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Research In Brief

Master Gardener–Led Lessons Increase Knowledge in Gardening and Environmental Science for Iowa Summer Camp Youth

Abstract

Gardening and nutrition lessons for children can affect knowledge, actions, and behaviors that support more healthful lifestyles. The objective of the study described in this article was to determine the effectiveness of a master gardener–led education program for youth at a week-long summer camp in Iowa. Garden knowledge was assessed via a pretest, a posttest, and a 6-month follow-up. Campers increased their garden knowledge after the week-long camp. In addition, a 6-month follow-up questionnaire was mailed to parents to obtain information about changes in participants' behaviors. More than 75% of parents noticed positive garden-related behavior changes in their children.

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Introduction

A popular healthful living initiative focuses on education of children through school and community gardens (Cater, Fox, & Fletcher, 2012; DeMarco, Relf, & McDaniel, 1999; Phelps, Hermann, Parker, & Denney, 2010; Skelly & Bradley, 2000). Through these lessons, children engage in experiential activities to learn life skills, such as appreciating nature, acting responsibly, and growing and preparing food. The primary objectives of these gardening programs are to increase exposure to fruits and vegetables, to improve preferences for fruits and vegetables (Heim, Stang, & Ireland, 2009; Morris, Neustadter, & Zidenberg-Cherr, 2001; Morris & Zidenberg-Cherr, 2002), and, ultimately, to improve eating habits (McAleese & Rankin, 2007; Parmer, Salisbury-Glennon, Shannon, & Struempler, 2009). The overall goal of the project described herein was to immerse youth in experiential learning activities that explored the origins of food and provided access to healthful food choices.

Master gardeners' support and instruction have been essential components of classroom garden projects (Alexander, North, & Hendren, 1995; Cater et al., 2012). As garden experts, master gardeners are trained to teach youth in community gardens and to supplement instruction in school gardens. Although master

gardeners are valued as experts in school gardens, few studies have measured their impact as educators of youth. The primary objective of the research reported here was to determine the knowledge and awareness of youth in environmental science and general garden concepts after education delivered by master gardener volunteers.

Materials and Methods

Sampling Procedures

Study participants were children 9 to 17 years of age (n = 57) who voluntarily attended a week-long camp at the State 4-H Center in Madrid, Iowa. Thirty-nine children attended one of three camps in 2012, and 18 children attended one camp in 2013. Each day during the camp week, the campers received 2.5 hr of gardening and nutrition programming created by staff at Iowa State University. The program was offered in July 2012 to 9- to 17-year-old youths and again in July 2013 to 9- to 12-year-old youths. Data from preprogram, postprogram, and 6-month follow-up questionnaires were collected from youths who had obtained parental consent. Participants received a $25 incentive at the end of camp and a $25 incentive after completing the 6-month follow-up questionnaire. Several additional youths attended and participated in the camp education without data collection due to lack of parental consent.

Lesson Setup

Although nutrition and culinary lessons also were taught and evaluated (Mabary-Olsen, Litchfield, Foster, Lanningham-Foster, & Campbell, 2015), the study reported here focused on garden education activities taught by master gardener volunteers. Two or three master gardener volunteers taught multiple activities for 50 min during a 2.5-hr block each morning for the 5 days of camp. Garden lessons were adapted from 4-H horticulture lessons available to master gardeners at Iowa State University. Lessons were modified slightly to match instructor experience. Garden concepts included garden planning; composting; garden pests; soil, seed, and plant physiology; and resource conservation.

Survey Instrument

The survey and lessons were pilot tested with a group of campers in June 2012 for the purpose of obtaining feedback. The questionnaire was modified after the pilot test to include "I don't know" as a possible answer and to divide one complex question into two questions. The Iowa State University Institutional Review Board (IRB) approved the survey instrument before it was administered to campers. To establish face and content validity, the survey instrument also was reviewed by gardening professionals and university staff who specialize in surveys administered to youth. Cronbach's alpha reliability tests were conducted on the preprogram, postprogram, and 6-month follow-up completed questionnaires, resulting in the values of 0.537, 0.661, and 0.748, respectively, denoting increasing reliability the more the survey instrument was used. The increasing reliability indicates that items represent a more cohesive concept over time. The survey instrument included two open-ended questions and 16 close-ended questions. Of the 16 close-ended questions, five were matching and 11 were multiple-choice. Seven of the close-ended questions related directly to environmental science concepts, eight to general garden knowledge, and one to familiarity with the master gardener program.

In 2012 and 2013, the survey was administered at the beginning of camp and the end of camp. In 2013 only, 6 months after camp ended, the camper survey instrument and a parental survey instrument were mailed to study participants and their parents. The parental survey consisted of 22 questions: five related to demographics, six related to gardening practices, and 11 related to observations of behavior change. The IRB approved the parental survey instrument prior to mailing. It was also reviewed by survey specialists and horticulture professionals for face and content validity prior to mailing.

