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The Effects of School Gardens on Students and Schools: Conceptualization and Considerations for Maximizing Healthy Development

Emily J. Ozer, PhD

There are thousands of school gardens in the United States, and there is anecdotal evidence that school garden programs can enhance students' learning in academic, social, and health-related domains. There has been little rigorous research, however, on the effects of school gardens or on the factors that promote the sustainability of these programs. This review draws on ecological theory to conceptualize school gardens as systemic interventions with the potential for promoting the health and well-being of individual students in multiple interdependent domains and for strengthening the school environment as a setting for positive youth development. This review (a) summarizes the small literature regarding the impact of school garden curricula on student or school functioning, (b) provides a conceptual framework to guide future inquiry, (c) discusses implications of this conceptualization for practice, and (d) suggests further research needed to better inform practice.

Keywords: *school gardens; youth; health; youth development*

Historical and Policy Context

There is a growing U.S. movement for the “greening” of schoolyards through gardens at school sites, and much enthusiasm for the potential of garden-based learning in promoting healthy youth development. There are multiple rationales for the value of schools gardens, chiefly as outdoor “learning laboratories,” as aesthetically pleasing spaces for children to play, and, most recently, as places to promote the consumption of fresh produce among a youth population with markedly elevated rates of obesity and type 2 diabetes (Hedley et al., 2004). In the late 1990s, Delaine Eastin, then California’s Superintendent for Public Instruction, called for “a garden in every school.” State legislation was passed that set aside small start-up funds for schools interested in planting instructional gardens that included teaching and practice of sustainable waste-management techniques such as composting and recycling. There are now estimated to be more than 2,000 school gardens in the state of California being used for academic

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instruction in subjects including science, math, nutrition, environmental studies, and health (Graham, 2002) and many more nationally (National Gardening Association, 2004). In June 2004, national legislation was signed into law as part of the Child Nutrition Bill that—if appropriated for funding—could help cover the initial costs of school gardens in conjunction with nutrition education.

In school garden programs that grow edible produce, students generally learn science and nutrition concepts relevant to growing food while they work in the garden. Students harvest the vegetables and, in some programs, learn to cook nutritious meals from the harvest. Some programs include a “farm-to-school” component in which the school purchases produce from local farmers for its lunch program, and students visit farms to understand where food comes from and how it is grown (for information on the National Farm to School Program, go to <http://www.farmtoschool.org>). In food-growing garden programs, one central health-related goal is to stimulate youth—some of whom subsist on diets heavily based on packaged foods—to increase their consumption of fresh produce. Students also get some exercise as they engage in weeding, digging, and other manual labor associated with garden maintenance.

Goals of Review

Because of the current obesity crisis in the United States and the potential of school gardens and farm-to-school programs for promoting healthier eating, these models are likely to receive even greater attention in the coming years. In addition to evaluating the effects of school garden programs on nutrition and weight outcomes, it is important to test the potential influence of school gardens on other key health, academic, and psychosocial outcomes for school-aged youth. Drawing on principles of social ecology and community psychology (e.g., Kelly, Ryan, Altman, & Stelzner, 2000; Stokols, 1996), this review conceptualizes school gardens as systemic school-level interventions with the potential for (a) promoting the health and well-being of individual students in multiple domains (i.e., areas of functioning) and (b) strengthening the school environment as a setting for positive youth development. The growth of school garden programs has not been accompanied by systematic assessment of their impact. If there is to be “a garden in every school,” program development would be strengthened by identifying the characteristics of school gardens that are most effective in achieving intended outcomes. The central goals of this article are to (a) summarize the small research literature on the effects of school garden programs, (b) provide a conceptual framework to guide future inquiry, (c) identify implications of the conceptual framework and existing research base for practice, and (d) suggest further research needed to better inform practice. Prior to addressing these goals, an overview of the range of school garden implementation models and curricula is provided as context.

OVERVIEW OF IMPLEMENTATION MODELS AND CHALLENGES

Implementation Models

School garden programs and curricula build on models of hands-on, problem-based environmental and science education. They also are a form of community garden, providing a new setting for interactions among members of the school community and potentially promoting the social networks, sense of connectedness, and skills of the

community (Twiss, Dickinson, Duma, & Kleinman, 2003). Organizations concerned with sustainable agriculture and food systems have provided support for school gardens and farm-to-school programs as approaches for teaching children about ecological systems, linking food consumption to sustainable agriculture, and promoting land stewardship (for more information on the Center for Ecoliteracy, go to www.ecoliteracy.org). The current obesity crisis is focusing attention on these programs as a school-based means of promoting nutrition and exercise, but it should be noted that the overarching goals of many school gardens extend beyond individual health and behavior to environmental sustainability.

