student learning capabilities. County agents used these lessons with in school and after school groups, non-profit groups, as weekend youth-based workshops and at Ag Days. Ag Days are used by the LSU AgCenter to introduce children to components of agricultural production, including sugarcane plants, cotton bales, farm equipment, vegetable plants, insects, arbor, fisheries, and other agriculture-related displays, as well as information about agricultural production and commodities by local experts.

Results and Discussion

Fourteen agents participated in the workshop and the pre- and post-workshop surveys. Overall knowledge of the 13 knowledge-based butterfly and butterfly

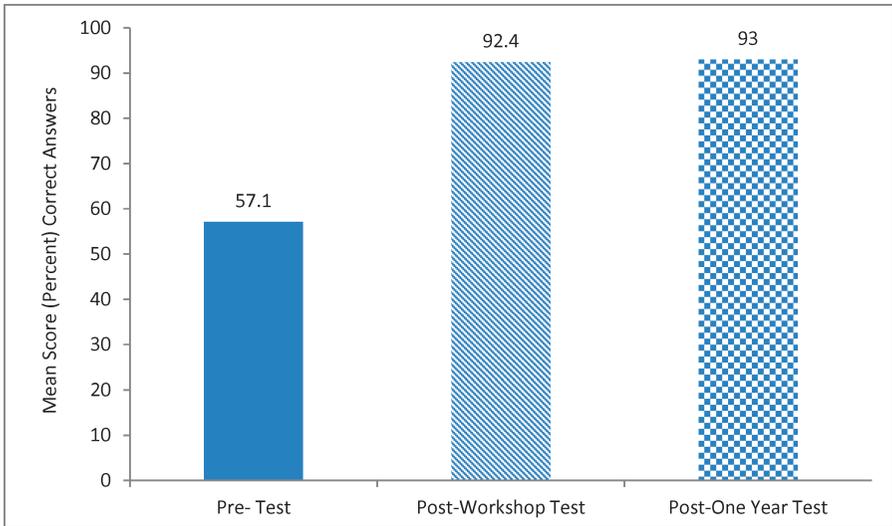


Fig. 1. Change in agent's mean scores from the pre-test to post-workshop test to post-one-year test (pre-test and post-workshop test n = 14; post-one-year test n = 11).

plant questions was increased from 57.1% in the pre-workshop test to 92.4% in the post-workshop test. During the year following the training, there had been one retirement and two job transfers, so only 11 agents repeated the post-one-year test. Each of the three garden projects initiated by the agents who left the program continued to be implemented, but the new agents using them were not asked to complete the post-test since they had not attended the training. There was only a slight increase in overall knowledge from 92.4% in the post-workshop test to 93.0% in the post-one-year test (Figure 1), indicating that agents retained the information throughout the year.

Individual questions that agents had the most trouble answering correctly on the pre-workshop test were Questions 2, 7, 9, 12, and 13 (Table 1). However, most agents answered those questions correctly on the post-workshop test, with the exception of Question 2 (“Do adult butterflies only feed on specific plants? Yes or No?”). This question could have been better written. Technically adult butterflies feed on nectar plants, of which there are many. But some may also feed on host plants that bloom such as the milkweed. Therefore, the question should have been left open ended for short answer response. A better revision of the question would be “Describe a plant an adult butterfly would feed on.” As the question was originally stated, the correct answer would have been “no” because adult butterflies will feed on any plant with nectar. Some agents might have answered “yes,” because they might have thought that, as adults, butterflies only feed on “nectar” plants. Another question that could have been better written was Question 11: “Do butterflies migrate?” This question could technically be answered “yes” or “no” depending on butterfly species.

The mean confidence level increased from 7.4 in the pre-workshop test to 8.1 in the post-workshop test, and for the 11 remaining agents, to 8.5 in the post-one-

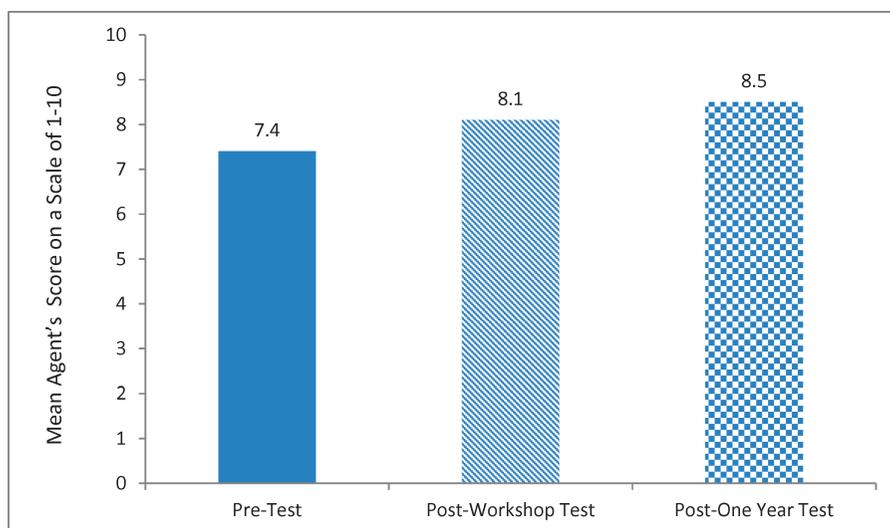


Fig. 2. Change in agent's mean scores on the comfort-assessment questions from the pre-test to post-workshop test to post-one-year test (pre-test and post-workshop test $n = 14$; post-one-year test $n = 11$).

year test (Figure 2). Based on scores from all three tests, the information presented in the workshop slightly boosted their confidence by providing them with answers to questions students might ask during butterfly specific activities.

A total of 14 agents were trained using these workshop materials. Agents used the materials to interact with 63 teachers and 2088 school-aged children. Participants ranged from school-based classrooms, 4-H groups, children attending workshops and garden days, to exhibits during Ag Day events. Agents reported using the training materials to enhance school-based newsletters, 4-H newsletters, and articles written for local newspapers. Contacts from these publications are difficult to estimate, but allowed the agents to further distribute the information to their local communities. The entire grant project budget was \$5000. The cost per participant can be viewed in several ways. The cost to train these 14 agents was \$357.14 per agent. The cost to use the gardens and materials to train/work with teachers was \$79.37, and the cost per participating student was \$2.39. Results indicate that this program successfully trained agents to conduct butterfly gardening programming in their local areas by increasing the subject knowledge of butterflies and butterfly gardening and the confidence level of working with students.

Project future. All participating agents indicated that they would continue to use the butterfly gardens as demonstration areas for both student and home gardeners. Most agents said that with additional funding (from their respective parishes) they would replenish the consumable supplies and continue to use the lesson plans. All lessons are posted online and free for any educator to use. Additional funds are being sought to host this workshop for a larger number of agents with the intention of not only creating new butterfly habitats throughout Louisiana but also to teach additional youth about butterflies.

This program would be greatly enhanced by combining the current format with that of online educational tools from projects such as The Journey North Project (Journey North 2009) and other websites that offer free butterfly curricula. We also hope to create a student assessment tool to determine if there is a positive gain in students' knowledge of butterflies and butterfly habitats as a result in participation in this project.

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