Data Collection

The survey was administered by the same IRB-trained researcher immediately upon campers' arrival and again before they left camp. The participants were allowed as much time as needed to complete the survey. All campers took the survey simultaneously. Once collected, completed questionnaires were separated and randomly assigned unique identification numbers for coding and pairing pre- and postprogram questionnaire results and to protect participant identities. As mentioned, in 2013 only, 6 months after the camp ended, a follow-up questionnaire with the same set of questions was mailed to campers, along with a parental survey. Due to an 89% response rate (16 out of 18) for these items, no additional follow-up was necessary.

Data Analysis

Surveys were coded such that higher scores reflected more correct responses. All data were analyzed using SAS (version 9.3; SAS Institute, Cary, NC). A generalized linear mixed-effects model with a binomial response distribution was used for the analysis. A random effect for students was included in the model to account for the correlation of test scores within each student. After this model was applied, contrasts were used to answer specific questions. *P*-values were adjusted through the use of Tukey's adjustment for type I error inflation that occurs from multiple testing. Parental surveys were analyzed using descriptive statistics.

Results

Students answered more questions correctly after the gardening program was administered, suggesting an overall increase in their knowledge of plants, gardening, and environmental science (Table 1). The one exception was for the question "What information is always on the seed packet?" Comparing the 6-month follow-up questionnaire (n = 16) to the preprogram questionnaire (n = 57), the scores also increased on every question, although not all increases were statistically significant.

Table 1.

Proportions of Correct Answers for Survey Questions Before and After a Garden Education Program for Youth in Central Iowa

Question	Pretest proportion (n = 57)	Posttest proportion (n = 57)	6-month follow-up proportion (n = 16)
What is a Master Gardener?	0.40[z]	0.67	0.73
Where is the best place for a vegetable garden?	0.56	0.58	0.86
Why is plant spacing important?	0.58	0.65	0.73

What are the following tools?	0.74	0.82	0.85
What is soil pH and why is it important?	0.25[z, y]	0.53	0.66
What information is always on the seed packet?	0.06	0.05	1.00[w]
Which value place is N, P, and K on a fertilizer label?	0.23	0.34	0.35
What are the three components of soil texture?	0.17	0.26	0.33
What can and cannot be added to compost piles?	0.64[z]	0.77	0.73
Which is the most important reason for thinning?	0.36[z]	0.60	0.66
Why is it important to remove weeds?	0.74	0.86	0.93
What is vermicomposting?	0.28[z, y]	0.56	0.73
Which USDA hardiness zone is Iowa located in and when is that important?	0.03[z, y]	0.15	0.33
What are some wasteful watering practices?	0.23	0.32	0.40
What are the names of the following bugs?	0.37[y]	0.40[x]	0.94
Which of the bugs are good or bad?	0.66[z, y]	0.81	0.86

[z]Pretest vs. posttest comparison ($p \leq .05$) significance. [y]Pretest vs. 6-month follow-up comparison ($p \leq .05$) significance. [x]Posttest vs. 6-month follow-up comparison ($p \leq .05$) significance. [w]All campers answered correctly; no test for significance.

The comparison of the preprogram and postprogram questionnaires revealed seven significant *p*-values out of 16 questions (Table 1). Significant gains in correct responses included those related to definition of a master gardener, soil pH, composting, thinning, vermicomposting, hardiness zones, and good and bad bugs. Also, the comparison of the preprogram questionnaires and the 6-month follow-up questionnaires suggested that campers were more likely to correctly answer questions about soil pH, vermicomposting, hardiness zones, bug identification, and good and bad bugs. Other questions showed score increases but were not statistically significant. Comparing the postprogram questionnaires to the 6-month follow-up questionnaires, campers from 2013 further improved their knowledge about seed packets and bug identification.

Responses from the 6-month follow-up parental questionnaire (n = 16) suggest that parents generally agreed that a gardening experience elicited positive behaviors (Table 2). At least 75% of parents noticed that their children exhibited more interest in gardening or landscaping, greater interest in planting vegetables, increased consumption of fruits and vegetables, consumption of a wider variety of fruits and vegetables, a greater respect for plants and nature, and more interest in planting a wider range of vegetable varieties. Parents noted little to no change in their children's concerns about getting dirty or interest in bugs. All parents also reported that they discussed garden topics with their children after the intervention week (data not presented).

Table 2.

