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An Inter-professional Framework for Quality Improvement of School Gardening Programming

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Abstract

Background: School gardens are exemplary learning environments for providing hands-on nutrition and health education, promoting time outdoors, and developing collaborative skills. However, randomized controlled trials of school gardening programming to provide evidence of the robust benefits to child health can be time consuming and costly. We therefore sought to develop an inter-professional framework for continuous quality improvement (QI) of school gardening programming to improve health outcomes while limiting program implementation and evaluation costs.
Methods: This QI cohort study took place in two elementary schools and served 75 students in Palm Beach County, Florida during the 2019-2020 academic year. Students participating in a non-profit sponsored after-school gardening club completed investigator-designed pre- and post-assessments from which unique lessons pertaining to health and food literacy were developed to target knowledge deficits. We present a lesson pertaining to harvesting, preparing, and sampling foods as an exemplar for this framework. Paired and independent samples t-tests and chi-squared tests were used to compare student learning outcomes.
Results: Twenty-seven students (36%) participated in the harvest lesson, which led to marginal improvement in overall food literacy compared to non-participants (X^2=3.6, P=0.057).Considering cumulative garden club activities, club participation improved students' likelihood to individually prepare fresh fruits and vegetables (P=0.002).
Conclusion: This project provides an important framework for inter-professional collaboration to engage in QI of small-scale school gardening programs. Future work should focus on the creation and implementation of further lessons to develop a full, individualized, health-oriented curriculum that optimizes learning outcomes, and thereby health, for elementary-aged children.

Keywords: School garden, Food literacy, Health literacy, Gardening, Quality improvement

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1. Introduction

In the United States, approximately 1 in 5 school-aged children is obese with low income communities disproportionately affected (1).The epidemic of obesity has resulted in the childhood emergence of medical conditions, including type 2 diabetes mellitus, hypertension, dyslipidemia, and obstructive sleep apnea, which were previously considered adult-limited conditions (2). Positive energy balance from excessive caloric intake, combined with increased sedentary activity, is presently the most common cause of childhood obesity (2). Promotion of a balanced diet stands to combat excessive caloric intake and promote healthy cardiovascular outcomes (3).

School gardens represent a unique opportunity to influence childhood health outcomes through promoting both healthful behaviors and time spent outdoors in natural spaces. The school garden setting provides an important and early exposure to fresh fruits, vegetables, and herbs in addition to hands-on nutrition education enabling for cultivation of an early appreciation for food. A study suggested that strategies to increase childhood fruit and vegetable consumption include increasing food literacy, and increasing the availability, safety, and convenience of fruits and vegetables,(4) two aspects at which school gardening programs are exemplary. A systematic review suggested that hands-on education in the forms of gardening or cooking improves childhood vegetable consumption more than simple nutrition

education (5). Further, numerous studies demonstrated improved health literacy, health outcomes, group interconnectedness, and leadership skills in children who participate in school gardens (6-8). An increased amount of time spent outdoors may benefit children on several emotional and psychosocial levels, including improved mental well-being and overall health and cognitive development (9). Natural play spaces, such as gardens, provide not only an opportunity for increased physical activity but can also encourage diverse types of interaction and play (10).

Overall, school gardens are important learning environments, which cultivate exploration, curiosity and intrigue in addition to stimulating the refinement of many important psychosocial, academic and health-oriented behaviors. School gardening activities are essential to deliver in the childhood years given that childhood eating habits moderately persist into adulthood and therefore can affect health outcomes later in life (11). The majority of studies pertaining to school garden programs to date are randomized controlled trials aimed at detailing program efficacy and outcomes (12-14). However, data and approaches pertaining to quality improvement of small-scale, local programs, to ensure the effective allocation of limited funding and resources, are lacking. We therefore chose to undertake an inter-professional quality improvement initiative of a small-scale gardening program with the aims of improving the health and food literacy, prosocial qualities, and time outdoors of participating elementary-aged children.

2. Methods

To optimize the health outcomes resulting from school garden participation, a partnership was developed between local health-professional students, elementary educators, and the sponsoring non-profit organization in the form of a prospective QI cohort project. Our framework for inter-professional evaluation and garden club optimization is depicted in Figure 1. The goal of such a framework was to best aid in the allocation of limited funding and resources to optimize child health outcomes through school garden programming. Students from two local elementary schools, each serving predominantly low-income children, electing to take part in the non-profit sponsored after-school garden club were included. All students completed a pre-survey at the beginning of their garden club activities and an identical post-survey at the end of the academic year (2019-2020 school year). Each garden club was overseen and coordinated by a point teacher on a weekly or biweekly basis for a number of hour-long after-school sessions over the course of the academic year. While activities historically had been informal and individualized by educators at participating schools, this project aimed to develop, pilot, and systematically assess new lessons tailored to the weaknesses of participating students.

