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# School Gardening: Improving Environmental Attitudes of Children Through Hands-On Learning<sup>1</sup>

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## Abstract

Project GREEN (Garden Resources for Environmental Education Now), a school garden program, was integrated into the curriculum of seven elementary and junior high schools in Kansas and Texas. The objective of the study was to evaluate whether students participating in garden activities were gaining more positive attitudes about environmental issues. Students' environmental attitudes were significantly more positive after participating in the school garden program with post-test mean scores 0.26 points higher than the pre-test mean scores. Demographic comparisons indicated that female and Caucasian students, as well as students from rural areas, had more positive environmental attitudes after participating in the garden program compared to other students within each respective group.

**Index words:** environmental education, horticulture, children's gardening.

## Significance to the Nursery Industry

Results from research studies have indicated that children's outdoor experiences are important in the long-term development of children because they impact career choices and conservation efforts (11, 29). Findings from the Project GREEN school gardening research study indicated that gardening activities, accompanied by educational lessons, positively influenced children's environmental attitudes. Educational programs, such as Project GREEN, that introduce horticulture and environmental issues to children are important to the horticultural industry. The youth participating in these programs will be the customers and employees of the future. The horticulture industry can help the success of these youth programs through support in terms of plant materials, labor and expertise, in turn encouraging children to investigate horticulture as a professional career in addition to becoming responsible environmental stewards.

## Introduction

As human pressures on the environment increase, schools have been given a greater degree of responsibility to educate children on caring for the environment. Although the preservation of the environment has been a popular topic for decades, resources and training materials for teachers have not kept pace (26). This has led to teachers feeling inadequate in their presentation of environmental educational materials to students (1). Therefore, it is important to provide resources to educators to make the incorporation of environmental education a positive experience for both teachers and students.

One method of integrating environmental education into the classroom is through an activity-based curriculum including hands-on experiences. It has been reported that students tend to learn better when they are actively involved and hands-on activities help to improve their acquisition of new knowledge, skills, and attitudes (20). Activities help students apply the information they receive rather than just memorize it (31). Horticulture, because it is an activity-based, hands-on discipline, may aid in the incorporation of environmental education into existing curricula.

Past research also indicates that children who participate in numerous outdoor activities have more positive environmental attitudes compared to children with fewer outdoor

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**Table 1. Summary of schools, their location, number of students and grade level participating in the school garden program.**

Participating school	City and state	N	Grade levels	Public vs. private
All Saint's Elementary School	Kansas City, KS	102	3-8	Private
Bozeman Elementary School	Lubbock, TX	139	3-6	Public
College Station Junior High School	College Station, TX	248	7	Public
Havencroft Elementary School	Olathe, KS	14	2	Public
Lamar Elementary School	Corpus Christi, TX	27	4	Public
Rock Prairie Elementary School	College Station, TX	31	4	Public
St. John's/Holy Family Elementary School	Kansas City, KS	37	3-8	Private

experiences (27). Gardening is definitely an outdoor activity, and may play a role in improving the environmental attitudes of children.

The major goal of the Project GREEN research program was to determine if the outdoor activity of gardening can influence the environmental attitudes of children. The main objectives of this study were to: 1) develop a garden activity guide and 2) evaluate whether students were developing positive environmental attitudes by participating in the school garden program.

### Materials and Methods

*Activity guide.* The *Project GREEN Activity Guide: Book 1, Math and Science* (34) was developed for elementary and junior high school teachers. It is divided into six units each consisting of an introduction and individual learning experiences with several objectives and a variety of activities. There are 33 different exercises within the six units. The guide includes activities that can be integrated into existing classroom curriculum and is available through the Instructional Material Service, Texas A&M University, College Station, TX.

Topics in the Project GREEN activity guide include identifying insect and plant parts, using fertilizer, attracting birds and butterflies to the garden and graphing plant growth and rainfall. Each of the 33 activities in the guide includes the discipline focus areas, the objectives of the activity, a short introduction, the time required, materials needed and steps to complete the activity. Most activities require one hour or less to complete. These activities are intended to supplement existing curricula and do not build upon each other.

*Population.* The study was conducted during the 1995/1996 school term. The research was in collaboration with public and private schools in Texas and Kansas. Seven schools were included in the study. Descriptions of each school are provided in Table 1. A total of 598 students volunteered to be pre-tested at the start of the spring semester in January and post-tested at the end of the gardening season in May.

