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**AUSTIN**

# *school garden*



**REPORT**

# ACKNOWLEDGMENTS

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## SUPPORTED BY



# Austin School Garden Report

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## EXECUTIVE SUMMARY

**Background:** School gardens have led to health and academic benefits in children for decades, but despite their long history, there are no best practices, so there is inherent inequity on what schools and children experience these school garden benefits. This is a missed opportunity for health, diet, food systems, physical activity, and community engagement. School garden development typically relies on grassroots efforts among an individual school community. A lack of support and identification of best practices has led to high failure rates. The Austin School Garden Landscape Report aims to evaluate school garden use and barriers as reported by school staff and administrators at 109 public schools across 8 independent school districts in the Austin, Texas metropolitan area. The responding schools represent schools with a diverse age range, size, socioeconomic status, and level of community support in both urban and rural communities. Our goal with this report is to identify school garden practices that most strongly contribute to garden use and sustainability, helping us to develop recommendations on those practices for prioritization.

**Methods:** In partnership with the City of Austin's Office of Sustainability, we assembled a panel of experts, to develop surveys for teachers and administrators. The surveys were designed to assess the fundamental barriers and strategies relevant to school gardening programs implementation and success. We administered the surveys to school administrators and teachers who were involved in their school gardens. We also developed an observational evaluation tool for the physical garden space and trained research personnel completed these garden observations at schools across the Greater Austin area. Descriptive and frequency analyses were run to identify the top barriers reported and strategies implemented. Subsequently, we assembled a panel of 10 Austin area school garden experts to identify schools that have thriving school gardens based on physical characteristics, teacher, student and community usage, and integration into the school culture and curriculum. Regression analysis were run to assess which strategies/barriers predict thriving school garden programs.

**Results:** Surveys were completed by 523 school teachers (4.8 teachers completed the survey per school) and 174 administrators (1.6 per school) from 109 schools, where 70% were elementary schools and the majority served Hispanic students eligible for free and reduced-price lunch. The top three barriers reported by teachers to sustaining a school garden were: insufficient workdays/community involvement, inadequate administrator/district support, and inadequate funding. The top three barriers reported by administrators were: lack of funding, inadequate training/knowledge, and low teacher involvement. Approximately 23% of gardens (n=25 schools) were identified by our panel of experts as thriving. The following factors were linked to an increase in the odds of having a thriving garden, in order of greatest to lowest predictive barrier: adequate district/administrator support; increased student usage; provision of teacher training; available garden curriculum; an active garden committee; adequate and consistent funding; and community/non-profit support.

**Conclusion:** Certain practices have a strong and direct effect on the likelihood of a school garden to be used and last into the future. Administrative and district support is consistently related to sustaining successful school gardens and should be a starting benchmark when a school is considering implementing a garden. Additional funding, garden training, and garden curriculum are also related to garden success. In addition, garden leadership committees and partnerships with local community and non-profit organizations may help maintain and sustain school gardens.

## INTRODUCTION

### Health benefits of school gardens

In the U.S. and other industrialized countries, gardens are an increasingly common school-based, health-promotion strategy to increase fruits and vegetables (FV) intake. In the past decade, multiple studies have shown that school gardens can improve dietary intake and dietary-related psychosocial variables in children.<sup>1-4</sup> Wang and colleagues,<sup>5</sup> found that fourth and fifth grade students with the most exposure to a school-based nutrition and gardening intervention increased their preference and intake of FV by ½ cup a day. A randomized controlled trial showed that fourth-grade students who received 16 weeks of nutrition education alone or nutrition education plus gardening significantly improved FV intake, compared to controls, at 16 weeks; only the group of students exposed to gardening retained gains six months later.<sup>6, 7</sup> A 7-week community garden, nutrition, and cooking intervention called “Growing Healthy Kids,” targeting low-income Hispanic families, yielded significant increases in child FV intake and in-home FV availability, as well as significant reductions in body mass index (BMI); this was not a controlled study.<sup>8</sup> Our research team completed a 16-week randomized controlled trial, called LA Sprouts, to test the effects of an after-school gardening, nutrition, and cooking intervention with 375 primarily Hispanic third- to fifth-grade students on health outcomes. We were the first group to show that the intervention students, compared to controls, significantly improved dietary fiber and vegetable intake and reduced BMI and waist circumference.<sup>9</sup>



### Academic benefits of school gardens

Elementary school teachers show a high level of interest in school gardening programs, believing that they enhance student academic performance, language, arts, and healthful eating.<sup>10</sup> A few randomized controlled trials have shown that school gardening programs can increase science scores in third- to fifth-grade students.<sup>11, 12</sup> Other studies have found that school garden curricula improve environmental attitudes, interpersonal skills, and horticultural knowledge.<sup>13, 14</sup> Our initial evaluation of the TX Sprouts program, a school-based cluster randomized controlled gardening, nutrition, and cooking intervention<sup>15</sup> found that the TX Sprouts intervention significantly increased test scores of the students compared to the control group. We also found that children stayed on task in the classroom more often and were more physically active during garden days compared to non-garden days.

### Growth potential for school garden programs

An estimated 27% of U.S. public elementary schools have garden programs, but they are less common in communities with lower socioeconomic status.<sup>16</sup> A survey of 1,000+ Virginia teachers indicated that 88% of teachers had a high level of interest in using gardening in the classroom, but felt they needed supplemental training to integrate gardening into their teaching.<sup>17</sup> Most of the existing curricular resources are not evidence-based and focus more on math, science and horticultural knowledge than on nutrition and health. Teachers need training and education, as well as access to resources, to be confident to teach in outdoor spaces. Currently, school gardens are considered supplemental to a school versus being a core part of the school, like a cafeteria or playground. Currently, there are 96

school campuses, or 74%, with school gardens in the Austin Independent School district, but no best practices have been established to help these schools grow and sustain their school garden programs. Thus, finding ways to make school gardens core classrooms is key and warrants further investigation.

### School health mandates

Public schools are the ideal place to reach nearly all of the 23.9 million K-5 children in the U.S.<sup>18</sup> School gardens have become more widespread over the past decade, as they have the potential to improve health in millions of children.<sup>19</sup> Currently, 40 states—78% of the nation—require nutrition education for all students<sup>20</sup>, yet only 15 states' explicitly address teacher professional development for health education. This means that most U.S. teachers are mandated to teach nutrition education with little or no training. Texas schools are required to implement prevention programs that include nutrition instruction as well as health and physical education according to the Texas Education Code, Section 38.014.,<sup>21</sup> which is rooted in the Centers for Disease Control and Prevention's Whole School, Whole Community, Whole Child model,<sup>22</sup> and aligns with National Health Education Standards,<sup>23</sup> and Association for Supervision and Curriculum Development standards. Evidence suggests that long-term implementation of school-based health-promotion strategies can lead to behavior change.<sup>24</sup>

### Sustainability of school gardens

Despite the amount of substantiated benefits associated with school gardening education integration, few studies have systematically evaluated sustainability factors essential to the success of these programs. Long-term maintenance of school garden programs is a growing concern for stakeholders.<sup>25, 26</sup> One of the key strategies for successful school gardening programs is to have an educator/gardener teach all or some of the garden and nutrition lessons.<sup>19, 27</sup> This role can be filled by a designated educator/gardener in the first year, but other staff need to be trained<sup>19</sup> to sustain the program in subsequent years and over summers. The percentage of schools that already have school gardens (~27%)<sup>16</sup> and the percentage of elementary school teachers expressing interest in school gardening (88%)<sup>17</sup> suggest that teachers and schools represent a large market segment with significant room for growth.