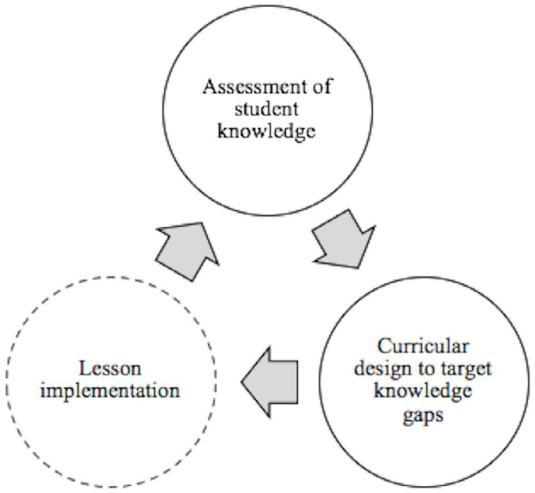

Figure 1: The figure shows an inter-professional framework for optimization of garden club programming. Activities indicated by the dashed line are the responsibility of classroom teachers. Activities indicated by the solid line are the responsibilities of the health-professional (medical, nursing) student. All activities are overseen and coordinated by the sponsoring non-profit organization.

The pre-survey included 18 items regarding food literacy, diet habits, prosocial behaviors, science interest, and time spent outdoors. One survey item pertained to diet habits and probed students to indicate how often they consume 19 fruit and vegetable items (daily, weekly, monthly or never). Questions were adapted from published sources and tailored to our population and goal outcomes (12, 15). The pre-survey was administered at a single garden club session at each school and results were tabulated to inform curricular development for the remainder of the academic year. The post-survey, which consisted of identical items to the pre-survey, was subsequently delivered online due to school closures during the COVID-19 pandemic. Survey items were scored between 0 and 4. Average scores were calculated for each survey item and composite scores were calculated for food literacy and prosocial qualities with higher scores indicating better performance.

Data are presented as mean ± standard deviation. Statistical tests were computed in SPSS Version 26 (IBM

SPSS Inc, Chicago, IL). Paired samples t-tests were utilized to compare longitudinal student improvement. Independent samples t-tests were applied to compare continuous variables representative of learning outcomes for groups of students (lesson participants vs. non-participants). Chi-square or Fisher exact tests were utilized for comparison of categorical variables as appropriate. For all statistical analyses, an alpha of less than 0.05 was considered statistically significant.

Herein, we present the design and outcomes of a harvest-style lesson, in which students collected, washed, prepared, and sampled food items from the garden, as an exemplar of this inter-professional quality improvement framework. Students enjoyed their food items in a buffet-style sampling, voted on their favorite foods tasted during the activity, and were invited to write a haiku about their experiences of gardening and tasting.

This study was deemed exempt from review by the Institutional Review Board at the University of Miami given that it did not meet the federal definition of research pursuant to 45 CFR 46. Regardless, parents of all students signed written permission forms for their child to participate in the gardening club and associated QI activities.

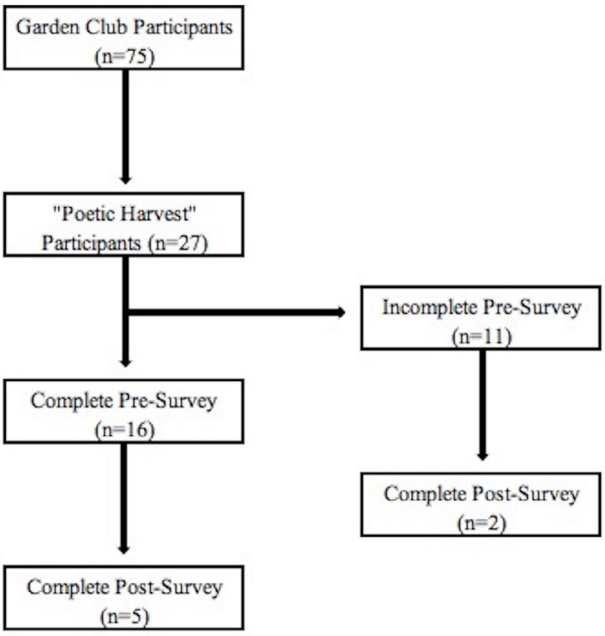

Figure 2: The figure consists of a flow chart depicting evaluations completed by garden club participants over the academic year. While 27 students participated in the "Poetic Harvest" lesson, not all students completed pre (beginning of academic year) and post (end of academic year) evaluations.