*Implementation of the garden program.* The participating schools each received garden materials and 4' x 8' raised garden beds as part of the incentive for participating in the research project. Schools also received bedding and vegetable transplants and seeds to plant within the garden area, as well as copies of the Project GREEN activity guide.

Results from a teacher questionnaire distributed at the conclusion of the study indicated that all schools used the Project GREEN activity guide and implemented an outside garden program. However, there were differences in the gardening

season length at each school, the amount of time teachers gardened weekly and the number of gardening activities actually completed.

*Instrumentation.* Questions included in the environmental attitude inventory were taken from existing instruments developed to test environmental attitudes for children and adolescents (2, 4, 9). The inventory included 13 statements that students rated on a 3-point Likert scale (18) (Table 2). Most statements included within the inventory pertained to the environment in general, or to a topic related to plants. However, four statements on the inventory related to environmental issues that are commonly publicized, such as threats to endangered species.

The three possible responses to each statement were A = 'Agree,' B = 'Neither Agree nor Disagree,' and C = 'Disagree.' Sixty-five students in grades three through eight were involved in a pilot test to help measure the reliability and validity of the instrument. Any questions that were considered problematic by a number of children were reworded, and/or adjusted for reading levels. The reliability of the instrument was 0.67.

The pre-test questionnaire included a section for student biographical information including questions on gender, grade, ethnicity and place of residence.

*Data collection.* Copies of pre-tests were distributed to the schools by hand or through postal delivery at the beginning of the spring semester in January 1996. Post-tests were distributed in the same way at the end of the spring semester in May 1996. The questionnaires were returned to the re-

**Table 2. Environmental attitude statements included on the school garden program environmental attitude inventory.**

Statement
1. Poisonous snakes and insects should be killed.
2. Special places should be put aside for animals that are endangered.
3. It is all right to litter if you don't get caught.
4. The animals that we eat are the most important ones to protect.
5. People should try to recycle as much as they can.
6. People should protect animals and plants.
7. All plants and animals are important.
8. Plants that grow in parts of the world where there are few people are not important.
9. Big companies do not have a right to pollute rivers and streams.
10. People should be able to use their land any way they want.
11. Big animals that eat smaller animals are mean.
12. We should use weed killer to kill the weeds on the roadsides of highways.
13. It is a good idea to make room for houses by cutting down trees.

**Table 3. Comparison of the pre-test and post-test environmental attitude scores of children participating in the school garden program.**

Group	Number of cases	Mean score <sup>z</sup>	t	Sig
Pre-test	575	31.45	-1.712	0.087*
Post-test	575	31.71		

\*Statistically significant at the 0.10 level using a paired t-test.

<sup>z</sup>Scores ranged from 13 to 39. An attitude score of 26 indicated a neutral environmental attitude. A score higher than 26 indicated a positive environmental attitude. A score lower than 26 indicated a negative environmental attitude.

searcher by hand or through the mail. Before analysis, pre- and post-tests were coded with numbers to ensure respondents' anonymity and for pairing of responses.

*Data analysis.* All data were analyzed using the Statistical Package for the Social Sciences for Windows™ Release 7.0 (28). Student scores were tabulated by allocating points for various answers. One point was allocated to answers reflecting a negative environmental attitude. Two points were given to those answers that were neutral, and three points were allocated to positive environmental attitude answers.

Scores ranged from 13 to 39. An attitude score of 26 indicated a neutral environmental attitude. A score higher than 26 indicated a positive environmental attitude whereas, a score lower than 26 indicated a negative environmental attitude.

Scores were entered into the SPSS (28) spreadsheet. Missing answers were coded as missing values. The differences between pre- and post-test scores were tested using paired t-test analyses. In additional comparisons of demographic information, multivariate ANOVA tests were used with pre-tests acting as covariates.

## Results and Discussion

Significant differences were found in students' environmental attitudes after participating in Project GREEN ( $p = 0.087$ ) (Table 3). Students' scores averaged 0.26 points higher on the post-test indicating more positive environmental attitudes. While the scores from this analysis indicated that

children's environmental attitudes were already at a positive level before participating in the school garden program (Table 3), children's environmental attitude scores were more positive at the conclusion of the gardening program.