### Barriers to School Gardens

Several studies have evaluated school gardening programs to identify barriers to garden maintenance and predicting factors contributing to their sustainability. Pervasive challenges included the lack of centralized organization,<sup>28, 29</sup> materials and resources,<sup>25, 30, 31</sup> consistent maintenance,<sup>32</sup> and general



interest;<sup>25</sup> whereas a strong community support network,<sup>33-35</sup> paid garden coordinator with management responsibilities,<sup>32, 36</sup> incorporated curriculum,<sup>37</sup> and established funding<sup>26, 32</sup> were strategies needed to sustain school garden programs. A cross-sectional descriptive study of school garden landscapes and teacher responses in Portland, Oregon found that having a paid garden coordinator doubled student participation in the gardening program.<sup>36</sup> The GREEN tool was created by Burt *et al.*<sup>36</sup> to increase school garden integration with four domains and multiple

components to find the optimal solution. The domains listed include: 1) Resources and Support; 2) Physical Garden; 3) Student Experience; and 4) School Community. Although this evidence-based approach describes how school gardens can become best integrated, the actual implementation has not been studied. Burt *et al.* surveyed 99 school gardeners (which included teachers, administrators,



parents, and garden educators) primarily from New York State and Washington DC areas and found that time, staff, funding, curriculum and space as the greatest barriers to their school gardens.<sup>25</sup> This study suggested the following opportunities to address the time and staffing issues: strengthening of garden committees, professional development, and community outreach. However, this study used mainly descriptive and frequency analyses to identify these barriers and opportunities. One of the goals of the current study is to identify what variables in each of the above domains predict having a thriving sustainable school garden program. We hypothesized that schools with strong administrative and district support, clearly organized garden leadership, available garden resources and trainings for teachers would have the most successful school gardens.

## METHODS

### Institutional Review Board Approval

Approval was obtained from UT Austin's IRB, and by each independent school district. Student volunteers were required to complete the following online training modules: Human Subjects Research Training through The Collaborative Institutional Training Initiative (CITI) Program and Financial Interest Disclosure Form through the UT-Austin Office of Research Support and Compliance.

### Survey Development

Intensive evaluation and planning meetings were conducted with collaborators, representing the City of Austin-Office of Sustainability, the Sustainable Food Center (SFC), Austin Independent School District (AISD), and the University of Texas at Austin (UT-Austin). Using the panel of experts and existing literature, including the Portland School Garden Assessment study survey<sup>36</sup>, we developed two versions of a survey questionnaire (one version for school administrators and one version for school teachers). These surveys were designed to evaluate perceptions of use and challenges of school garden programs. Questions from survey fell into four domains, established from the GREEN tool developed by Burt *et al.*<sup>36</sup>: 1) Resources and Support; 2) Physical Garden; 3) Student Experience; and 4) School Community. The surveys were revised/expanded to include 38 questions for the administrator version, 33 questions for the teacher version. Surveys were available either online via Qualtrics or were given in hard copy format. A majority of the schools preferred completing hard copy surveys, which is why both options were given.

We also developed a Garden Observation Log to evaluate the garden space, which examines physical features such as number and types of garden beds, types of materials used for construction of beds, square footage of entire garden, location/type of water sources, etc. The observation log included 24 questions and included photographs of the physical garden.

### Study Design

Sustainable Food Center provided a list of 216 schools across the Greater Austin area that had physical gardens, which included any type of garden (native, herb, or vegetable). We contacted 150 of these schools, 110 of which agreed, to complete the surveys. Consent forms were required from each principal to allow school participation, as well as individual consent forms from each participant, allowing anonymous use of their responses. Research personnel from UT Austin, or the administrator at the school would present a brief overview of this project and expectations at a faculty meeting and then distribute surveys to those who volunteered to participate. In some cases, no presentation was given and the administrator would email the faculty about the project and ask teachers to voluntarily complete the surveys.

Both administrators and teachers were asked to respond to surveys regarding their school garden using either paper surveys or using electronic surveys via the Qualtrics platform. Teachers were eligible to participate in this study if they had some involvement with their school garden. Research personnel picked up the completed paper surveys from participating schools, completed the garden

observation logs, and took photographs of the school gardens. Teachers who completed the surveys (via paper or online) were awarded a \$5.00 gift card incentive for their participation.

### Panel of Experts on School Gardens

A panel of 10 experts who work extensively with school gardens across the Greater Austin area was formed to assist with this project. An electronic list of the schools included in the analytic sample was shared with each panel member. Each expert was asked to identify school gardens with which they were familiar as “Thriving” based on physical appearance, upkeep, and teacher and student usage/integration of the school garden. The experts completed this electronic assessment individually and responses were not shared among the panel to avoid groupthink bias. Experts were only asked to comment on schools that they had directly worked with in the past three years. Thriving school gardens were coded if one or more expert identified them as such.

### Data Management and Storage

Data was stored in REDCap (Research Electronic Data Capture), which is a secure web application for building and managing databases. The database is ideal for field data collection and will be accessible to all key personnel at any location. Research personnel entered paper survey data into REDCap and online Qualtrics survey data was exported directly into REDCap. Data entry was done using the *two-person double data entry* method for accuracy to avoid input errors. All paper materials were locked in file cabinets in a secure locked office only accessible by the study personnel.

### Statistical Analyses

Summary statistics, and graphical analyses were used to examine the frequencies and distributions of data. Logistic regression analysis was run to assess factors associated with success ratings of the school gardens. *A priori* covariates included: school district, free and reduced lunch status, ethnicity/race of students. Statistical analyses were conducted with IBM SPSS Statistics Version 25.





## RESULTS

Table 1 displays the demographics of participating schools. Complete data were obtained on 109 schools spread across eight independent school districts in Greater Austin, Texas. The majority of the schools were elementary level. Population size of the schools averaged around 600 students with a range of 53 to 3,125 students. While this convenience sample includes both low-income and middle/high income schools and a variety of race/ethnicities, the majority of the schools had a high population of free and reduced-price lunch eligible populations and were Hispanic.

Table 2 shows the physical garden descriptions as assessed with the physical garden observation survey. School gardens ranged in size from 10 to 12,000 square feet. Garden age ranged from brand new to 20 years. Figure 1 shows the types of beds/plants in the school gardens. The majority of school gardens had vegetable, native, and herb beds. A minority of them included other elements such as a rain garden and fruit trees.

Almost all of the schools have their gardens located a short walk from the school building and two thirds offer some type of seating at the garden. Half of the gardens are protected by some type of fence or barrier. Only 35% of gardens were indicated as having covered area, which offered shade in their garden. Our research staff, which was largely undergraduate research assistants, visited each school garden and ranked the status of the physical garden as unmaintained/disrepair, somewhat maintained, or well-maintained. Approximately 17% were evaluated as being in disrepair/unmaintained, 38% were somewhat maintained, and 46% were well-maintained.

**Table 1: Demographics of Schools (n=109)**

<b>Demographics:</b>	<b>Value</b>
Type	
Pre-K	11 (10.1)
Elementary school	74 (67.9)
Middle School	11 (10.1)
High School	13 (11.9)
Districts surveyed	8
Free and Reduced Lunch (%)	62.8 ±33.2
Ethnicity/Race (%)	
Hispanic	61.0 ±26.0
Non-Hispanic Black	9.0 ±8.2
Non-Hispanic White	22.9 ±24.1
Asian	3.6 ±4.5
Other	3.5 ±2.3
Teachers completing survey	523
Teachers completing survey per school	4.8 ±3.1
Admin completing survey	174
Admin completing survey per school	1.6 ±0.8
Student Population Size	602.1 ±440.1

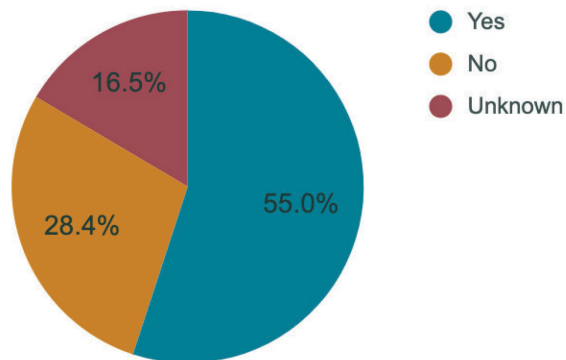
**Table 2: Physical Garden Characteristics**

<b>Characteristic</b>	<b>Value</b>
Size of Garden (sq ft)	783.6 ±1817.5
Garden Age (y)	2.2 ±1.4
Number of Beds	
One	13 (11.9)
Two	23 (21.1)
Three	43 (39.4)
Four	19 (17.4)
Five	12 (11.0)
Type of beds/plants	
Vegetable	89 (81.6)
Fruit Trees	32 (29.4)
Native	95 (87.2)
Rain	20 (18.3)
Herb	81 (74.3)
Seating Available	76 (69.1)
Shade Covered	27 (35.6)
Not shade covered	48 (63.2)
Walking distance from school	
Short walk	101 (92.7)
Long walk	8 (7.3)
Wheelchair accessible	54 (49.5)
Compost bin	49 (44.9)
Garden protected with fence or barrier	56 (51.4)
Physical Observation of Garden Condition	
Disrepair/Unmaintained	18 (16.5)
Somewhat maintained	41 (37.6)
Well-maintained	50 (45.9)

Data are mean ±SD or n (%).