3. Results

Seventy-five students (77% third grade, 61% female) across two elementary schools participated in our non-profit sponsored after-school garden club activities. Among them, 27 third grade students participated in the exemplar "Poetic Harvest" lesson. Given that attendance varies between garden club sessions, not all students participated in associated pre and post evaluations. Student participation in evaluative components is depicted in Figure 2.

During the harvest lesson, the following foods were gathered from the school garden, washed and displayed for tasting: chives, lettuce, lavender, mint, radish, beets, green pepper, dill, kale, parsley, cilantro, and banana pepper. Herbs were incorporated into dishes prepared by parent volunteers, including corn salsa, kale salad with mandarin and almonds, and fresh pesto. Each student was allowed to place three votes toward their favorite food items. Students placed a total of 77 votes toward their favorite items from the tasting, with beets (n=11, 14%) and lettuce (n=11, 14%) receiving the most votes. Though beets were harvested from the garden, the ones served to students were pre-cooked by a parent volunteer. Six haikus (22% of students) were collected from students with only two of the six poems written utilizing the correct number of syllables per line.

"Corn salsa is sweet
It looks like a veggie mud
My god, it's super!"

"I'm a strawberry
I'm healthy and good for you
You like to eat me."

Among students who completed post-surveys, those who participated in the harvest (n=7) did not differ from non-participants (n=17) on any specific food literacy measure. Post-surveys showed no difference in the consumption of spinach or lettuce, foods sampled during the harvest lesson, in participants compared to non-participants. Among students who completed both pre- and post-surveys (n=13), students who participated in the harvest lesson (n=5) were marginally more likely to improve their overall food literacy over the course of garden club participation compared to non-participants (X^2=3.6, P=0.057).

Other lessons implemented throughout the academic year involved locating garden items and tools in a bingo game, learning about the five food groups using My

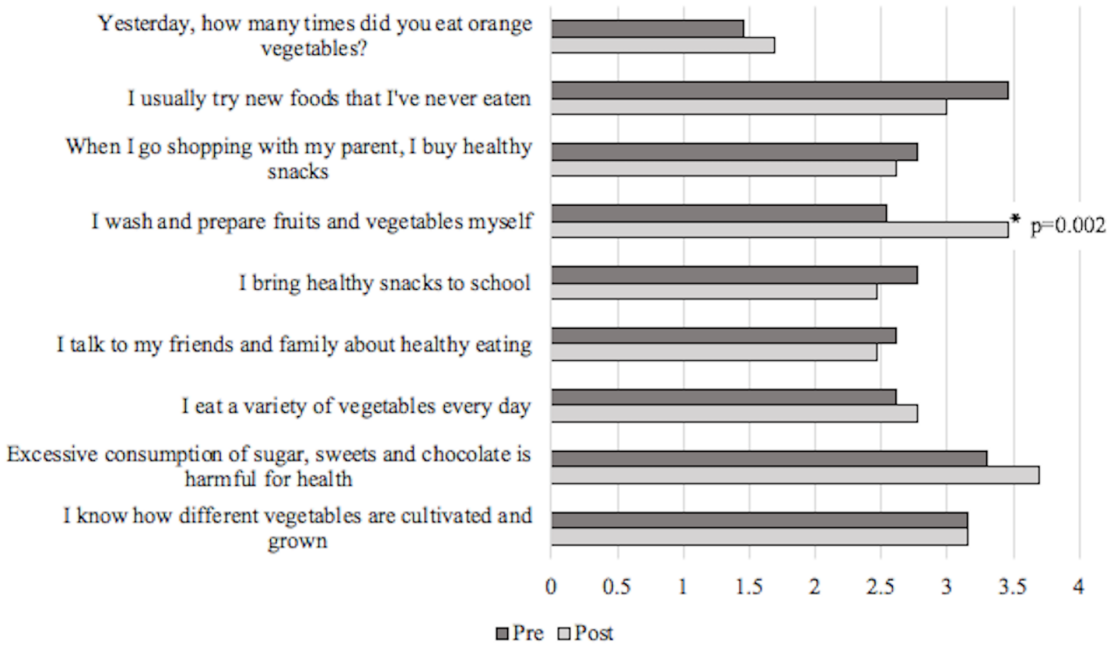

Figure 3: The figure shows food literacy assessment outcomes of thirteen students before and after participation in garden club activities. With the exception of orange vegetables, items are scored between 0 and 4 with 0 corresponding to "never" or "strongly disagree" and 4 corresponding to "always" or "strongly agree." Statistically significant differences (P<0.05) are marked with an *.

