Enhancing the Health of School Garden Programs and Youth: A Systematic Review

Amelia C. Huelskamp

Abstract

Schools often credit instructional gardens with improving fruit and vegetable consumption and physical activity in children. Many schools are able to obtain funding and supplies to establish a garden program, but there are challenges to program sustainability that often result in garden failure. This systematic review compares recommendations for garden sustainability to maximize the effects of gardens on child and adolescent health. Search terms ("school garden" OR "instructional garden" AND sustain* AND strategy OR practice) were applied to academic databases, including ProQuest Central, ERIC, Agricola, and Science Direct. Articles had to address strategies for sustaining gardens used for educational purposes. The search resulted in 694 peer-reviewed articles, of which 17 met the eligibility criteria. A review of article references resulted in two additional articles (n = 19). Most common recommendations included building a broad network of support in the community, providing professional development to teachers involved with the garden, and providing teachers with standards-based curricula to integrate the garden into multiple content areas. To increase the effect of gardens on student health behaviors, health educators should use the National Health Education Standards, Characteristics of an Effective Health Education Curriculum, and Healthy Behavioral Outcomes to integrate gardens into health education.

Key Words: school garden, sustainability, health education, nutrition

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Introduction

In recent years, educators have discussed school gardens as a strategy for improving health behaviors in youth, particularly in schools serving high-risk students (Ozer, 2007). Numerous studies support an array of benefits associated with school gardens, including higher physical activity levels, more positive attitudes towards trying unfamiliar foods, and increased fruit and vegetable consumption (Chawla, Yost, & Escalante, 2011; Morgan et al., 2010; Parmer, Salisbury-Glennon, Shannon, & Struempler, 2009; Ratcliffe, Merrigan, Rogers, & Goldberg, 2011). Many of the studies supporting the effects of school gardens on child and adolescent health are limited to children in a single grade level or school (Commack, Waliczek, & Zajiczek, 2002; Koch, Waliczek, & Zajiczek, 2006; Saunders et al., 2010). However, the sheer volume of the literature suggests that while individual studies may lack generalizability, many teachers, administrators, and young people in the United States and abroad view gardens as a way to enhance health and school connectedness.

Some states such as California, Louisiana, Oregon, and Vermont have distributed information to school districts for establishing new garden programs, often with lesson plan ideas for integrating the garden into health, science, and language arts, as well as other content areas. Integration of the school garden across content areas has been found to improve staff buy-in, thus increasing the lifespan of the garden (Burt & Burgermaster, 2017; Burt, Koch, & Contento, 2017; Hong, Benson, Russell, Powers, & Sanderson, 2017; California School Garden Network, 2006). However, compared with the number of resources available for establishing new garden programs, there are fewer resources available to help schools overcome the many challenges of maintaining a school garden over the course of many years (Drake & Lawson, 2015).

It is common for teachers and administrators establishing a new garden to think of sustainability in terms of maintaining the physical space with strategies like creating a volunteer rotation, opting for perineal plants that require minimal care, and recruiting summer help. These strategies do not address the more deeply rooted and complex challenges to garden sustainability that most schools face, such as discontinued funding, staff turnover, and low community interest (Cohen & Reynolds, 2015; Beery, Adatia, Segantin, & Skaer, 2014; United States Botanic Garden, n.d). In their study on the challenges of establishing and maintaining community gardens across Canada and the United States, Drake and Lawson suggest that, "if practitioners are interested in sharing knowledge, it is crucial to understand just what issues are important across specific locations, even if those issues manifest differently" (2015, p. 242). Among the gardening organizations surveyed by Drake and Lawson, more than 1,600 community gardens failed between 2007 and 2012, often for similar reasons such as lack of interest among those responsible for the gardens, and loss of funding (2015, p. 247). Some of the studies included in this review found that the majority of the school gardens in the sample population were less than three years old, suggesting that survival beyond three years is somewhat uncommon (Collins, Richards, Reeder, & Gray, 2015; Dawson, Richards, Collins, Reeder, & Gray, 2013). The experiences of school and community gardeners who have faced and overcome these common challenges could contribute to collective knowledge that will improve the odds of success for schools hoping to establish, expand, or salvage their garden programs.

Amelia C. Huelskamp, PhD, MA, Assistant Professor, The University of North Carolina, Wilmington. 601 South College Road, Campus Box 5956, Wilmington, NC 28403; Email: huelskampa@uncw.edu; Phone: 910-962-7308; Fax: 910-962-7073. National Chapter, Member-at-Large. The author has no conflicts of interest to disclose.