## Domain A – Resources and Support

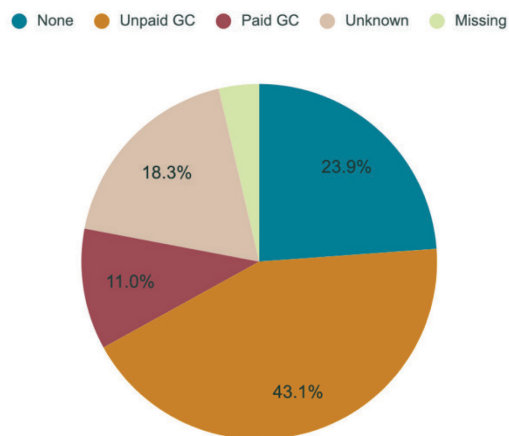
Domain A metrics, as identified on the GREEN tool,<sup>36</sup> consist of those measuring support and resources given to the school garden that support its use and sustainability. School gardens can begin in a variety of ways, from an individual teacher's efforts to a school-wide project. But regardless of how a garden is started, support is needed to keep a garden sustainable over the long term. Some sort of funding existed for 39% of the gardens surveyed to support their sustainability, while 17% reported no funding, and 31% did not know if they had funding and 13% did not answer. Of those that did answer the amount of funding question, 9% reported under \$500 annual budget, 6% reported between \$500-2000 annual budget, and 13% reported over \$2,000 annual budget. Approximately 65% of the school gardens surveyed



**Figure 1: Garden Committee Breakdown**

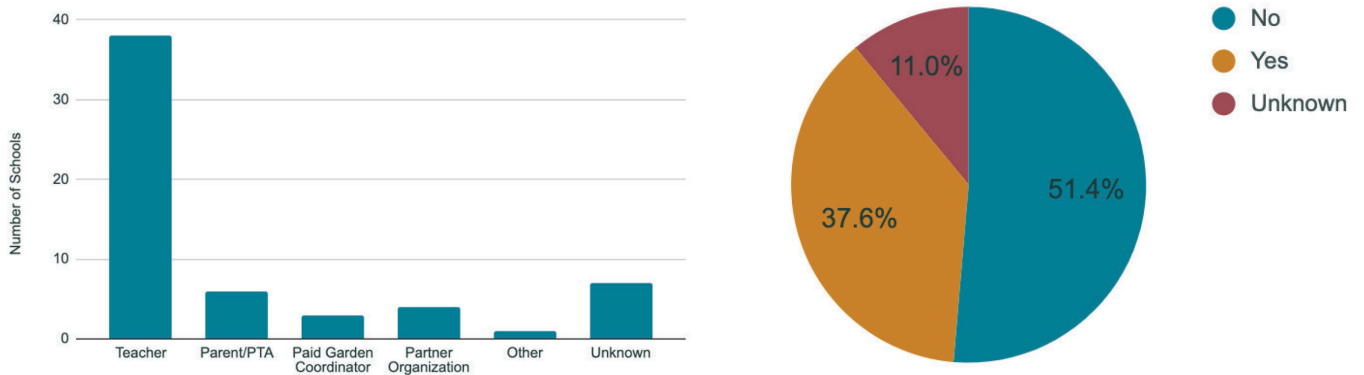
and 13% reported over \$2,000 annual budget. had teachers who responded that their garden had administrator support. Only 3% replied they did not have administrator support while 21% said they did not know and 11% did not answer. Figure 1 shows the prevalence of garden committees at schools. Just over half of the 109 schools have a committee who manages the garden at their school, while 28% said there was not a garden committee and 17% said they did not know if there was such a committee. Since the teachers who were surveyed were selected as users of the garden, we might deduce that this 17% unknown reflects either no garden committee or an ineffective garden committee that is not communicating with staff about use and maintenance of the school garden.

Figure 2 shows the prevalence of garden coordinators at schools. Over half of schools have a person designated as the garden coordinator. Of those schools, only 12, or 11%, have a garden coordinator who holds a paid position. Of note, the survey question did not distinguish between type of paid garden positions. Thus, respondents from these 60 schools may have categorized a “garden coordinator” as teachers who are paid to teach and are also acting as the garden coordinator. Forty-eight, or 44%, of schools have an unpaid garden coordinator. The breakdown of individuals who serve as the garden coordinators is shown in Figure 3. Sixty four percent of garden coordinators are teachers, whereas 10% are parents, 7% are from non-profit or community organizations, 5%



**Figure 2: Garden Coordinator Prevalence**

are paid garden coordinators, and 14% are other or unknown. In the 60 schools that had a garden coordinator, it was reported that over half of these garden coordinators worked in the garden between 0-10 hours per week, 6% between 10-20 hours per week, 8% between 21-40 hours per week, while 36% was missing. In addition to internal use of the garden, respondents were asked about partner or outside organizations that use the garden. In addition to internal use of the garden, respondents were asked about partner or outside organizations that use the garden (Figure 4). Over one third of schools have a partner organization that uses and helps with the garden. Of those who reported having a partner organization, over 80% have more than one outside organization that uses the garden.

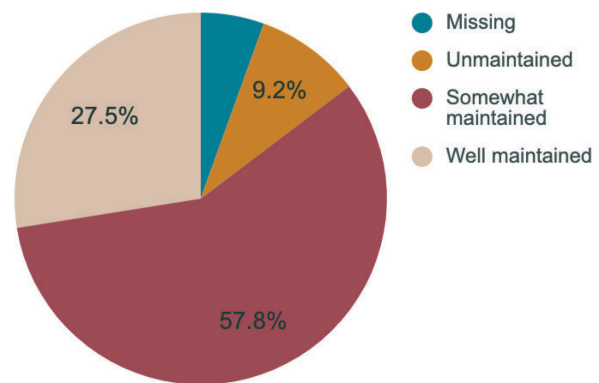


### Domain B – Physical Garden

Figure 5 shows the administrators' and teachers' perception of the school garden condition. Only 28% of schools surveyed perceive themselves as having a well-maintained garden, while 58% reported having a somewhat maintained garden, 9% reported having an

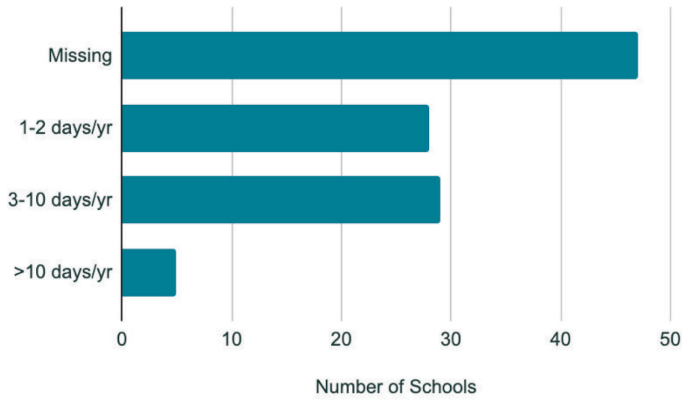
**Figure 3:** Garden Coordinator Breakdown

unmaintained garden, and 6% were missing. Figure 6 shows the number of workdays. Sixty-two of schools, or 57%, reported hosting garden workdays throughout the year, while 47 schools or 43% did not answer this question. Twenty-eight, or 26%, report hosting 1-2 workdays per year, 27% reported 3-10 workdays per year, while 5% reported over 10 workdays per year.