Plate, and creatively expressing feelings toward the garden in an acrostic poem. To gauge the effects of garden club participation, longitudinal statistical comparisons were undertaken for 13 students with complete pre- and post-survey data. Composite food literacy scores improved for 9/13 (69%) students. Mean scores increased from 25.8±6.1 to 27.0±4.6 though this change was not statistically significant (P=0.34). Regarding the individual food literacy components, students were significantly more likely to independently prepare fresh fruits or vegetables on post-assessment (mean 2.54 vs. 3.46, P=0.002). No change was noted in any other individual component of food literacy assessment (Figure 3). There was no change in composite prosocial skills, science interest, or time spent outdoors over the course of the evaluation period.

4. Discussion

This quality improvement initiative highlights the challenges of systematic implementation and evaluation of small-scale school gardening activities and the necessity for an inter-professional collaboration to support optimal learning outcomes. The input and expertise of medical professionals, such as medical students, elementary educators, and experienced gardeners are equally necessary to develop and implement lessons focused on child health and wellness. To ensure the sustainability of small-scale programs, it is essential for lessons to focus on areas in which students are not already competent.

Data from our baseline food literacy assessments indicated that students were already quite knowledgeable about the negative health impacts of sugar, sweets, and chocolate; therefore, resources instead were devoted to the instruction of other topics with which students were less familiar. In particular, students infrequently talked to their family about healthy eating or prepared fresh fruits and vegetables independently. Lessons, such as our harvest lesson discussed here, were developed to target these items. Longitudinal comparison of data from pre- and post-surveys demonstrated significant improvement in student ability and willingness to independently prepare fresh fruits and vegetables. Child participation in meal preparation has been previously associated with increased intake of vegetables and other healthy food items (16). Autonomy of food preparation has also emerged as a main theme in qualitative studies of childhood food literacy (17). Our program aimed to develop lessons, which sparked enjoyment through offering novel gardening experiences that students felt compelled to share with family members. Prior studies have shown that childhood gardening interventions lead to increased availability of fruits and vegetables in the home (18).

We discuss here only one lesson as an example of our inter-professional framework for curricular development, implementation, and evaluation. Participation in this

lesson, including taste-testing of garden items, improved the overall food literacy of participants and, surprisingly, beets and lettuce surfaced as favorite foods among participating third grade students. Prior studies reported that children begin rejecting new food offerings as early as pre-school, though repeated offerings can modify food preferences (19). Our program strives to overcome the rejection of new foods through repeated and early exposure during the elementary school years. Moreover, students may be more inclined to try foods that they view as popular among their peers (20). To this end, our harvest lesson involved "voting" for favorite food options, and took place in a buffet-style setting, which allowed students to build their plate of foods and subsequently enjoy their samples with friends.

Some limitations to this work include our small sample size and the lack of continuity in pre- and post-survey participation. Outcomes from pre- and post-surveys may have also been impacted by varying survey distribution methods (in-school completion of pre-survey compared to online completion of post-survey). Further, the results from this QI initiative are not meant to inform generalizable knowledge and are pertinent only to our specific program and population.

While this work mainly informs the direction of our non-profit sponsored garden club for future years, we wish to highlight the framework for garden club optimization so that other small-scale programs can adopt and individualize their own lessons and target outcomes. Within our program, continued efforts will be placed upon developing unique lessons that improve childhood health and food literacy. Once each lesson has a distinct evaluable outcome, lessons can be strategically implemented to target specific subject areas. None of our lessons led to quantifiable improvement in prosocial qualities, so activities particularly focused around leadership and collaboration will be implemented in the future to continually nurture these skills.

5. Conclusion

While the number of elementary school gardens has grown substantially in recent years, disparities remain in their location and the demographic of children served. The students who participated in our program represent a wide range of racial, ethnic, and income backgrounds and effectively helped to fill this gap. Introduction to gardening and consequently healthy food items is essential for this vulnerable population who may be predisposed to poorer health outcomes than their more affluent peers. Success of these endeavors will stem largely from the partnership established between healthcare professionals, educators, and gardening experts. Collaborative implementation has been, and will continue to be, integral to continued pursuit of this work and thereby enrichment of child health outcomes through school gardening programming.

Ethical Approval: This study was deemed exempt from review by the Institutional Review Board at the University of Miami given that it did not meet the federal definition of research pursuant to 45 CFR 46. Regardless, parents of all students signed written permission forms for their child to participate in the gardening club and associated QI activities.

Conflict of Interests: none declared.

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