Percentages of Parents Who Agree or Strongly Agree with Statements About Their Children's Behavior After a Garden Education Program for Youth in Central Iowa (n = 16)

Parental observation[a]	Percentage
My child is more interested in gardening or landscaping.	93.8%
My child has a greater interest in planting vegetables.	81.3%
My child is eating more fruits and vegetables.	75.0%
My child is eating a greater variety of fruits and vegetables.	75.0%
My child has developed a greater respect for plants and nature.	75.0%
My child wants to plant a wider range of vegetable varieties.	75.0%
My child has fewer concerns about getting dirty/grubby.	31.3%
My child is more interested in bugs.	18.8%

[a]A 5-point Likert scale was used for response choices.

The majority of parental questionnaires were completed by females (88%) and parents between the ages of 41 and 50 (50%). A plurality of the respondents (38%) had a household income of greater than $65,000, and a majority (81%) maintained a vegetable garden and landscape. All parents had gardening experience, with 87% reporting some (50%) to a lot (37%) of gardening experience. Campers (n = 57) reported residing in 37 hometowns; 33% were from rural areas (<2,500 population), 51% were from other nonurban areas (2,500–49,999); and 16% were from urban areas (>50,000) (U.S. Census Bureau, 2010).

Discussion and Conclusion

Master gardener–led garden instruction has been shown to be a beneficial experience for youths and adult volunteers (Alexander et al., 1995). In the study reported here, significant improvements in scores from pretest to posttest demonstrate that hands-on garden education improved garden knowledge. For those questions that showed no significant increase, eight out of nine trended upward. Additional significant differences may have been found with a larger sample size. Although the participants lost some knowledge over time, they retained much of what they learned. These findings are important because gardening education helps children (a) develop and strengthen necessary life skills (Kim, Park, & Son, 2014; Robinson & Zajicek, 2005; Waliczek, Bradley, & Zajicek, 2001), including gardening itself (Lohr & Pearson-Mims, 2005), and (b) develop a greater appreciation for science (Klemmer, Waliczek, & Zajicek, 2005; Smith & Motsenbocker, 2005).

Behavioral changes of youth participants, as observed and reported by their parents, included showing a greater interest in gardening and landscaping and having a greater respect for plants and nature as a whole. More specifically, parents noted that their children exhibited greater interest in planting and consuming more vegetables and planting a wider range of vegetables. The majority of parents in the study had considerable garden experience, maintained a vegetable garden and landscape, and frequently engaged in discussions about gardening with their children. Therefore, the youths in the study might have had multiple opportunities to engage in gardening activities at home.

The majority of children in the study were Caucasian, from homes with a household income greater than $65,000 and from families with previous gardening experience. Eighty-four percent of respondents were from towns smaller than 50,000, distributed across 21 counties in Iowa and one county in Nebraska. These demographics contrast with Davis, Ventura, Cook, Gyllenhammer, & Gatto (2011), who studied low-income, inner-city Latino children with little to no garden experience. It is to be expected that those with little garden experience would demonstrate changes in behavior after participating in garden education for 12 weeks. In the study discussed here, after just 1 week, we saw increases in knowledge and changes in behavior in youths with greater prior exposure to gardening. Despite participants' prior exposure to gardening, master gardener educators positively affected their knowledge and behavior.

Our study did not address changes in preferences, actions, or behaviors with respect to fruit and vegetable consumption. However, a parallel study (Mabary-Olsen et al., 2015) showed an increase in fruit and vegetable preferences by youth. Responses on the parental follow-up questionnaire in our study corroborated these results. The garden program likely contributed to this outcome.

From the study, it is apparent that master gardeners are effective teachers of youth. Master gardeners have long been valued as youth gardening educators in the classroom (DeMarco, Relf, & McDaniel, 1998). Variations in the lesson delivery were likely because lesson delivery varies from person to person. The teacher variable was minimized by having the same master gardeners teach the same lessons every day.

The 6-month follow-up questionnaire data (Table 1) calls to question the use of questionnaires without a proctor. The results for the seed packet and bug identification questions showed tremendous increases, from 0.05 to 1.00, and 0.40 to 0.94, respectively, from the postprogram questionnaire to the 6-month follow-up. These results could indicate that the children either took the initiative to look up answers or received help from an outside source. These possibilities imply that the children were engaged in the topic and wanted to

do well. However, for future studies, conducting a proctored follow-up questionnaire would be advisable.

Future studies should look at youth preferences for engagement in various garden activities and interests. How master gardener–led garden education directly influences long-term knowledge gain and fruit and vegetable consumption should be investigated. Also, it would be interesting to characterize the positive effects of intergenerational gardening interaction or activities (Krasny & Doyle, 2002) on the development of life skills of youths (Brill, 2011; Cochran, Catchpole, Arnett, & Ferrari, 2010).

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