School garden programs vary widely in scope, intensity of participation, and integration into the regular school curriculum even within the same district. Although some school gardens include a wide expanse of plantings, others consist of a small number of aboveground planter boxes. With the exception of two surveys conducted in California and Florida, there has been little systematic documentation of school garden implementation. The main findings of the California survey—which had a 43% response rate representing 4,184 out of a total of 9,805 public school principals in the state—were that (a) gardens were more frequently reported in elementary and K-8 schools than in secondary schools; (b) 89% of principals viewed academic enhancement as the purpose of the garden in their school; (c) the subjects most frequently taught in the school gardens were science (95%), environmental studies (70%), nutrition (66%), language arts (60%), and math (59%); and (d) teachers were most frequently responsible for managing the garden program, followed by parent volunteers and students (Graham, 2002; Graham, Beall, Lussier, McLaughlin, & Zidenberg-Cherr, 2005). The Florida survey of 71 teachers indicated that most gardens were less than 2 years old and had a strong focus on environmental education (Skelly & Bradley, 2000).

Although the development process and scope of school gardens vary by school and district, there have been broad national and state efforts to develop and disseminate garden curricula. The U.S. Department of Agriculture, via the 4-H youth education branch of the Cooperative Extension Service, began disseminating the Junior Master Gardener's Program in 1999 and now has approximately 4,000 registered implementers (Boleman & Cummings, 2004). The Departments of Education in both California and Louisiana have developed school garden curricula with activities that promote specific state-achievement standards or learning objectives for each elementary grade level (California Department of Education, 2002; Louisiana Department of Education, 2004).

Partnership With Nonprofit Organizations

Several highly developed projects represent collaborations between school sites and nonprofit organizations, such as The Edible Schoolyard in Berkeley, California, and Earthworks in Boston, Massachusetts. The Edible Schoolyard involves weekly garden classes for sixth-graders and a full-service kitchen for weekly cooking classes (for more information on The Edible Schoolyard, go to www.edibleschoolyard.org/classroom.html); in 2005, the program will expand to include a new dining commons and school lunch program made with locally and organically grown seasonal produce. Earthworks has planted more than 20 fruit orchards in urban schools since 1989 and runs an Outdoor Classrooms environmental education program in elementary schools focused on “connecting children to the natural world while making science relevant and interesting and on promoting children’s stewardship of their neighborhoods and schoolyards (Earthworks, 2004). Both The Edible Schoolyard and Earthworks programs partner with national service programs and have volunteers from those programs working on-site.

Implementation Challenges

Schools face multiple challenges in the implementation of garden programs, mainly related to limited resources of funding, personnel, and time. A survey and case study evaluation in Los Angeles found that 14% of district schools included in the study previously had an active garden program that was not sustained (Azuma, Horan, & Gottlieb, 2001). Reasons given for the closure of the garden program were lack of (a) time on the part of teachers or maintenance staff “overloaded” with other duties, (b) funding, (c) support on the part of parents or volunteers, (d) gardening experience, and (e) space (e.g., space previously available for the garden lost because of an increase in portable classrooms). Other factors contributing to program closure were ineffective integration into the curriculum, vandalism, challenges in maintaining the garden during school vacations, illness or death of the teacher leading the program, and the garden program not being valued as a teaching tool in a time of increased accountability for student achievement. These conditions highlight the importance of developing a broad base of support for the school garden program among teachers and administrators at the school site as well as among parents and community volunteers. Not surprisingly, schools in the study with successful, sustained programs attributed their success to widespread, long-term support of the principal, teachers, parents, and students: for instance, “continued involvement of all stakeholders,” “everyone in the school community offers support and guidance. The school garden is an integral part of the curriculum at each grade level” (Azuma et al., 2001, p. 25). At one school, replanting low-maintenance annuals instead of vegetables helped sustain the program given limited time resources.