* Corresponding Author

The purpose of this systematic literature review is to identify strategies for improving school garden longevity. Strategies recommended by schools and organizations with successful garden programs could be helpful to others hoping to use gardens to increase healthy behaviors in their students. For this review, a school garden is any space with cultivated plants that is available to students for educational or health purposes. The garden space could include flowers, vegetables, fruit trees, ornamental trees, and cover crops like timothy or clover. It could also include other elements like sculpture, play spaces, or benches.

Methods

The author used the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) to guide the development of search protocol for this study (National Academy of Sciences, 2011). PRISMA provides authors with a set of 27 items recommended for inclusion in systematic reviews and meta-analyses focused on clinical trials or other interventions. Because gardens serve as forms of intervention in schools, rehabilitative programs, and other settings, the author used PRISMA guidelines in developing the search protocol to improve the thoroughness and quality of the search, and subsequently, the findings.

The author conducted a search of multiple databases to locate peer-reviewed studies pertaining to strategies for sustaining school gardens. Because ProQuest Central includes peer-reviewed literature from a broad range of disciplines, the author conducted this search first. Following the initial search, the author checked discipline-specific databases to identify additional articles that may emphasize the use of service learning, curriculum integration, environmental science, agricultural techniques, or other unique strategies to improve garden longevity. For example, the author searched ERIC, which is devoted to education-related literature, for articles focused on garden sustainability for enhanced academic achievement or learning outcomes. The author also searched Science Direct and Agricola for articles with a heavier emphasis on the sciences.

Inclusion Criteria

To be included in the review, all sources had to address at least one sustainability-related recommendation relevant to the educational use of gardens in any public, private, or chartered preschool, K-12 school, or community garden organization. Sources focused on community garden programs were included because these programs often provide educational opportunities to community members, and some recommendations for sustainability might translate well to schools, even though sustainability concerns in schools are not always the same as the concerns faced by communities-at-large. Additionally, all sources had to be peer-reviewed and available in the English language.

Because teachers have used school gardens for instructional purposes in the United States as far back as the early twentieth century, the author applied no limits to date of publication. It is likely that challenges to sustainability are different today from those faced early in the history of school gardens, but limiting the date range could have potentially excluded historical perspectives that are still relevant today.

Exclusion Criteria

Some of the articles entering the full review process did not explore sustainability strategies based on the success or failure of specific garden programs. For example, two sources were editorial pieces written by garden proponents, but with no methodological basis. A third source was an essay on applications of permaculture for school gardens. Because these sources did not document the successful practices of one or more garden programs, the author elected to exclude them.

Search String

The author searched ProQuest Central and Science Direct on September 14, 2017 using the following search string:

(*school garden* OR *instructional garden*) AND *(sustain*) AND (*practice* OR *strategy*)

ERIC and Agricola were searched on October 5, 2017 using the same search string, which returned no results for either database.

ProQuest Central returned 500 results, and Science Direct returned 194 results. The author reviewed all titles and abstracts to determine relevance, which resulted in the elimination of 536 articles, and identification of an additional 123 articles as duplicates. The author reviewed the remaining 35 articles in their entirety.

Data Extraction and Analysis

Of the original 35 articles entering the full review process, 17 were excluded because they did not meet all of the inclusion criteria. The researcher organized any recommendations for maintaining a successful school or community garden into a table. This organization of recommended strategies allowed for identification of recurring themes and a comparison of practices across regions. For each study, the author(s), date of publication, sample, purpose, methods, and findings were included in the table. The author also extracted any sustainability challenges mentioned in the articles and organized these into a second table, allowing for an analysis of most common reasons cited for garden failure. A review of the references of each article revealed two additional sources not identified in the database searches. The complete review process is illustrated in Figure 1.

Results

Results for this review included 19 peer-reviewed articles (n = 19). All of the results addressed recommendations for sustainability, but study methods varied widely. Almost half of the results (47%) were quantitative studies (n = 9), and the remainder (53%) were a mix of qualitative and mixed methods studies (n = 10). Of the quantitative studies, eight were cross-sectional (Armstrong, 2000; Burt & Burgermaster, 2017; Collins, Richards, Reeder, & Gray, 2015; Dawson, Richards, Collins, Reeder, & Gray, 2013; Drake & Lawson, 2015; Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Graham & Zidenberg-Cherr, 2005; Smith, Hansen, & Bryant, 2017). One randomized controlled trial used baseline and post-intervention measures to determine whether a garden program and associated curriculum successfully reduced obesity in Latino children, and provided key strategies for successful garden program implementation (Martinez, Gatto, Spruijt-Metz, & Davis, 2015).

