SUSTAINABILITY VIA ACTIVE GARDEN EDUCATION (SAGE): THE PROCESS OF INCORPORATING WATERING INTO STRUCTURED PRESCHOOL CURRICULUM

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Abstract

School gardens provide rich outdoor learning opportunities for young children. Practical considerations about garden maintenance, in particular, watering, can impeed success. This manuscript chronicles the development of garden maintenance strategies in Sustainability via Active Garden Education (SAGE). SAGE installed raised-bed gardens and provided a complete curriculum focused on increasing children's active time and improving healthy eating habits while fostering garden stewardship. SAGE was implemented by trained research personnel in four early care and education (ECE) facilities in Houston, Texas (SAGE 1, Summer, 2013), one ECE facility in Phoenix, Arizona (SAGE 2, Spring, 2017), and 24 ECE facilities in Phoenix, Arizona (SAGE 3, Autumn 2017- Spring 2020). ECE facilities offered structured education to preschool-aged children (3-5 years) from low-income families (~70% Hispanic/Latino). The SAGE curriculum was implemented weekly or twice weekly in 1-hour, continuous sessions that included songs, games, and interactive learning activities involving garden maintenance, i.e., watering the garden. In SAGE 1, watering was completed once a week with high observed fidelity (92.9%). Exit interviews demonstrated ongoing garden maintenance after the formal implementation of SAGE was over. SAGE 2 was adapted to increase watering to twice a week, every time the curriculum was implemented with high fidelity (93.8%). Additional water usage for watering the garden twice a week incurred $7.23USD annually in 2017. SAGE 3 was completed at 24 ECE facilities. Gardens cost approximately $251USD (in 2018) in supplies and were easy to install. Watering fidelity was again high (91.4%). The most common reason for not watering was rain. Gardens were watered more consistently when teachers were leading the session (94.7%) compared to when SAGE led the session (88.9%; $p < .048$). The SAGE studies demonstrated that with modest resources, minimal training and a structured curriculum, preschools can achieve regular garden maintenance, offering unparalleled outdoor learning opportunities for teachers and young children alike.

Keywords: *preschool children, gardens, early care and education, resource-limited settings, Hispanic or Latino, physical activity, healthy diet*

1. INTRODUCTION

School gardens in early care and education (ECE, preschool) facilities have become a popular strategy for promoting outdoor learning opportunities [1]. School gardens provide rich learning opportunities about biology, ecology, health and conservation, and can provide lifelong skills for under resourced communities [2]. However, few studies have developed, documented and investigated practical considerations about maintaining school gardens [3, 4]. Gardens require regular maintenance, such as watering, training and support, and allocation of resources [5].

A possible solution to ensuring consistent garden maintenance is to leverage routine tasks (e.g., watering) as learning opportunities for young children [6]. Scheduling watering into the weekly curriculum can have many benefits, such as helping children understand the importance of routines and consistency, learning about teamwork and collaboration, increasing knowledge about plants, food and science, and promoting outdoor active time—important for early child fitness and locomotor development [7-10].

Co-developed with community partners, ECE facility directors, teachers and parents, Sustainability via Active Garden Education (SAGE) is a presented in a series of three studies based in ECE facilities that changed the environment and provided a curriculum to meet US health and education standards [5, 11]. This manuscript describes the garden watering activities and investigates whether there is any difference when outside experts or teachers led water activities in ECE gardens in SAGE.

2. MATERIALS AND METHODS

2.1. Materials

2.1.1. SAGE Overview

SAGE was co-developed with preschool teachers and directors as well as interested community partners and parents using the plant life cycle as a metaphor for human development as a strategy to respond to pressing community concerns about the burden of cardiometabolic diseases [11, 13]. SAGE included an onsite ECE facility garden (see below), a 12 session curriculum, in classroom teacher training and support, and free online materials in English and Spanish available [14]. The complete SAGE curriculum can be found online (https://sites.google.com/asu.edu/sageasu/home). SAGE was implemented by trained research personnel in four ECE facilities in Houston, Texas (SAGE 1, Summer, 2013), one ECE facility in Phoenix, Arizona (SAGE 2, Spring, 2017) [15], and 24 ECE facilities in Phoenix, Arizona (SAGE 3, Autumn 2017- Spring 2020) [12]. ECE facilities were licensed and offered full or half day structured education to preschool aged children (3-5 years) from low-income, underserved families (~70% Hispanic/Latino).