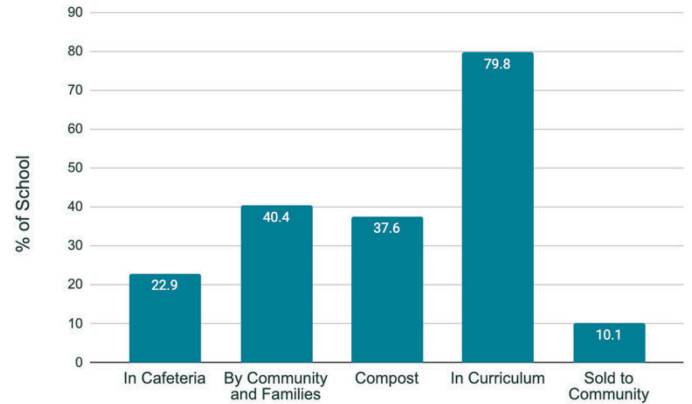


**Figure 5:** Perception of Garden Condition

Teachers and administrators were asked to identify if and how the harvest was used. **Figure 7** displays harvest uses in the schools. Approximately, 80% of respondents selected that the harvest was used as part of the curriculum. Approximately, 40% of respondent teachers and administrators reported that the harvest was used in the community and given to families. Other harvest usages included compost (37.6%), in the cafeteria (22.9%), and as items sold to the community through a farmer's market or fundraiser (10.1%).



**Figure 6:** Number of Garden Workdays per Year

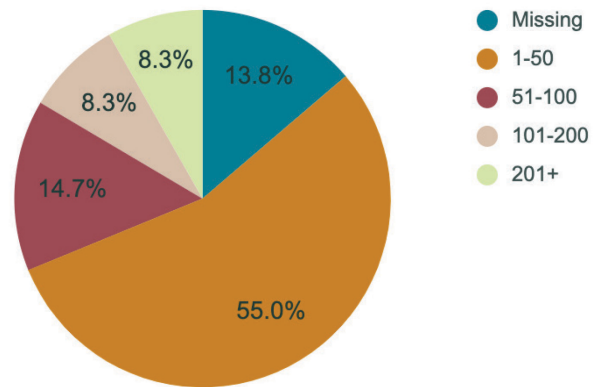


**Figure 7:** Harvest Use at Schools

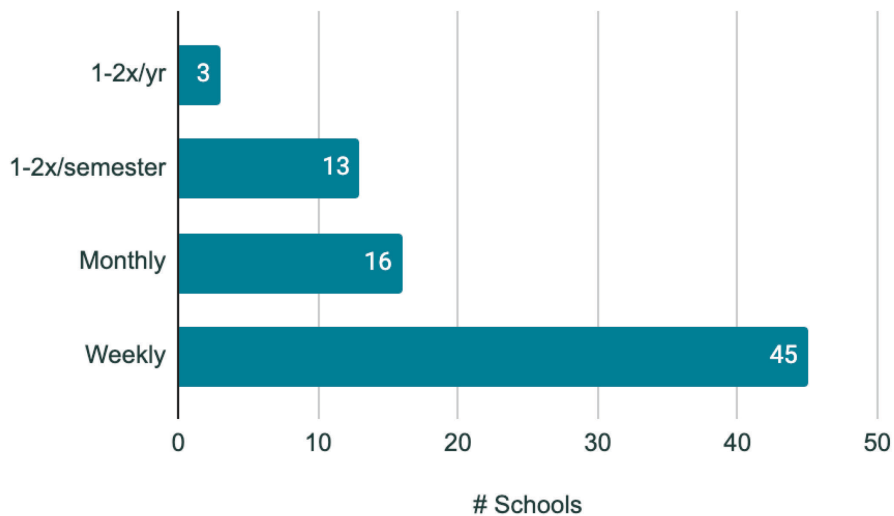
### Domain C – Student Experience

The third domain of survey data gives greater detail on the student experience in using the school garden. Figure 8 shows annual student usage of the garden. In our surveyed population that averages 602 students per school, 55% of schools reported only 1-50 students using garden, while ~15% reported 51-100 students, 8% reported 101-200 students using the garden, and 8% reported 201 or more students using the garden each year.

Frequency of teachers who taught in the school gardens is displayed in Figure 9. Almost half replied that they taught weekly in the garden, approximately 15% said they taught monthly in the garden, 13% reported 1-2 times per semester and only 3% reported 1-2 times per year.



**Figure 8:** Annual Student Garden Usage

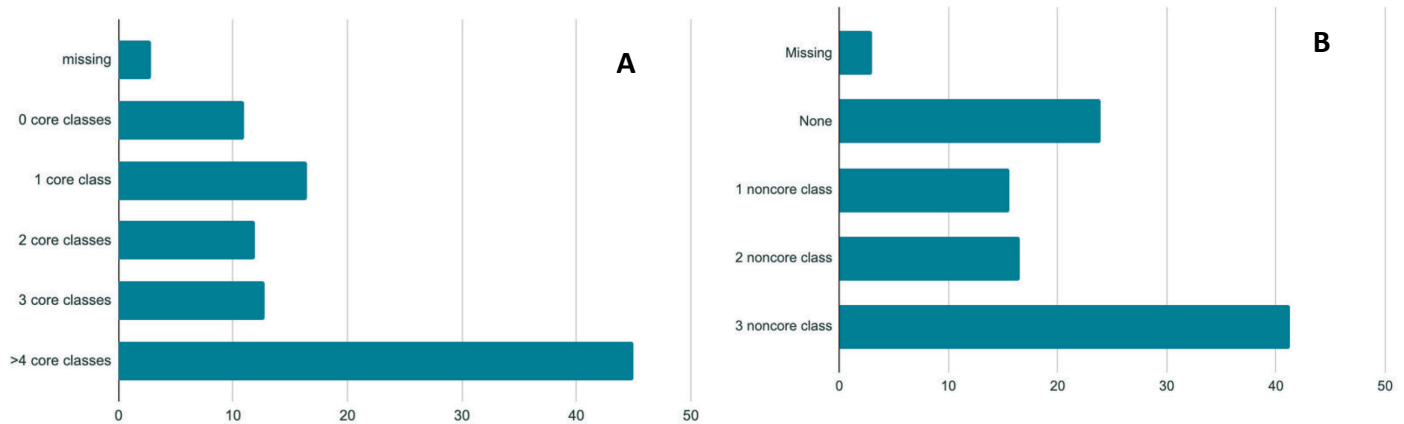


**Figure 9:** Teacher frequency



Figure 10 A-B displays number of core and non-core courses being taught in the garden. Over 85% of schools surveyed use the garden for teaching core courses. Of the schools teaching core courses in the garden, 45% of schools reported four or more core courses being taught in the garden. Additionally, 80% of schools teach at least one non-core course in the garden. Of the schools teaching non-core courses in the garden, about 41% of schools reported having three or more non-core courses that were taught (e.g. art, PE, music, etc.).

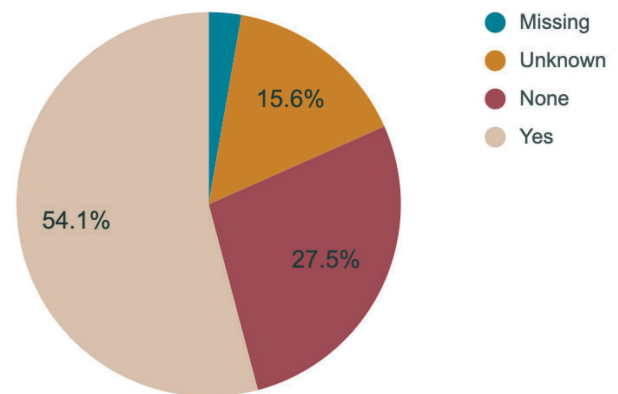
Only 28.4% of schools utilize a specific garden curriculum in their students' garden experience. However, our survey did not ask what type of garden curriculum was used.