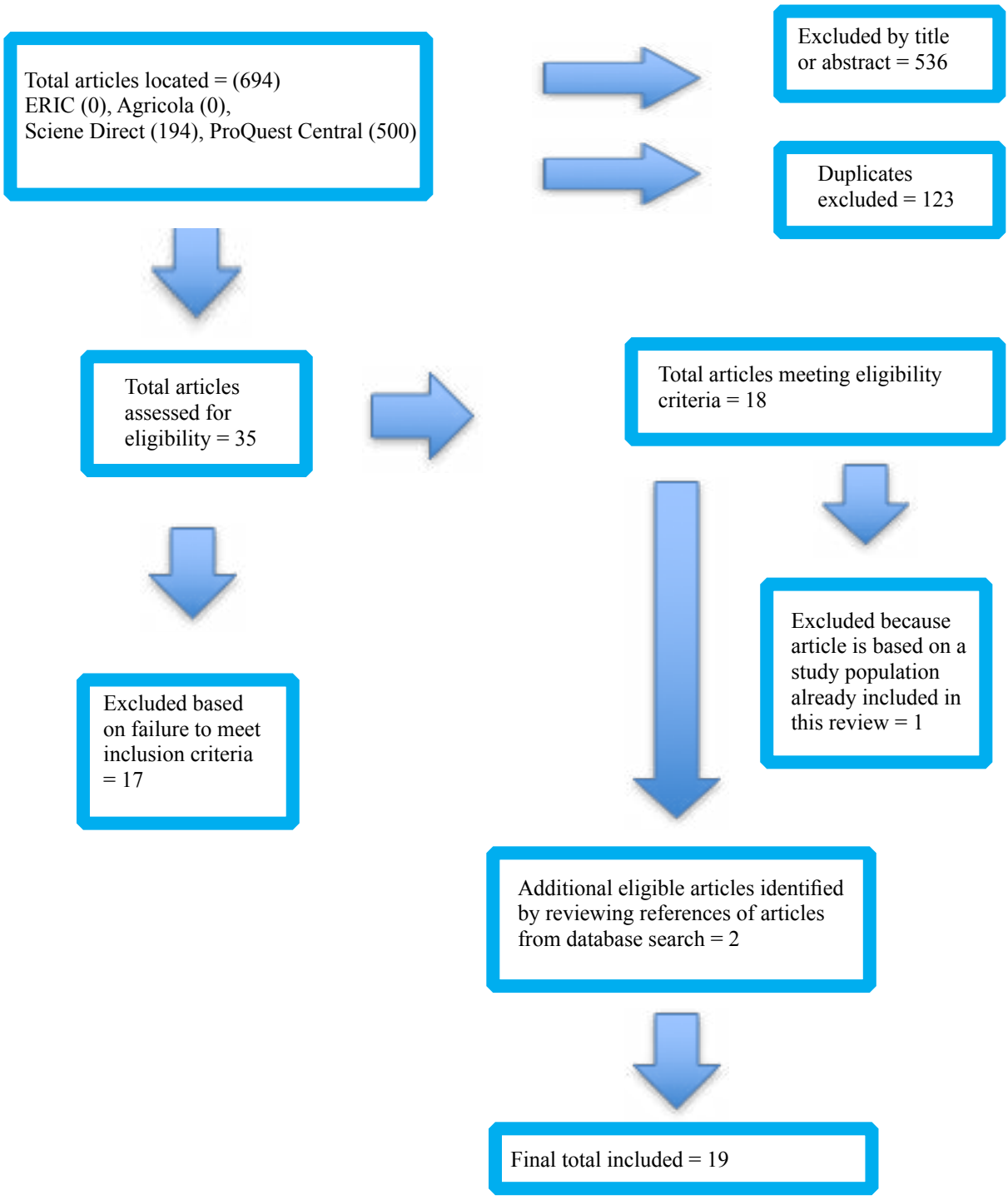

Figure 1. *A Flow Chart Depicting the Search and Screening Process.*

Of the qualitative studies, three used structured or semi-structured interviews with garden coordinators, principals, volunteers, or other key informants (Cohen & Reynolds, 2015; Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011; Townsend et al., 2014). One qualitative study utilized only document analysis (Hong, Benson, Russell, Powers, & Sanderson, 2017). There was one case study (Erickson, Barken, & Barken, 2015). Most of the mixed methods studies combined interviews with cross-sectional surveys or pre and post measures (Burt, Koch, & Contento, 2017; DeMarco, Relf, & McDaniel, 1999; Grier, Hill, Reese, Covington, Bennette, MacAuley, & Zoellner, 2015). One study combined results from a student food recall survey with analysis of garden coordinators' logbooks and journals related to garden implementation (Beery, Adatia, Segantin, & Skaer, 2014). All results are shown in Table 1.