2.1.2. SAGE Gardens

SAGE programming included the installation of a garden designed to enhance young children's engagement [6, 11]. SAGE gardens were above ground and built from cinderblocks (8in X 8in X 16in, ~ 20.3cm X ~ 20.3cm X ~ 40.6cm) with final dimensions of 4' X 6' (~1.2m X ~1.8m). Several gardens contained a trellis to help plants grow and all were filled with soil. Garden maintenance, including planting seeds and seedlings, watering and weeding was conducted during SAGE sessions as curriculum activities [12].

2.1.3. SAGE Fidelity Checklist

The SAGE fidelity checklist was a one-page assessment of delivery of curriculum components (e.g., active games, songs, garden maintenance) [12]. SAGE fidelity checklists were completed by a non-implementing SAGE research team member during each SAGE session. Curriculum components were checked off when completed using paper and pencil. Unique fidelity checklists were designed to match each SAGE session. Fidelity checklists also recorded the date, start and stop time, outdoor temperature, whether it was raining, whether activities were completed outdoors or indoors, and whether SAGE team members or classroom teachers were leading the session.

2.1.3. Exit interviews

Exit interviews were conducted with the four teachers participating in SAGE 1 approximately 2 weeks following completion of active SAGE implementation. Exit interviews followed a semi-structured interviewer guide to understand success and challenges of SAGE curriculum implementation including garden maintenance. Interviews were recorded, transcribed and searched for evidence of ongoing garden maintenance [5].

2.1.4. Costs incurred

In SAGE 2, the ECE provided for their water bill from the months before SAGE started through the months that SAGE was implemented. These were compared, and the difference computed to account for extra water attributable to the garden. In SAGE 3, receipts for garden materials were tabulated to compute the total price for garden materials.

2.2. Methods

The SAGE curriculum was implemented in participating centers twice a week in 1-hour, continuous sessions that included songs, games, and interactive learning activities involving garden maintenance and fruit and vegetable taste tests [15]. Trained SAGE staff led all the SAGE sessions in SAGE 1 with teachers learning how to complete the sessions alongside SAGE staff over a six-week period. In SAGE 2, SAGE staff first led the full curriculum over a six-week period, and teachers led the first half of the curriculum repeated a second time over a three week period. In SAGE 3, SAGE staff led the full curriculum over a six-week period, and then teachers led the curriculum a second time over a second six week period using the "see one, do one, teach one" method [12]. Garden maintenance was included in approximately 50% of the SAGE 1 sessions, and in every session in SAGE 2 and SAGE 3. Garden maintenance was scripted into the curriculum whereby the curriculum implementer would organize the children and other adults to move outdoors to water the garden and sing the "Seedling Song" while watering (see 2.1.1., above, for link to the complete song lyrics and tune). ECE facilities were provided small, child-sized plastic watering cans to carry water from the source to the garden in SAGE 2 and 3.

3. RESULTS

3.1 SAGE 1

In SAGE 1, garden watering sessions were scheduled to occur once per week at four ECE facilities. Fidelity checklist observations were available from a total of 14 sessions which included garden watering. Observations that were missed were typically because the session had been missed at the site on that date. Six sessions contained explicit garden maintenance or watering opportunities, although the most completed were 5 (Table 1). When the SAGE team was able to complete a session at the ECE facility, watering was generally completed (13/14 sessions, 92.9%).

	Sessions where watering was completed	Sessions observed	Sessions not observed
Site 1	5	5	1
Site 2	4	4	2
Site 3	1	2	4
Site 4	3	3	3

Table 1. Summary of structured watering curriculum sessions completed in SAGE 1

SAGE 1 exit interviews were completed with teachers from participating ECE sites. Teachers stated that the SAGE gardens were ongoing after the SAGE was completed. For example, Site 1 explained that,

> "[The children] will all get their little container and … then they go water all the plants before we go in. It is hot out there, so they know—especially when it hasn't rained. They know the difference from when it rains and is wet that it is okay. If it hasn't rained, the plants need water, so they are helping keep them up."

Site 2 remarked that "[The children] still go over to the garden, and there is another cucumber. They are screaming, 'There is another one! There is another one! It is getting bigger!'" Site 3 mentioned that they

allocated one day a week to garden maintenance: "Well if you come on Monday, and we take care of the garden, and we talk about what's growing in the garden." Site 4 noted that "[the children] still go over there and look at it and look for some plants to see if there's actually fruit or vegetable growing."

3.2 SAGE 2

In SAGE 2, two classrooms completed a total of 16 sessions. Fidelity checklist observations were available for all 16 sessions and demonstrated that watering was completed at 15/16 (93.75%) for both classrooms. On the day that the watering was not completed, it was raining, and children remained indoors to complete the SAGE curriculum. Additional water usage for watering the garden twice a week incurred $7.23USD annually in 2017.