With little if any funding available from the state or the school districts for the overwhelming majority of school gardens, most school gardens rely heavily on donations of funding, technical assistance, labor, and materials from school and community members. For example, in one of the Los Angeles school gardens profiled in the case study evaluation, the school used a \$4,000 minigrant from the mayor’s office to buy plants, the garden planter boxes were built and installed by parent volunteers, and the student council cleared the boxes and purchased additional plants (Azuma et al., 2001). Although the gardens are often developed and maintained by volunteer efforts on the part of teachers, parents, and community members, there are clear benefits to funding at least a part-time teacher or garden coordinator to dedicate time to the garden program and its integration into the school curriculum. Not surprisingly, multiple practitioners expressed that having a paid staff person to organize the program is key to a well-coordinated and sustainable school garden program. In schools with active parent participation and fundraising, like the public K-8 Rooftop School in San Francisco, the PTA provides the sole funding for a part-time garden coordinator’s salary.

KNOWLEDGE BASE OF EFFECTS OF SCHOOL GARDEN PROGRAMS

This section begins by summarizing the small scientific literature on the relationship of school garden programs to youth development and health outcomes. This discussion then considers the observations of practitioners regarding the value, impact, and limitations of school garden programs. These perspectives are particularly critical because there is an active practice of school garden programs but little peer-reviewed research in this area. This review is further informed by interviews conducted by the author with

garden coordinators and observations of classes at approximately 20 school garden sites in two school districts in Northern California as well as interviews with several policy makers and district-level school garden coordinators in the region.

Peer-Reviewed Research

Using the keywords “school” and “garden,” the author searched the Psychinfo, PubMed, and ERIC electronic databases as of July 2005. Any published articles on school garden programs were read to identify any studies of the effects of garden programs or activities on students’ physical health, mental health, or academic performance. A search was also conducted using the keywords “community” and “garden”; these articles were then reviewed to identify any studies of community gardens at school sites. These three databases provide coverage of the research literature in the areas of health, education, psychology, and youth development. The reference sections of all identified publications were reviewed for further articles. School garden program Web sites and other relevant Web sites were searched to identify potential articles. Searches were also conducted on the Google search engine using “school garden” or “instructional garden” as keywords. Case study descriptions of school garden curricula or process studies of attitudes toward the curricula that did not assess any health, mental health, or academic outcomes were excluded from this review of published literature.

Fewer than 10 peer-reviewed journal articles were identified from these searches. After accounting for multiple publications from the same project, 5 separate research studies were identified and their findings are summarized below. This research was conducted mainly in the field of horticultural education and focused primarily on outcomes of health-related knowledge and food preferences (see Table 1). Four studies examined nutrition or physical activity outcomes. A well-designed, quasi-experimental study among 200 students (9 classes from 3 schools) found that fourth-grade children’s knowledge and preferences toward some but not all vegetables were greater in schools in which a school garden-enhanced nutrition education curriculum was implemented (Morris & Zidenberg-Cherr, 2002). A smaller pilot study (97 students from 2 schools) from the same research team used a pre/post design and reported that first-grade students in a school with a vegetable garden were more likely to taste vegetables than students in a control school (Morris, Neustadter, & Zidenberg-Cherr, 2001). Research using a pre/post design with a sample of 111 third- and fifth-graders from 5 schools suggested that a garden-based nutrition program was associated with more positive attitudes toward eating fruits and vegetables but was not associated with changes in self-reported eating behavior as measured by the 24-hour diet recall (Lineberger & Zajicek, 2000). Pre/post evaluation of 338 youth from school garden programs developed as part of community initiatives indicated increases in consumption of fruits/vegetables and physical activity (Twiss et al., 2003), although the statistical significance of the pre/post differences was not tested. One quasi-experimental study tested the impact of a school garden program on the attitudes toward school and interpersonal relationships of 598 children attending Grades 2 through 8. The findings suggested positive effects for girls but not boys and should be interpreted cautiously given the large variation in grade level and lack of information about students’ actual exposure to the program (Waliczek, Bradley, & Zajicek, 2001).

In summary, this small literature appears promising but inconclusive thus far. More research using rigorous evaluation designs and sufficiently large samples are needed to test the effects of school garden programs. Methodological considerations for future research are discussed in the final section.