Table 1. *Recommended Practices for School Garden Sustainability*

Author(s)	Purpose	Sample	Methods	Findings
Armstrong, 2000.	Describe goals and practices in successful community gardens.	20 community garden programs representing 63 total gardens in upstate New York.	Gardeners from each program completed surveys about the goals of their programs and practices used in their gardens.	Over half of the gardens had at least 10 regular volunteers, and half of the programs distributed a regular newsletter. Nearly all (90%) provided technical assistance to gardeners, and 30% provided education. Differences between reasons for gardening in rural versus urban areas suggests diverse needs. Rural farms were more likely interested in preserving culture and tradition, while urban farms were more likely to focus on mental and physical health benefits of gardening, and greater access to fresh fruits and vegetables.
Beery, Adatia, Segantin, & Skaer, 2014.	Identify processes and outcomes for food gardens in two different schools.	2 schools establishing permaculture food gardens.	Garden champions documented gardening interventions at each school. Students completed food recall surveys to assess effects on dietary intake.	Funding for both gardens was limited to one year. One garden failed after the initial year due to low budget. One garden survived, possibly because it had greater community support. Authors recommend mentorships from an experienced external gardener over a period of several years. Dietary changes were statistically insignificant, but attitudes towards fruits and vegetables improved.
Burt & Burgermaster, 2017.	Identify predictors of garden integration in New York City.	211 New York City school gardeners	Gardeners took a 2-part survey. Part 1 collected demographic data about each garden, and Part 2 used 19 Likert Scales to determine level of garden integration.	Size of the garden budget, extent of community partnerships, and evaluation of the garden and associated programming correlated positively with greater garden longevity.
Burt, Koch, & Contento, 2017.	Establish a tool describing how to establish and sustain a school garden.	21 schools in New York City meeting the requirements for a well-integrated school garden program.	Survey determined level of garden integration and garden characteristics. Interviews with key garden contact at each school. Children systematically observed during garden experiences.	Large proportion of successful school gardens are in containers and greenhouses. Many are not on school grounds. Majority had a group of adults and students responsible for garden care. All schools integrated multiple subjects into garden time (science, food/nutrition, language arts, etc.). All schools partnered with an external organization before starting the garden. Schools evaluated garden features to make changes that better met the needs of the school. Garden coordinators recommend a diverse network of partners and professional development for staff.

Cohen & Reynolds, 2015.	Describe goals and resource needs of urban agriculture projects, including community gardens, educational gardens, and commercial farms in New York City.	31 key informants, including urban gardeners and farmers, and employees of non-profit and philanthropic organizations supporting urban agriculture.	Key informants from four different stakeholder groups completed structured interviews. Researchers coded data to describe common goals and resource needs.	Urban farmers and gardeners identified goals related to environmental health, public health, education, and economic health of their communities. The greatest needs they identified included growing space, media like soil and amendments, funding, agency and political support (e.g. policymaking, regulations, security), networking, and program evaluation assistance. Some informants also felt that city resources more commonly went to affluent neighborhoods.
Collins, Richards, Reeder, & Gray, 2015.	Describe garden characteristics, practices, funding sources, and barriers in New Zealand primary and secondary schools.	491 primary and secondary schools in New Zealand.	Principals or garden coordinators from each randomly sampled school completed a mailed questionnaire.	Just over half of schools had a garden where students engaged in growing edible produce, and about half of those gardens were less than three years old. Programs most commonly grew vegetables and frequently sent produce home with students and/or ate produce in the classroom. Most common content areas for curriculum integration included science, health, and PE. Garden coordinators recommended building up resources gradually prior to garden implementation and using crop failure as a learning experience, rather than viewing it as failure.
Dawson, Richards, Collins, Reeder, & Gray, 2013.	Describe garden characteristics, practices, funding sources, and barriers in early childcare education centers (ECEC) in New Zealand.	382 ECEC providers in New Zealand.	A random sample of ECEC providers completed mailed questionnaires.	Funding for most ECEC gardens came from the centers themselves, so schools should build garden costs directly into budget as operating costs. Due to lack of land or usable space, authors recommend using portable containers or planting vertically on walls or fences. Most of the sample gardens (60%) were established in the last year or two.
DeMarco, Relf, & McDaniel, 1999.	Survey and interview teachers experienced in using gardening as a teaching tool to identify common factors for successful garden use and integration.	236 elementary teachers from 42 states who received a Youth Gardening Grant between 1994 and 1996.	Teachers completed a rank order grouping to identify factors most important to integrating gardens into the curriculum. 28 of the surveyed teachers living in Virginia also completed an interview about using school gardens.	Having someone responsible for gardening tasks was ranked as the most essential factor, followed by access to space, funding, and administrator support, in that order. Participants also ranked access to equipment, adequate instructional time, teachers' gardening knowledge, and sufficient volunteer help as essential, but less critical than the other factors. It is essential to establish favorable teacher attitudes toward garden prior to attempting curriculum integration.
Drake & Lawson, 2015.	Describe the challenges and experiences of community gardeners across contexts.	445 community gardeners in the U.S. and Canada	Web-based survey sent to American Community Gardening Association and Community Food Security Coalition e-mail lists.	Larger community garden organizations reported greater support from local governments. Improving networking skills and practices could increase levels of external support for gardens.