3.3 SAGE 3

SAGE 3 was completed at 24 ECE facilities. Gardens cost approximately $251USD (in 2018) in installation supplies, including cinder blocks, soil, mulch, a shovel, a hose, a hose nozzle, 2 moving boxes, and the delivery fee. Assembly took 2 SAGE personnel approximately one hour to complete.

An average of 11 sessions were completed per site, ranging from 8 – 23 (M = 17, SD = 4.5, Median = 16); however, the last 4 ECE facilities received fewer sessions, in part, owing to pandemic closures. Excluding these four increased the range from 16-23 sessions (M = 18, SD = 3.8, median = 20). On average, 2 SAGE (M = 1.6, SD = .6) and 2 ECE personnel (teachers and teachers' aids; M = 2.2, SD = .7) and 17 (SD = 3.9) pre-schoolers attended sessions.

Garden maintenance/watering data were complete from 406 sessions, with watering completed at 371 (91.4%). The SAGE team led more sessions (235, 57.9%), compared to teachers 171 (42.1%). Reasons cited on the fidelity checklist for not watering included garden had already been watered or it had just rained (n = 18), no equipment access (e.g., watering can/hose not available, n= 6), safety concerns (n = 2), child issues (i.e., misbehavior, injury, n = 2), garden vandalism (n = 2), or no reason was documented (n = 5). However, gardens were generally watered more consistently when teachers were leading the session (94.7%) compared to when SAGE led the session (88.9%), $X^2(1) = 4.228$, $p < .048$, phi = .102.

4. DISCUSSION

This manuscript chronicled the consistency of watering in preschool gardens in three SAGE studies in two American cities and investigated whether consistency varied by implementer type (SAGE personnel or classroom teachers). In SAGE 1, we demonstrated proof of concept, but relocating the SAGE headquarters from Houston, a subtropical climate, to the dryer climate of Phoenix meant more frequent and consistent watering would be needed. SAGE 2 showed more frequent and improved garden maintenance implementation, and SAGE 3 showed very high garden maintenance. Surprisingly, in SAGE 3, when given appropriate training and opportunities, teachers demonstrated higher rates of garden maintenance (watering) than did the SAGE team, perhaps reflecting knowledge, pride and a sense of ownership in their gardens [5].

Preschool gardens offer a relatively inexpensive opportunity for engaging with nature, increasing physically active time, learning about food and science, and allowing children to experience the outdoors in a supervised and safe setting [2]. The SAGE studies demonstrated that with training and support, teachers can become enthusiastic stewards of the garden and overcome a common barrier—consistent watering—to maintaining school gardens, even in a desert climate. Although waiting several weeks or months for seed to generate edible produce can seem daunting, making watering the garden part of a regular class routine, combined with songs and garden exploration, makes watering a highly anticipated and joyous time for young gardeners.

In SAGE 3, we were able to document reasons observed for not watering, which were most commonly due to rainfall or the garden already having enough water. SAGE 3 occurred in Phoenix, AZ, referred to as "the Valley of the Sun," because of its desert climate. Unpublished anecdotal reports from teachers from participating ECE facilities often discussed the garden being one of the most popular components of SAGE, and perhaps this enthusiasm led to additional "garden maintenance" on non-SAGE days.

Including watering as a regular curriculum component allows children to observe how different weather conditions can affect garden water needs, which may in turn increase understanding of nature, the environment and climate changes [9, 16]. It was troubling to learn that several ECE sites had to avoid garden maintenance owing to safety concerns, child issues, or vandalism. However, these were about 1% of the total possible watering occasions, making watering the school garden seem like a relatively low risk, high reward strategy for ECE facilities to consider.

Limitations of these studies include implementation and measurement inconsistencies, particularly in earlier SAGE studies, likely attributable to site scheduling challenges, SAGE staffing relying on part-time student schedules, and miscommunication. Strengths of these studies include a clear plan of co-development, relying on the combined expertise and experience of scientists and school partners, and detailed data about garden build and maintenance costs.

5. CONCLUSIONS

The SAGE studies demonstrated that with modest resources, minimal training and a structured curriculum, preschools can achieve regular garden maintenance. Routine watering was completed in over 91% of scheduled sessions, and when teachers led sessions, this number went up to nearly 95% of scheduled sessions. Watering sessions were most commonly missed for rain. Researchers and practitioners should include garden maintenance as a strategy to increase outdoor learning time for pre-schoolers.

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