Practice-Related Observations and Claims

Although there is little research on the impact of school garden programs, there are numerous observations and testimonials that these programs make a difference for students and schools. This anecdotal information is gleaned from program reports, program Web sites, and interviews conducted by the author with approximately 20 school garden coordinators and policy makers experienced in working with school gardens. Interviews and observations of school garden sites were conducted with the approval of the UC Berkeley Office for Protection of Human Subjects and the school districts. These observations and claims by advocates of school garden programs—not yet subjected to empirical evaluation—suggest potential directions for future research. What are the areas of impact suggested by those with direct experience with school gardens? In addition to nutrition, science learning, and environmental awareness, there are observations of school gardens promoting students' achievement, motivation to learn, psychosocial development (e.g., self-esteem, responsibility), behavioral engagement, and cooperation with peers (Pranis, 2004). School garden coordinators and policy makers have also cited a range of positive impacts on the school culture and environment, including collective pride that this is a “good” school; increased sense of “ownership” of the school by the students; the creation of a safe, adult-monitored setting during recess for children who do not feel comfortable on the blacktop; and increased roles and involvement at the school for immigrant and other parents who have agricultural but not formal academic skills.

CONCEPTUAL FRAMING OF POTENTIAL EFFECTS OF SCHOOL GARDENS

Conceptual framing of how school garden programs may exert their effects is important for informing practice and for the development of a coherent research and evaluation literature. School garden programs differ, but all have experiential education activities that are taught in a growing environment and some adult(s) who supports the students' learning in the growing environment. A social ecological-transactional perspective of human development views the child as nested within immediate contexts or micro-systems (e.g., school, family, community) that reciprocally interact with each other and the child over time to shape development (Bronfenbrenner, 1979; Cicchetti & Lynch, 1993). The transactional emphasis of this framework draws attention to how the different contexts that shape development influence each other as well as the child. The ecological principle of interdependence (Kelly et al., 2000), in which changes in one component of an ecosystem will produce changes in other components, further suggests that (a) changes in the school may set in motion processes of change in the family and community environments, and vice versa and (b) changes in one domain of student functioning (e.g., nutrition, bonding to school, and peer relationships) may influence other domains of functioning. The remainder of this article is devoted to discussion of a conceptual model on the effects of school gardens that is informed by this social-ecological framework. Figure 1 provides a visual representation of the major points of this conceptual model, depicting the potential short-term (proximal) and long-term (distal) effects of each component of school garden programs (see boxes at left of figure). These effects are conceptualized on the level of the individual student, the family and school micro-systems, and the interconnections among micro-systems (meso-system). Peer