Erickson, Barken, & Barken, 2015.	Explore a social marketing approach to establishing a school garden.	Caroline Elementary School in Ithaca City School District, NY	Case study	Co-creation of the garden program increases buy-in and social marketing strategies can help secure volunteer and financial support. Cost to benefit ratio must be appealing to all stakeholders.
Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005.	Assess status of school gardens in California.	4,194 school principals in California	Survey sent to principals via e-mail and postal mail measured attitudes towards school gardens, resources needed, and barriers to sustaining school gardens.	A majority of schools (57%) had a school garden, and teachers were most commonly responsible for garden care, with parent volunteers and students providing additional support. Most principals perceived gardens as effective to enhance academic instruction, but not effective to enhance school meal programs. Most principals cited funding as the most needed form of support.
Graham & Zidenberg-Cherr, 2005.	Identify common barriers to garden-based education in California schools.	592 fourth grade teachers working in California schools reported that had school gardens.	Mailed questionnaire measured teacher attitudes and perceived barriers to integration of gardens into the curriculum.	Teachers perceived gardens as somewhat to very effective to improve science and nutrition education, as well as students' eating habits. Teachers reported that state resources to address barriers would be helpful to improve garden success. Authors recommend recruiting dieticians to train teachers to teach nutrition in gardens and classrooms, and more collaboration between teachers and foodservice staff.
Grier, Hill, Reese, Covington, Bennette, MacAuley, & Zoellner, 2015.	Assess implementation and effects of a community garden and nutrition education program on low socio-economic status youth.	Two public housing sites in Virginia serving 43 youth and 25 parents. Two site leaders were also involved in the study.	Semi-structured interviews with youth, parents, and site leaders. Attendance records and field notes kept for each week of the program. Baseline and follow-up surveys measured effects of the program.	Because the intervention targeted both youth and parents, unique barriers to program implementation included negative social norms, distractions, and interruptions generated by parents. Behavior management issues in the garden also reduced efficacy. Authors recommend separate sessions for parents and youth.
Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011.	Identify best practices for schools to establish and sustain school garden programs.	10 schools with highly successful school garden programs in California	Qualitative data analysis software used to compare themes from interviews with garden champions.	Successful garden programs have support from at least 3 groups of individuals (administrators, teachers, parent and community volunteers, and/or garden coordinators), and multiple funding sources. Garden coordinators submit multiple grant applications each year, hold annual fundraisers, and acquire donations from garden clubs or stores. A part or full-time garden coordinator is essential.
Hong, Benson, Russell, Powers, & Sanderson, 2017.	Identify common challenges and lessons learned in schools receiving USDA Farm to School grants.	83 school districts receiving USDA Farm to school grant funding between 2013-2015	Qualitative analysis of final reports submitted by each school district.	Schools with more successful garden programs engaged in community outreach and cross-curricular integration.

Jones, Weitkamp, Kimberlee, Salmon, & Orme, 2012.	Assess effects of Food for Life Partnership (FLP) on garden practices and outcomes.	55 primary schools participating in FLP in England	Garden champions in each school and students completed pre and post questionnaires. Garden champions completed semi-structured interviews. Students participated in focus groups following intervention.	Participating schools drastically increased the variety of plants grown, the amount of produce used in school lunches and nutrition education, and the amount of produce sent home with students and community members. Parent, student, and volunteer involvement in garden activities also increased in participating schools.
Martinez, Gatto, Spruijt-Metz, & Davis, 2015.	Identify key strategies for successful garden programs. Determine whether program is effective to reduce obesity in Latino children.	320 children in grades 3-5 involved in LA Sprouts program in Los Angeles, CA	2 out of 4 school sites participated in the intervention. Surveys and anthropometric data collected.	A strong interprofessional collaborative network reduced issues with funding, design, maintenance, buy-in, curriculum integration, and program evaluation. Community partners and volunteers included a landscape architect, after-school program leaders, parents, school staff and administrators, school board members, medical professionals, and university faculty and students. Sought stakeholder input throughout program implementation, and had in-depth conversations about expectations prior to program start. Avoided interfering with normal school day by implementing program during existing after-school programming.
Smith, Hansen, & Bryant, 2017.	Identify barriers to having a school garden and methods for integrating gardens into the school curriculum.	All elementary schools in Skagit County, Washington	Schools were surveyed to determine the status of their gardens (if they had one), and how gardens were integrated into the curriculum.	Garden coordinators commonly identified need for a garden curriculum, and professional development to train teachers to implement the curriculum in their content areas.
Townsend et al., 2014.	Describe volunteers participating in school garden programs in Victoria, Australia, and the benefits of volunteer partnerships for both the schools and the volunteers.	Six schools with garden programs and six comparison schools with no garden program.	Focus groups and semi-structured interviews conducted with school and community volunteers in six schools with garden programs, and with staff in six comparison schools. Researchers also conducted observations of participants.	Volunteers included parents and grandparents of students and former students, aging populations in assisted care facilities, adults with developmental disabilities, university students and faculty, and community organizations. Recommendations for increasing volunteer involvement included matching volunteer needs to roles in the garden program, and emphasizing benefits to volunteers.