The finding that students' environmental attitudes were already at a positive level was encouraging. Past studies have reported that environmental education has not been readily available to school systems for the past 20 years (33, 35). However, a number of studies have investigated the relationship between environmental knowledge and environmental attitudes and have found that increased knowledge fosters environmental concern in students from elementary school age to college age (5, 15, 23, 24). Research has shown that projects that provide children with direct experiences with nature are important in helping children understand the beliefs they derive from other sources (3).

Individual statement responses from the environmental attitude survey were analyzed to compare pre- and post-test group answers (Table 4). Of the 13 attitude statements, four were significantly different in comparisons of the pre- and post-test mean scores (Table 4). Statements with mean scores that increased to become significantly more positive involved issues that are often emphasized to children, including endangered species ( $p = 0.023$ ) (statement 2), littering ( $p = 0.009$ ) (statement 3) and pollution ( $p = 0.001$ ) (statement 9) (16).

Statement 12 concerned herbicide use on roadsides. The mean decreased from the pre-test to the post-test (Table 4). Students agreed with the statement 'weed killer should be used to kill weeds on the roadsides of highways.' The garden beds at each school were used to grow primarily vegetables and flowers. Students primarily learned traditional gardening techniques that involved removing unwanted plants (without the use of chemicals), and learned that these 'bad' plants hinder the 'good' plants' growth.

Chemical usage was not discussed with students in many cases and apparently, students were not able to distinguish between killing weeds in the garden without chemicals and killing weeds on the highways with chemicals. However, it is important for children to understand the implications of proper chemical usage and application. These research results indicate that children in the sample group were not being taught the possible impact of chemicals on the environment.

**Table 4. Comparison of pre-test and post-test individual environmental attitude statement means of children participating in the school garden program.**

Statement	Pre-test mean <sup>z</sup>	Post-test mean	2-tailed sig
1. Poisonous snakes and insects should be killed.	2.15	2.17	0.689
2. Special places should be put aside for animals that are endangered.	2.63	2.72	0.023**
3. It is all right to litter if you don't get caught.	2.69	2.76	0.009***
4. The animals that we eat are the most important ones to protect.	2.00	1.97	0.449
5. People should try to recycle as much as they can.	2.86	2.83	0.175
6. People should protect animals and plants.	2.80	2.82	0.457
7. All plants and animals are important.	2.73	2.70	0.339
8. Plants that grow in parts of the world where there are few people are not important.	2.57	2.53	0.381
9. Big companies do not have a right to pollute rivers and streams.	2.61	2.74	0.001****
10. People should be able to use their land any way they want.	1.85	1.92	0.100
11. Big animals that eat smaller animals are mean.	2.38	2.41	0.472
12. We should use weed killer to kill the weeds on the roadsides of highways.	2.03	1.96	0.074*
13. It is a good idea to make room for houses by cutting down trees.	2.49	2.53	0.232

\*\*\*\*, \*\*\*, \*\*, \* Statistically significant at the 0.001, 0.01, 0.05 and 0.10 levels, respectively, using a paired t-test.

<sup>z</sup>Means derived from Likert type scale: 1 = Agree, 2 = Neither Agree nor Disagree, 3 = Disagree.

**Table 5. The influence of student demographics on environmental attitude scores of children in the school garden program.**

Group	N	Mean score <sup>a</sup>	Standard deviation	df	F	Significance
Gender						
Female	328	31.98	3.80	1	5.251	0.022**
Male	247	31.36	4.13			
Ethnicity						
Caucasian	290	33.19	3.48	3	4.455	0.004****
African-American	113	29.48	3.67			
Hispanic	151	30.55	3.84			
Native American	13	31.92	4.70			
Age						
8 to 9 years	116	30.46	3.79	3	1.294	0.276
10 to 11 years	139	31.19	3.73			
12 to 13 years	295	32.60	3.93			
14 to 15 years	23	29.87	3.61			
Place of Residence						
Farm	66	32.45	3.57	1	2.946	0.087
City	507	31.63	3.99			

\*\*\*\*, \*\*\*, \*\*, \* Statistically significant at the 0.001, 0.01, 0.05 and 0.10 levels, respectively, using a multivariate analysis of variance.

<sup>a</sup>Scores ranged from 13 to 39. An attitude score of 26 indicated a neutral environmental attitude. A score higher than 26 indicated a positive environmental attitude. A score lower than 26 indicated a negative environmental attitude.