**Figure 10:** Number of Core (A) and Non-Core (B) courses being taught in the garden

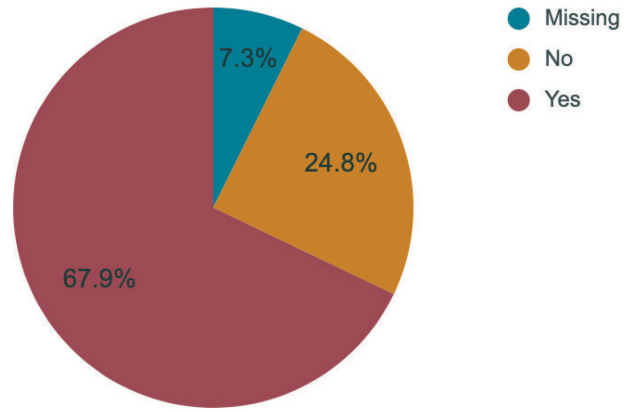
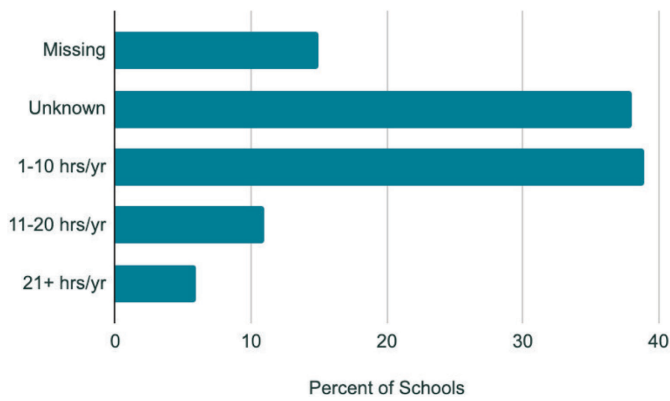
### Domain D- School Community

Figure 11 shows volunteer and parent support in the garden. We surveyed for volunteer support (parental and/or external) as well as the presence of teacher trainings specific to the garden. Approximately, 54% of schools reported having volunteer or parental support of the garden, whereas 28% of schools reported that they did not have volunteer or parental support. Figure 12 displays hours worked by volunteers/parents. Of the schools reporting volunteer garden support, a third of these schools did not know how many hours volunteers work, a third reported these volunteers work in the garden 1-10 hours a year, 10% of schools have volunteers that work 11-20 hours a year and 6% of schools have volunteers working more than 21+ hours a year in the garden. Figure 13 shows the number of schools that provide trainings for teachers on using the school garden. Approximately 68% of the schools surveyed reported that they had some kind of teacher training around the school garden.



**Figure 11:** Volunteer and parent support in the garden



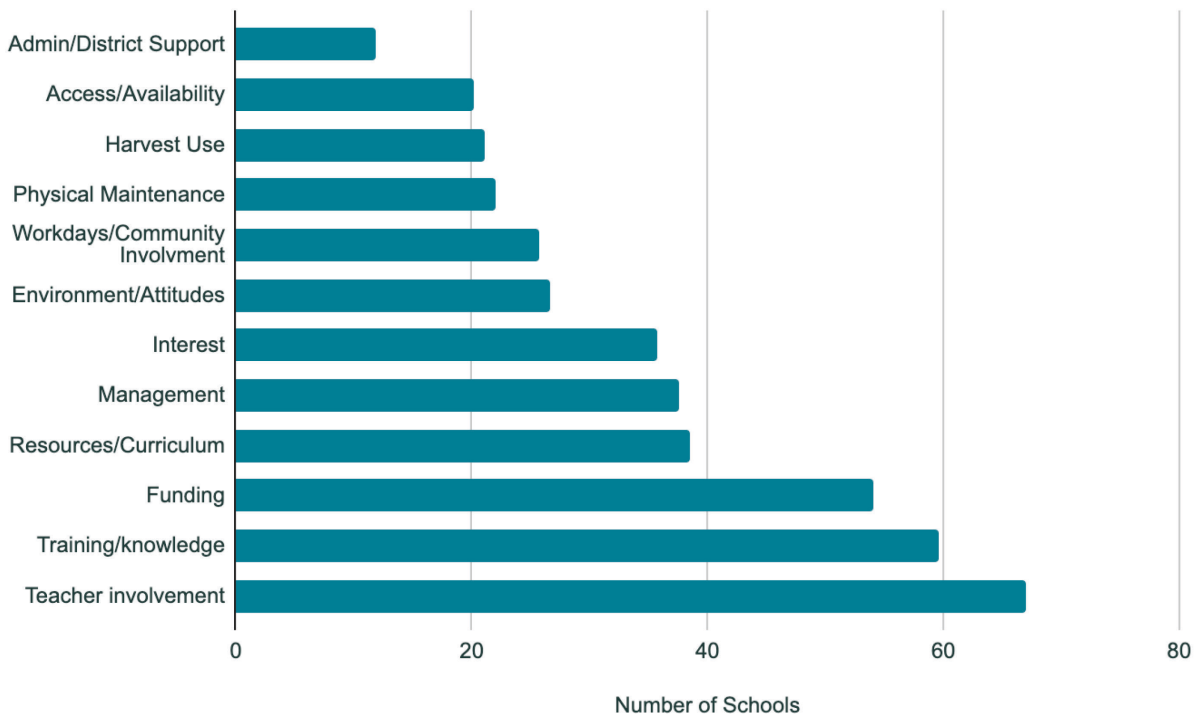


### Barriers

Both teachers and administrators were asked to identify barriers which hindered garden use by school staff. The survey did not ask respondents to prioritize which posed the biggest challenge. Figure 14 displays the frequencies of barriers identified by the teachers. This data is important not only in identifying the most commonly cited barriers but also in identifying differences of barrier perception by teachers when contrasted with barrier perception by administrators. The top three barriers reported over 50% of teachers, included: 1) inadequate funding, 2) insufficient administrator/district support, and 3) low workdays and community involvement. Figure 15 displays the frequencies of barriers as identified

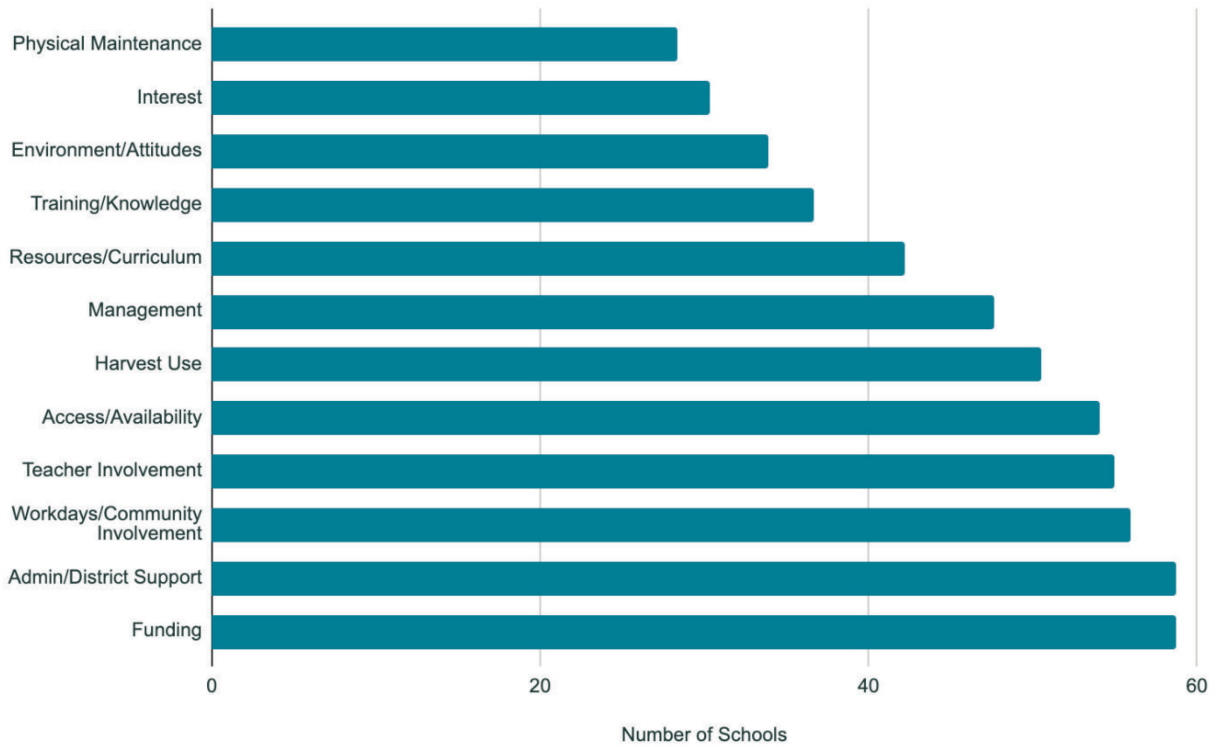
**Figure 12:** Hours worked by volunteers in garden