Note. Table 1 summarizes the purpose, population, methods, and findings of all peer-reviewed literature that met the inclusion criteria for this review.

The most common recommendation for long-term garden sustainability was to establish an extensive network of community supporters. Nine of the 19 reviewed articles recommended a broad volunteer base with funding and support from people outside the school (Armstrong, 2000; Beery, Adatia, Segantin, & Skaer, 2014; Burt & Burgermaster, 2017; Burt, Koch, & Contento, 2017; Erickson, Barken, & Barken, 2015; Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011; Hong, Benson, Russell, Powers, & Sanderson, 2017; Martinez, Gatto, Spruijt-Metz, & Davis, 2015; Townsend et al., 2014). In one study, more than 50% of respondents reported having a team of 10 or more volunteers to help maintain the garden (Armstrong, 2000). In another study, authors found a positive correlation between larger networks of community supporters and the length of time garden programs had been in operation (Burt & Burgermaster, 2017). One study evaluating the success and practices of the *LA Sprouts* program, implemented in Los Angeles elementary schools, cited that support services from diverse professionals was crucial for garden program success (Martinez, Gatto, Spruijt-Metz, & Davis, 2015). The authors listed a landscape architect, medical professionals such as nurses and nutritionists, and university faculty as instrumental in program success (Martinez, Gatto, Spruijt-Metz, & Davis, 2015).

The second most common recommendation was to provide training or professional development to teachers and staff to improve gardening knowledge and skills, as well as integration of the garden into the curriculum. This recommendation was made in six of the 19 reviewed articles (Armstrong, 2000; Burt, Koch, & Contento, 2017; Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Graham & Zidenberg-Cherr, 2005; Martinez, Gatto, Spruijt-Metz, & Davis, 2015; Smith, Hansen, & Bryant, 2017). One study stated that bringing in external personnel to assist with teaching garden-based curricula jeopardizes garden sustainability, and school staff should receive training to teach garden-based nutrition and lessons in other content areas without relying on external assistance (Martinez, Gatto, Spruijt-Metz, & Davis, 2015). Three studies mentioned that lack of teacher knowledge, experience, and interest in gardening posed significant challenges, and that garden training would help improve sustainability (Collins, Richards, Reeder, & Gray, 2015; Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Graham & Zidenberg-Cherr, 2005). Two studies stated that teachers need professional development to implement a garden curriculum, or to integrate garden-based lessons into their existing curricula for health, physical education, science, and other content areas (Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011; Smith, Hansen, & Bryant, 2017).

Cross-curricular integration may be instrumental to address a third commonly cited strategy for sustainability. Three studies cited staff buy-in as a critical factor for survival of school garden programs (DeMarco, Relf, & McDaniel, 1999; Erickson, Barken, & Barken, 2015; Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011). When a larger proportion of teachers, administrators, and other staff members see the garden as an effective way to improve student health and academic achievement, the garden is less susceptible to elimination (DeMarco, Relf, & McDaniel, 1999; Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011). Four of the reviewed studies recommended integration of the garden into the school curriculum to increase staff buy-in (Burt, Koch, & Contento, 2017; Hong, Benson, Russell, Powers, & Sanderson, 2017; Smith, Hansen, & Bryant, 2017; Collins, Richards, Reeder, & Gray, 2015).