*Demographic comparisons.* Past studies have indicated that demographic variables such as ethnicity, gender and age have been known to influence environmental attitudes (14, 17, 22, 25). Findings in the school garden program indicated that there were statistically significant differences between the comparisons of gender ( $p = 0.022$ ) (Table 5), ethnicity ( $p = 0.004$ ) (Table 5), and place of residence ( $p = 0.087$ ) (Table 5), but no differences among age groups ( $p = 0.276$ ) (Table 5).

Multivariate analysis of variance (MANOVA) tests were run to compare the post-test scores of each of the demographic variables of interest. Pre-test scores were used as covariates in this analyses to ensure that any differences in initial scores were taken into account.

*Gender comparisons.* While all students were well above the median neutral score of 26, female students participating in Project GREEN had more positive environmental attitude scores than male students (Table 5). Females' post-test scores were 0.62 points higher than males' scores and there was, additionally, less variation in scores ( $p = 0.022$ ) (Table 5).

Past studies found that gender does influence attitudes toward ecological topics. Boys and girls have been known to view nature and vegetation differently (14, 22). Women possess a stronger concern for environmental issues (17), and this stronger concern has led to more positive environmental dispositions (7, 14).

Traditionally, the horticultural industry has been a male-dominated field. While results from the Project GREEN study indicated that females had more positive environmental attitudes at the conclusion of the study than did males, positive overall results indicated the program was still effective for males. Since studies show that males generally have more negative environmental dispositions (7, 14), it may be important for educational programs such as Project GREEN, to target this population in order to encourage the development of positive environmental attitudes during childhood.

*Ethnicity comparisons.* Students from all ethnic groups had positive environmental attitudes, but significant differences were found between these groups (Table 5). Post-hoc tests (LSD) determined where differences occurred. Caucasian students scored higher on the environmental attitude survey than did Hispanic students and African-American students, 3.71 and 2.64 points, respectively.

Project GREEN research findings are similar to those of past studies that reported that ethnicity influenced environmental attitudes (17). Kellert (17) found that Caucasian children reported a greater amount of affection for animals and the outdoors, than did children from other ethnicities. Many researchers have tried to explain the ethnicity differences in environmental dispositions, especially the differences that occur between African-Americans and Caucasians. Researchers have mentioned overall lifestyle differences in groups including socioeconomic status, differing priorities, education, political status and employment opportunities as possible reasons for the gap between the two groups on environmental attitudes (12, 21, 30, 32).

It is important for the horticulture industry to recognize the fact that all ethnicities do not have similar environmental attitudes due to many different factors. Since the horticulture industry employs people from many ethnic backgrounds, this finding may help in understanding differences between these groups.

*Place of residence.* Results indicated that the main portion of the sample group of students were from the city (88.5%), and a smaller portion (11.5%) resided on farms (Table 5). Students who lived in more rural areas scored 0.82 points higher on the environmental attitude survey compared to urban dwelling students (Table 5). These results are similar to past research findings that have indicated that students who live in more rural areas have a greater appreciation for nature and the outdoors and subsequently a better environmental disposition (7, 13).

Children are increasingly more likely to grow up in urbanized communities as more families move from rural to urban and suburban areas. In urban developments, children have fewer opportunities to interact with nature (29), which can impact environmental attitudes (7, 13). In the future, increasing numbers of employees within the horticulture industry may come from urban backgrounds, and with this background may come varying perceptions and attitudes on environmental issues.

*Age groups.* In contrast to other studies (6, 7, 10, 15, 32), age was found to be of no influence on environmental attitude scores of students participating in the school garden program (Table 5). Buttel (8) found similar results, reporting only a modest relationship between age and environmental dispositions and stating that other variables may be a better predictor of environmental concerns.

In conclusion, students involved in the outdoor activity of school gardening had more positive environmental attitudes after gardening regardless of the time spent, or number of activities completed, in the garden. In addition, demographic variables influenced results with female and Caucasian students, as well as students from rural areas, displaying more positive environmental attitudes after participation in the garden program compared to students from other groups. This information provides insight as to which populations might be targeted for more environmental education within the industry, and the populations that might be recruited for future positions. Since the children of today will be future industry professionals, it is important to continue efforts to educate them to make good environmental decisions.

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