**Figure 13:** Teacher Garden Training Available



by **Figure 14:** Frequencies of barriers to sustaining a garden reported by administrators.

administrators. The top three barriers reported by over 50% of administrators, included: 1) inadequate teacher involvement, 2) insufficient training/knowledge, and 3) inadequate funding. Of note, having district support was the lowest perceived barrier by administrators.



**Figure 15:** Frequencies of barriers to sustaining a garden reported by teachers.

### Experts

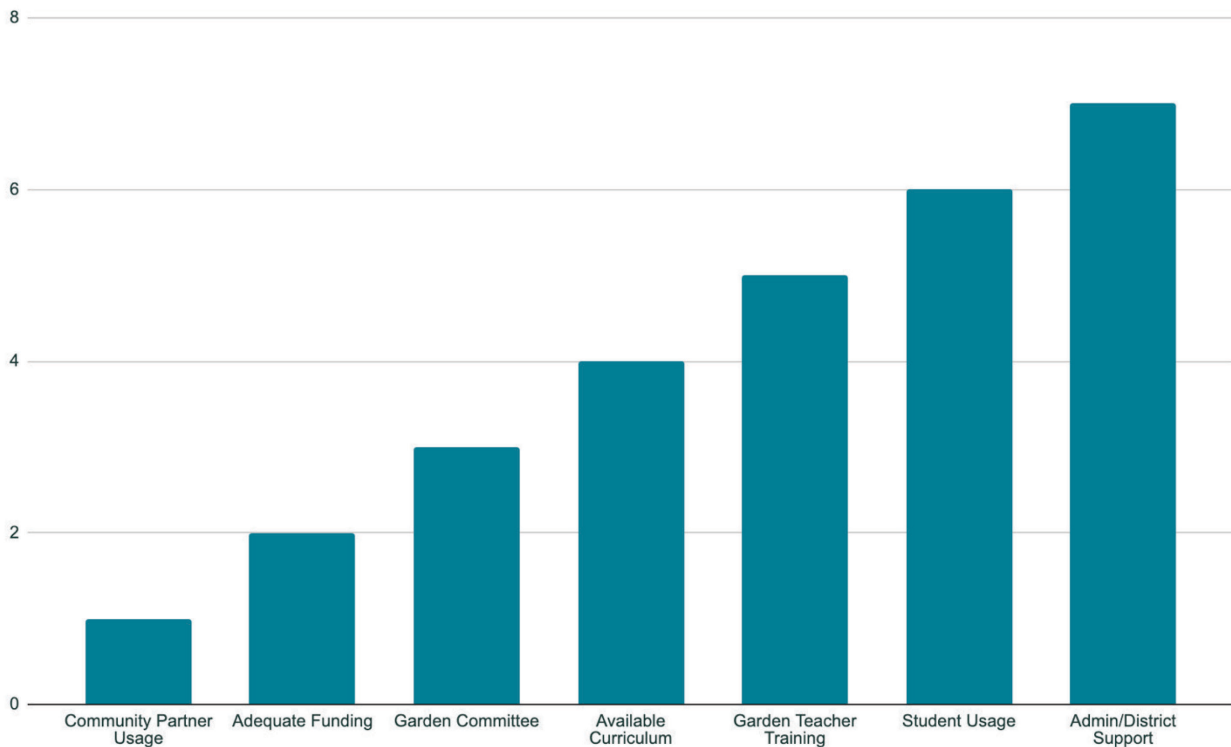
The panel of experts identified 25 schools, or 23%, as “Thriving” based on the physical condition of the garden, school usage of the garden and integration of the garden into the school community. Table 3 displays the regression analyses of which barriers/strategies predict having a thriving garden. Within the Resource/Support Domain, having funding and a community partner was linked to a 3-fold increase in the odds of a having a thriving garden ( $\beta=3.51$ , 95% CI 1.20, 10.26,  $p=0.022$ ;  $\beta=3.01$ , 95% CI 1.16, 7.83,  $p=0.024$ ). Having a garden committee was linked to over a 4-fold increased odds of having a thriving garden ( $\beta=4.67$ , 95% CI 1.26, 17.23,  $p=0.021$ ). Having administrator/district support was linked to a 12-fold increase in the odds of having a thriving garden ( $\beta=11.98$ , 95% CI 1.53, 9.34,  $p=0.018$ ). Having an available garden curriculum available was linked to an almost 5-fold increased odds of having a thriving garden. There were no variables within the physical garden domain that predicted having a thriving garden. Within the Student Engagement Domain, having a garden curriculum was linked to an almost 5-fold increase in odds of having a thriving garden ( $\beta=4.84$ , 95% CI 1.73, 13.56,  $p=0.003$ ). Having between 100-200 students using the garden was linked to a 4-fold increase in odds of having a thriving garden ( $\beta=4.53$ , 95% CI 1.02, 20.19,  $p=0.047$ ), while having 201+ students was linked to an 11-fold increase ( $\beta=11.30$ , 95% CI 2.39, 53.75,  $p=0.002$ ). Within the School Community Domain, having teacher garden training was associated with an almost 5-fold increase in the odds of having a thriving

garden ( $\beta=4.88$ , 95% CI 1.04, 22.95,  $p=0.045$ ). There was a trend for having a paid garden coordinator being linked to higher odds of having a thriving garden ( $\beta=6.00$ , 95% CI 0.92, 39.185,  $p=0.061$ ), whereas no significance was found with having an unpaid garden coordinator. As mentioned previously, the survey question about having a paid garden coordinator did not distinguish how the payment occurred and it is very likely that the present garden coordinators were paid teachers that were also acting as the school garden coordinator. Figure 16 shows the order of top significant predictors of having a thriving garden.

Table 3: Logistic regression of variables within each domain predicting a “thriving” garden.