Discussion

Schools and communities establish garden programs for diverse reasons (Armstrong, 2000; Cohen & Reynolds, 2015). While urban garden programs may be more likely to focus on increasing access to fresh produce, and improving mental and emotional health, rural programs might focus on preserving agricultural traditions (Armstrong, 2000). Regardless of the goals behind a garden program, it is critical to evaluate the garden program, seeking stakeholder input at all stages, from planning and implementation, to assessment of garden outcomes. Successful garden programs are more likely to evaluate the program and make changes based on the results (Burt & Burgermaster, 2017; Burt, Koch, & Contento, 2017), and garden programs that have been planned, established, and maintained with input from multiple stakeholders may be more likely to survive due to buy-in from diverse groups (Erickson, Barken, & Barken, 2015; Martinez, Gatto, Spruijt-Metz, & Davis, 2015). Evaluation of garden program goals can also help build the volunteer base by matching goals of different aspects of the program to the needs of different volunteer groups (Townsend et al., 2014). For example, if a goal of the garden program is to increase students' nutrition knowledge, then a local university with a school health education program may have faculty and students willing to volunteer for tasks such as writing or teaching a garden-based curriculum that addresses the *National Health Education Standards* (NHES) (Centers for Disease Control and Prevention, 2016).

There is a high level of agreement that school garden programs should work to establish a diverse garden committee, preferably composed of a combination of teachers, administrators, students, parents, and community members (Burt, Koch, & Contento, 2017; Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011; Townsend et al., 2014). Diverse committees with buy-in from several groups ensures that gardens will not die out

Table 2. *Challenges to garden sustainability identified in the literature.*

Author(s)	**Challenges Identified**
Beery, Adatia, Segantin, & Skaer, 2014.	Grant funding not always renewed Difficult to procure other funding sources after initial grant expires Maintenance during summer months Cultural views of gardening (garden chores used as a form of punishment) may need to be addressed
Burt, Koch, & Contento, 2017.	Steep learning curve Creating new lessons or adapting previously taught lessons Behavior management issues in garden spaces Large financial investment upfront
Cohen & Reynolds, 2015.	Lack of space and funding Lack of supplies and growing media (soil, mulch, etc.) Lack of assistance to establish support network Lack of expertise in program evaluation Low priority for city maintenance and policy makers
Collins, Richards, Reeder, & Gray, 2015.	Time constraints Lack of funding Lack of gardening knowledge and experience among teachers Lack of support among school staff
Dawson, Richards, Collins, Reeder, & Gray, 2013.	Lack of funding Lack of land or usable space High staff turnover rates Lack of time to devote to garden activities and curriculum
Drake & Lawson, 2015.	Four common issues across geographical and organizational contexts include funding, participation, land, and materials.
Erickson, Barken, & Barken, 2015.	Already over-burdened teachers have no time for garden responsibilities and curriculum integration
Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005.	Lack of time to integrate garden with academic instruction Lack of standards-based curriculum Lack of teacher knowledge, interest, and training
Graham & Zidenberg-Cherr, 2005.	Lack of time to integrate garden into academic instruction Lack of teacher interest, experience, knowledge, and/or training in gardening
Grier, et al., 2015.	Must address negative social norms related to fresh fruits and vegetables, and tasting unfamiliar produce in the garden.
Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011.	Lack of time and funding Lack of standards-based curriculum, and teacher training to implement Need a paid full-time garden coordinator Lack of support from one or more essential groups, including administrators, teachers, and parent and community volunteers
Hong, Benson, Russell, Powers, & Sanderson, 2017.	Need for increased support systems to grantees. USDA should assist schools in establishing partnerships.
Jones, Weitkamp, Kimberlee, Salmon, & Orme, 2012.	Schools not collaborating with Food for Life Partnership may not have the capacity for similar success in improving variety and amount of produce, or involvement of external collaborators.
Martinez, Gatto, Spruijt-Metz, & Davis, 2015.	Need financial incentives needed to improve buy-in among teachers already pressed for time. Need specialized equipment to create adequate green space Bringing in external instructors to deliver the curriculum is not sustainable
Smith, Hansen, & Bryant, 2017.	Lack of funding over time to sustain gardens. No standards-based curricula to integrate gardens into core content. Teachers need training to implement garden-based lessons.
Townsend et al., 2014.	Recruiting and retaining volunteer base

when a single leader or champion leaves the project. Two studies recommended having a garden expert to mentor the school over a period of several years, or possibly on a permanent part-time or full-time basis (Beery, Adatia, Segantin, & Skaer, 2014; Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011). Another study stated that survey participants ranked having a garden coordinator who is ultimately responsible for garden tasks as the most essential factor in garden sustainability (DeMarco, Relf, & McDaniel, 1999). Although one study advised avoiding reliance on external support (Martinez, Gatto, Spruijt-Metz, & Davis, 2015), a diverse community network can supplement a well trained group of teachers and school staff members as an added layer of protection against garden loss. Schools may even do well to consider financial incentives for teachers who are already pressed for time and hesitant to take on additional responsibilities in the garden program (Martinez, Gatto, Spruijt-Metz, & Davis, 2015). If financial incentives are not feasible, another possibility is to release teachers from some of their other school responsibilities to allow them sufficient time for garden duties.