<b>Domains</b>	<b>Beta</b>	<b>95% CI</b>	<b>p-value</b>
<b>Domain A: Resources / Support</b>			
Garden funded			
No	<i>Ref</i>		
Yes	3.51	1.20, 10.26	<b>0.022</b>
Community Partner Use			
No	<i>Ref</i>		
Yes	3.01	1.16, 7.83	<b>0.024</b>
Garden Coordinator			
None	<i>Ref</i>		
Yes GC	2.769	0.551, 13.914	0.216
Paid GC	6.000	0.919, 39.185	0.061
Garden Committee			
None	<i>Ref</i>		
Yes	4.67	1.26, 17.231	<b>0.021</b>
Administrator/District Support			
None	<i>Ref</i>		
Yes	11.98	1.53, 9.34	<b>0.018</b>
<b>Domain B: Physical Care</b>			
Perceptions of Garden Condition			
Disrepair/Unmaintained	<i>Ref</i>		
Somewhat Maintained	2.81	0.33, 24.04	0.345
Well Maintained	3.27	0.36, 30.10,	0.295
Physical Observation of Garden Condition			
Disrepair/Unmaintained	<i>Ref</i>		
Somewhat Maintained	1.03	0.23, 4.53	0.969
Well Maintained	2.14	0.54, 8.51	0.279
Workdays			
None	<i>Ref</i>		
Yes	0.15	0.18, 1.21	0.075
Sum of Harvest Use			
None/unknown	<i>Ref</i>		
1 use	2.00	0.32, 12.33	0.455
2 uses	3.27	0.62, 17.39	0.164
3+ uses	3.81	0.73, 19.28	0.106
<b>Domain C: Student Engagement</b>			
Garden curriculum available			
None	<i>Ref</i>		
Yes	4.84	1.73, 13.56	<b>0.003</b>
Student yearly usage			
1-50 students	<i>Ref</i>		
51-100 students	0.81	0.16, 4.18	0.801
101-200 students	4.53	1.02, 20.19	<b>0.047</b>

201+ students	11.30	2.39, 53.75	<b>0.002</b>
Teaching amount			
1-2 times per year	<b>Ref</b>		
1-2 X per semester	0.17	0.01, 3.89	0.265
Monthly	0.13	0.01, 3.08	0.209
Weekly	1.27	0.11, 14.95	0.851
Number of core classes use garden			
None	<b>Ref</b>		
1 core class	0.65	0.04, 11.45	0.767
2 core classes	6.88	0.67, 70.82	0.105
3 core classes	6.11	0.60, 62.23	0.126
4+ core classes	3.98	0.47, 33.87	0.207
Number of non-core classes use the garden			
None	<b>Ref</b>		
1 non-core class	1.64	0.29, 9.29	0.574
2 non-core class	2.19	0.43, 11.27	0.348
3+ non-core class	3.83	0.99, 14.84	0.052
<b>Domain D: School Community</b>			
Volunteers			
None	<b>Ref</b>		
Yes	0.94	0.35, 2.55	0.899
Hours volunteers work			
None	<b>Ref</b>		
1-10 hrs/yr	0.47	0.16, 1.28	0.170
11-20 hrs/yr	0.48	0.09, 2.58	0.393
21+ hrs/yr	1.08	0.17, 6.75	0.932
Teacher garden training			
None	<b>Ref</b>		
Yes	4.88	1.04, 22.95	<b>0.045</b>



**Figure 16:** Top significant seven factors for having a thriving garden.

## Discussion

Numerous studies have identified the health and academic benefits of school gardens, but few have identified barriers and strategies to sustaining school gardens. The GREEN tool, created by Burt et al. 36, was used to identify domains important in the successful school garden programs. This study is one of the first to identify what barriers within these domains predict having a successful garden. The top seven barriers to having a thriving garden are: inadequate administration/district support, low student usage, lack of garden-specific teacher trainings, lack of access to garden-based curriculum, non-existent garden committees, inadequate funding, and lack of community partner use.

## Resources and Support

When examining the barriers of garden use, at the top of the list for teachers was inadequate administrator support for the school garden. The regression analyses correlated well with this finding, and showed administrative support to be associated with a 12-fold increase in having a thriving garden. The school administrator can set the expectation (or lack of one) for teachers using the garden. It is very typical to see gardens fail over time when they are taken on by teachers or parents without administrative support, or when a school gets a new principal who doesn't set the expectation for garden use.

In contrast, administrators reported not having teacher involvement as being the top barrier to a successful school garden, while indicating admin/district support as being the lowest barrier. This contradiction indicates that most administrators accept the common position taken by school districts



that school gardens are the responsibility of the school and not the district, even though they are seen as a teaching tool. Furthermore, the administrators put most of the accountability of the school garden on the teachers. These findings also might showcase the lack of communication and unified priorities between teachers and administrators for garden usage. Administrators may feel that only a few of their teachers take advantage of the garden as a teaching tool. They could however, set the perception of the garden as a teaching tool that integrates into existing classroom curriculum and establishing clear expectations for its use by teachers could help garden usage become the norm rather than the exception.

There was a qualitative question on the survey that asked how administrators could be more supportive of the garden. Several suggestions came from that question, including administrators could encourage (and possibly incentivize) garden usage by teachers in each grade level. One potential way to overcome this is for administrators to encourage (and possibly incentivize) involvement from a teacher(s) in each grade level. Another way is to include the gardens in the school's professional learning and hiring practices. Some other options mentioned include: approval for produce to go into the school cafeteria; schedule garden workdays on the school calendar; provide substitute teachers so that teachers could attend professional development trainings and/or garden workdays; foster partnerships with community/non-profit groups that want to help in the garden; support locating and applying for funding/grants; support finding resources for teachers to use in the garden; and embed the garden into the school culture, for example help plan school wide events around the garden.

In the regression analyses, number of teacher users was not significantly linked to having a thriving garden. However, greater numbers of students that used the garden (>100 students per school) was a predictor for having a thriving garden. These results suggest that teachers who currently use the garden should try to encourage other teachers in their grade level to use the garden too. With this in mind, consideration of a teacher to teacher mentoring program that could encourage garden usage may also help improve school garden sustainability.



The saying “if you build it, they will come” often seems to be an approach to building a school garden, but it is certainly not a successful strategy in the majority of situations. Time and again, we see individual garden founders struggling to bring both their administration and teachers on board to seeing the school garden as an effective and well-used tool for teaching. This disparity between those who are users/non-users of the garden further creates an uneven experience for students, whereby the assignment of a student’s teacher at the beginning of the year dictates their exposure (or lack of) to the school garden. In order for a school garden to be successful, it requires broad teacher use and strong administrators/district support.

Garden leadership is extremely important in the sustainability of school gardens. Over half of the schools had garden committees and this was linked to a greater than 4-fold increase in predicting a thriving garden. Many garden committees consist of teachers, parents, and even some have students serving on the committee. Garden Leadership Committees identify when problems exist with school gardens and programming including maintenance issues, training, teacher involvement, needs for scheduling, communication around garden activities/harvest, host garden events, fundraise and more. They also play the critical role of delegating responsibility amongst members making it less likely that a garden will decline if its upkeep is tied to one person, as often happens at a school when a teacher or parent passionately starts the garden. Similarly, Burt et al.<sup>25</sup> suggested that forming garden committees is one way to bring school stakeholders and volunteers together in their efforts to support their school garden.

These findings suggest having a paid garden coordinator is linked to a thriving garden, but having an unpaid coordinator was not a significant predictor of a thriving garden. However, only 20% of schools reported having a paid garden coordinator. This low number might be reflective of teachers simply not knowing whether or not their garden coordinator is paid. The majority of the garden coordinators are teachers and it is unclear if the garden coordinator responsibilities were simply folded into their current teacher responsibilities, or if these teachers were given additional compensation to manage the garden. The survey questions did not specify what “paid” actually meant, which might explain the null effects of this variable. In future studies, it is important to specify what is meant by “paid” coordinators and identify the source of that funding. The Portland, Oregon report found that having a paid garden coordinator doubled student participation in the gardening program.<sup>36</sup> A garden coordinator can take an active role in several responsibilities including: setting up the physical garden maintenance schedule; establishing communications and schedules around garden usage; identifying trainings, curriculum, and resources for teaching in the garden; and communicating progress or needs of the school garden back to the administrators/district. However, if these responsibilities are in addition to their regular teaching responsibilities, they may be daunting and too much for one person to manage and be ignored when their other responsibilities are prioritized. Having the garden coordinator be on staff at the school helps the possibility that this person might be better integrated into the school culture. Several other studies have shown that having garden coordinator teach all or some of the garden and nutrition lessons is a key strategy for successful garden programs.<sup>19,27</sup> Approximately 10% of the garden coordinators were parents. While this is good way to utilize resources outside of the school, many times when this parent’s child(ren) graduate from the school, they no longer manage the garden. Such regular turnover of the garden coordinator can be a big barrier to schools who are attempting to sustain their gardens. Only 5% of the garden coordinators came from community/non-profit groups, which may be reflective of schools not being aware of services/resources that community/non-profit groups offer, or that there are few community/non-profit groups that offer such services. Finally, 14% of the garden coordinator positions were unknown, suggesting that many schools are unaware of the status of a garden coordinator at their school. Regardless, our data suggest that hiring or appointing a garden coordinator to specifically manage the garden can help schools have thriving school gardens.