Additionally, because staff buy-in is crucial for school garden survival, curriculum integration across content areas should be a primary goal. Successful garden programs are more likely to integrate the garden into multiple content areas, giving a larger number of teachers and staff members a sense of ownership in the garden (Burt, Koch, & Contento, 2017). As previously mentioned, some of the studies recommended professional development for teachers, and some of these studies also expressed that professional development should include teacher training to deliver a standards-based garden curriculum (Hazzard, Moreno, Beall, & Zidenberg-Cherr, 2011; Smith, Hansen, & Bryant, 2017). Garden-based curricula that help students meet standards in health, physical education, science, and other content areas could prove crucial since lack of time to teach garden-based lessons is a major barrier for many schools with garden programs (DeMarco, Relf, & McDaniel, 1999; Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Graham & Zidenberg-Cherr, 2005; Dawson, Richards, Collins, Reeder, & Gray, 2013). This suggests that garden-based curricula must help students meet performance indicators on high stakes tests, or else risk elimination.

For health education, integrating the garden into health lessons is an easy fit. Lessons learned in the garden help students adopt behaviors they will need for a lifetime of health, such as eating foods that are nutritionally dense and low in calories, finding more opportunities for physical activity, and engaging in activities that are mentally and emotionally healthy. These behaviors align well with the (NHES) endorsed by the Centers for Disease Control and Prevention (CDC) (CDC, 2016), and the *Healthy Behavior Outcomes* (HBOs) found at https://www.education.nh.gov/instruction/school_health/documents/behavioral_curr.pdf. Health educators should combine HBOs with the NHES, which focus on skills like setting goals and practicing health-enhancing behaviors that reduce health risks. Together, these should frame garden-based health education to have significant effects on student health behaviors. Table 3 provides an example of how to align garden-based education with the HBOs and NHES, as well as the *Characteristics of an Effective Health Education Curriculum*, which are evidence-based and endorsed by the Division of Adolescent and School Health (CDC, 2015).

By employing strategies that have worked in diverse communities to extend the life of garden programs, schools can incorporate gardens into their curricula to help students adopt healthy behaviors, thus improving student health outcomes. As the body of literature has shown, many schools and communities value their garden programs for the returns they see on their investment. While every garden program works toward different goals, there is no question that many programs have positive effects on the learning and health behaviors of the youth involved. Administrators and teachers attest that garden-based instruction improves achievement, eating behaviors, and other outcomes (Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005; Graham & Zidenberg-Cherr, 2005). Given the number of gardens that are still in their early stages, the experiences of well established garden programs may provide critical guidance to sustain programs beyond initial funding, and through the commonly encountered challenges that many gardens face. The strategies outlined here serve as a starting point, and networking with local successful garden programs could provide additional guidance to schools hoping to enhance student health by combining a garden program with a standards-based, evidence-based health education curriculum.

Delimitations

Although PRISMA guidelines recommend the PICO framework for reviews of clinical trials and interventions (National Academy of Sciences, 2011), the author chose not to use the PICO framework for data extraction in this review. While population, intervention, and outcomes were all items included in the data extraction, comparisons were not included because many of the studies reviewed had no comparison or control group. The number of studies reviewed would have been severely limited if only studies using an experimental or quasi-experimental design were included. As shown in Table 1, the majority of the studies located were qualitative studies or mixed methods studies.

Table 3. *An Example of Standards-based Health Education with Garden Integration.*

Topic	**Eating Healthy**	
National Health Education Standard	NHES 7.8.2 Demonstrate healthy practices and behaviors that will maintain or improve the health of self and others.	NHES 3.8.2 Access valid health information from home, school, and community.
Healthy Behavior Outcomes	Choose foods that provide ample amounts of vitamins and minerals and relatively few calories.	Eat healthy snacks.
Objectives	Students will be able to locate and compare nutrition facts for produce grown in the garden (kale, broccoli, cauliflower, and carrots) with nutrition facts from a variety of processed snack foods (potato chips, energy bars, and trail mix).	When given a variety of snack food options, students will be able to identify which options are the most nutrient dense and the lowest in calories.
Assessment	Students will complete a graphic organizer that compares calories, fat, protein, carbohydrates, sugar, fiber, vitamins, and minerals in a variety of garden produce and processed snack foods.	Students will work in small groups to assemble low-calorie, nutrient-dense snacks from a bag of options provided by the teacher.
Characteristics of an Effective Health Education Curriculum	Provides age-appropriate and developmentally-appropriate information, learning strategies, teaching methods, and materials.	Focuses on clear health goals and related behavior outcomes.

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