Community partnership was associated with having higher thriving school gardens. Community/non-profits can play a key role in helping with workdays and with physical maintenance of the garden, but they can also help with programming. In Austin, there are several non-profit organizations that provide resources, materials and trainings for school gardens including: The



Sustainable Food Center, Sprouts Healthy Communities Foundation, Whole Kids Foundation, OutTeach, Partners for Education, Agriculture and Sustainability (PEAS), Urban Roots, and Keep Austin Beautiful. Some of these services are free, while others are paid for their services. Only 38% of schools reported having a community partner organization, thus, is it that there are still not enough partner organizations to lean on, or is it that school campuses do not have the funds to afford partners, or do they just not know that partners exist, or is it a combination of all of the above. A consistent theme is that their existence and availability is not well known to schools. In addition, there are many more community groups that would likely get involved but don't know how to break into the school districts to express their availability. Thus, there is a need to connect community/non-profit groups with schools and school districts. Getting community group members to serve on the garden committee could be a way to integrate the community groups more into the school garden culture.

Adequate funding is another best practice to having a thriving garden. There are numerous grants available to build school gardens, but fewer funding mechanisms to help schools sustain their existing school garden. While the survey asked about annual funding for gardens, the majority of teachers/administrators did not know the actual amount of funding, but the range reported was from \$1 to \$2,500 per year. There are numerous grants available to build school gardens, but fewer funding mechanisms to help schools sustain their existing school garden.

Similarly, Burt et al. identified lack of funding as a top barrier to school gardens on the East coast.<sup>25</sup> There are low-budget approaches that can be used to get around lack of funding, including monetary donations, grants, supply donations and pass-along plants. However, when it comes to high-priced items like shade structures, outdoor classroom features and sheds that can increase the

likelihood of teachers use of the garden, funding becomes critical. It would be transformational to have more funding mechanisms available to help schools procure some basic hardscape additions that are critical to creating a garden that is welcoming and comfortable for teachers and their classes. In addition, there needs to be better channels to disseminate information about funding announcements/opportunities within schools and with communities. Many times, the funding announcements are hard to find and somewhat scattered. Currently, there is not a central site that identifies funding sources/announcements for school gardens by location.



## Physical Care

While none of the variables in the physical care domain predicted having a thriving garden, when examining the survey responses describing physical garden characteristics, a few features stood out. Only 35% of schools had shading. This low percentage is notable in Texas where students can expect high temperatures in early fall and late spring. A shaded area would certainly contribute to the perception of the garden as a tolerable place to be in hotter months. However, unless there is existing shade created by a tree or existing building, shade structures can be expensive additions to a school garden. Having a shade structure would make teaching outdoors more enjoyable in hotter months. Specific funding for shade structures is warranted.

When the schools were rated by our research staff on garden condition, 54% were rated as somewhat maintained or unmaintained. The schools were given no prior notice of the evaluation, so

there was no ability to prep the garden so it would score higher. Of note, this evaluation represents the garden at a single point in time and may not represent the garden's typical condition. In addition, the physical observation of the school garden did not significantly predict having a thriving garden. This suggests that one-time observation of the garden may not be reflective of the garden status throughout the year and is perhaps not the most effective evaluation method for classifying garden status.

### Student Engagement

Having available garden curriculum was linked to an almost 5-fold increase in having a thriving garden. There are numerous available garden curriculums that are either free or available at low-cost to schools, including Austin ISD Outdoor Learning Connections in the district curriculum, Junior Master Gardeners, LifeLab, Edible Schoolyard, Slow Food USA and many more. However, teachers have libraries full of existing curriculum they are expected to teach to their students, leaving little room to locate and regularly integrate a completely different garden curriculum. School districts can encourage use of the garden by either approving usage of an existing garden-based curriculum as part of their available lesson plans or creating options in their existing lesson plans to use the garden. When teachers are expected to locate and vet garden curriculum, this task is likely to be neglected as their schedules become busy during the school year. Another possible step toward easing the burden of garden curriculum hunting would be to create a central website to allow teachers to search and find garden-based curriculum for specific grade and content areas. In addition, the part a school garden can play in fulfilling nutrition education in schools is very under-utilized. Given that 40 states, 78% of the nation, require nutrition education be taught in public schools to all students<sup>20</sup>, it is important to provide nutrition education curricula to schools. Garden-based curricula are often mapped on school standards for math and science, but they also provide an ideal opportunity to infuse required nutrition education into the classroom.

Having over 100 students using the garden annually was a successful predictor of having a thriving garden. Our data showed that only 18% of schools had 100+ students who used the garden annually. This is an astonishingly low rate of use for a school sample that has such a large population, equating to only about 1-3 classes per school using the garden in most schools. The above student usage also seems relatively low compared to the data detailing the use of the garden by grade. In elementary schools, an average of four grade levels used the garden, compared to an average of two grade levels in middle schools, and four grade levels in high schools. Of note, only teachers that were involved in the school garden were surveyed, so these student numbers may be reflective of only the teachers that completed the surveys, and may be an underestimation.

### School Community

Providing garden training to teachers was also linked to an almost 5-fold increase in having a thriving garden. It is unreasonable to expect dedicated garden usage by teachers who may have no background in gardening and no district/administration directive to use the garden. Teachers are historically overworked and have very tight schedules. They need to receive training on how the garden can be used as a tool in their existing curriculum. Gardens provide a departure from traditional classroom learning which can be extremely valuable as an alternative way for students to learn critical skills, allowing students to have a more experiential and kinesthetic lesson. Currently, in the Greater Austin area, the SproUTing Teachers program, funded by Sprouting Healthy Communities Foundation, trains teachers how to teach in their gardens. Currently, this program is occurring in seven elementary schools with 44 schoolteachers. OutTeach offers trainings to teachers around school garden, but it is currently only being offered to one school in the Greater Austin area. The Sustainable Food Center used to offer garden-based teacher training to schools, but this program was recently eliminated. Provision of garden-based trainings to teachers in the Greater Austin is desperately needed.

## Limitations

A consistent theme throughout this study is that there was a lot of survey questions that were marked as either unknown or were missing. Given that we surveyed those teachers who used the garden the most, the large number of unknown responses was surprising. These results may reflect the haphazard way in how school gardens are managed and/or the lack of communication around school gardens. Often times one group manages the budget of a school garden, such as the PTA, and other stakeholders are unaware of the funding apart from the better managed budgets of the school or PTA. Close to 20% of stakeholders surveyed did not know if they even had a garden coordinator, which shows that school garden leadership is not well defined or empowered at schools and could definitely be improved. The use of a convenience sample is also a limitation, however it is widely used in studies like this, where we are asking a particular group of school garden stakeholders to answer survey questions. Nonetheless, the findings from this nonrepresentative sample limits generalizability.



## Conclusions

While school gardens are rapidly increasing and gaining popularity, very little research exists that identify best practices for school gardens. This study identified strategies, resources and support that are needed to facilitate successful school garden integration and sustainability.

Based on these findings, we recommend the following seven action items in order of greatest to least:

1. Adequate district/administrator support;
2. Increased student usage;
3. Provision of teacher training;
4. Available garden curriculum;
5. An active garden committee
6. Adequate and consistent funding;
7. community/non-profit support.

Implementation of these seven action items will help transform our schools into more hands-on, multi-faceted learning environments that will foster a love of learning among students of all ages. These seven action items could help create the thriving metropolis of school gardens that would enhance student education and experience!





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