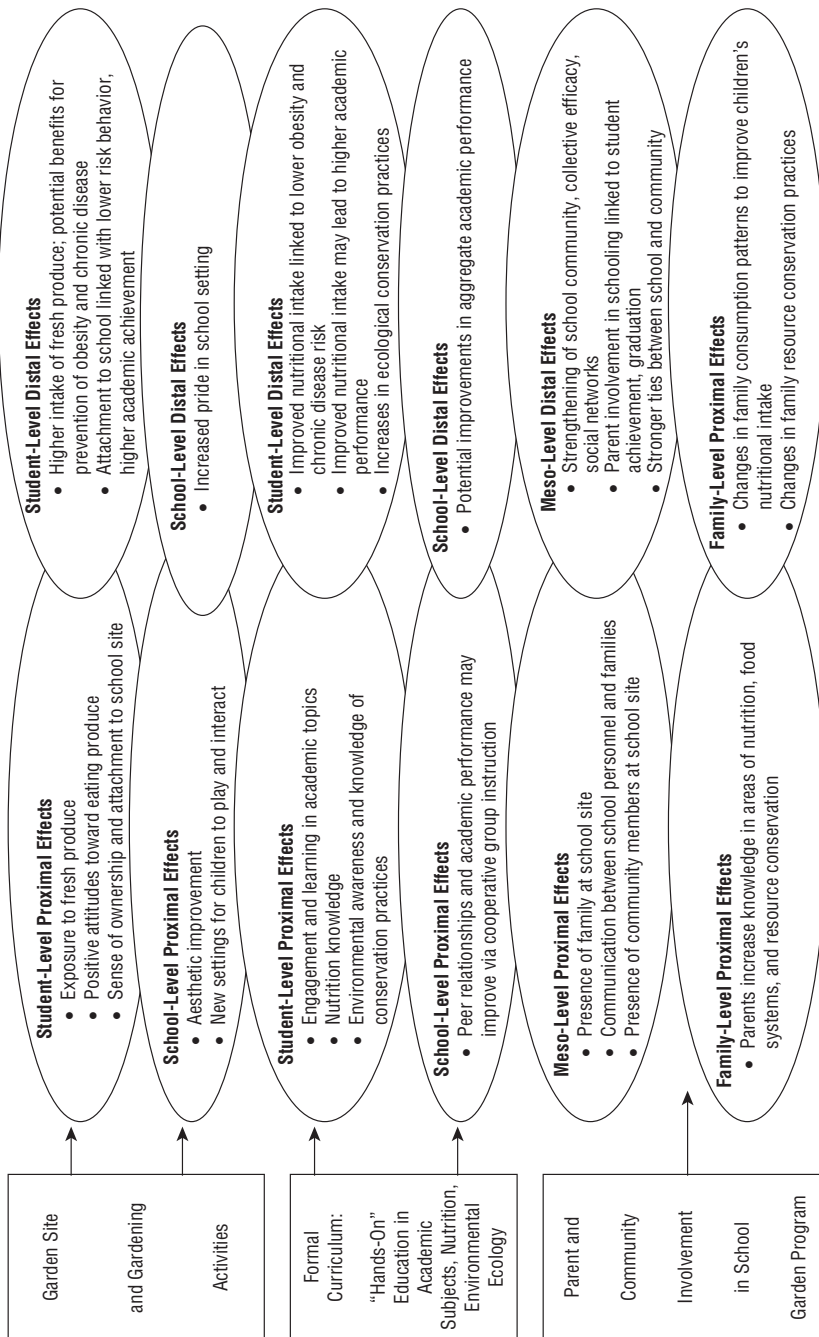


Figure 1. Conceptual model of potential effects of school garden programs. Figure is to be read from left to right, with components of programs (depicted in boxes) leading to potential proximal and distal effects (depicted in ovals).

relationships are discussed as a dimension of the school environment rather than as a separate micro-system because the focus is on student relationships within the school. The theoretical and empirical rationale for the consideration of each potential effect is described below and is followed by analysis of this conceptualization for practice and research.

Nutrition and Exercise

In the domains of nutrition and exercise, garden classes require some additional anaerobic exercise during the school day. Edible gardens provide students with the opportunity to become familiar with and eat produce that they have grown themselves, an experience that anecdotally increases the appeal of eating vegetables. Increasing the consumption of fruits and vegetables was a goal of the USDA's major "5-A-Day" campaign and is recommended by the American Academy of Pediatrics (2003) for the prevention of obesity among children. Although there has been surprisingly little epidemiological or experimental research on the relationship between consumption of fruits and vegetables and obesity (Rolls, Ello-Martin, & Tohill, 2004; Tohill, Seymour, Serdula, Kettel-Khan, & Rolls, 2004), inadequate consumption of vegetables among adolescents has been correlated with a range of poorer academic and health outcomes including lower academic performance, alcohol and drug use, being overweight, and weight dissatisfaction (Neumark-Sztainer, Story, Resnick, & Blum, 1996). It is notable that eating vegetables in a school garden program is a peer group activity, with the potential benefit of drawing on peer social influence to promote the view of consuming fresh produce as a normative practice. Nutrition curricula used in conjunction with some school garden programs teach topics such as food groups, nutritional and energy needs, how to read nutrition labeling, appropriate portion size, and the benefits of eating unprocessed foods (California Department of Education, 2001; Project Food, Land, & People, 2000).

Broader school policies and practices can serve to reinforce or undermine the work of the school garden or other nutrition-oriented programs. The school lunch and snack options send messages to students about appropriate food choices and also directly impact the environmental supports or constraints that students experience as they attempt to put into practice the lessons learned in the garden program. Creating a school environment that is supportive of healthful food choices will strengthen students' perceived self-efficacy to eat more healthfully and is more likely to lead to effective behavior change (Bandura, 1997). Many school districts have developed food policies in an effort to promote the nutrition of students. The sale of soda in vending machines has received particular attention because of data linking increased consumption of soda to obesity for youth (Ludwig, Peterson, & Gortmaker, 2001). New York and Los Angeles school districts banned sodas from school vending machines, and legislatures in states such as California, Massachusetts, Illinois, and Indiana are considering or have enacted statewide bans on the sale of soda in schools during the school day.

Although historically not covered by formal policy or curricular guidelines, informal school practices such as the use of candy to reward good behavior in classrooms, school fundraisers that involve candy sales, and the sometimes-poor nutritional content of food available at school-sponsored events can all undermine more formal nutrition education. Some districts have extended food policy beyond the school-lunch and vending-machine options to try to enhance the informal and family-based practices of the school community. The extent to which families and teachers follow these stated policies is not

known. Students spend only part of their day at school, so the resources and supports for healthful eating in the neighborhood and at home are also critical. It seems likely that school garden programs that have the goal of improving student nutrition will be more effective if parents become invested in the program. This could occur through activities such as parents' volunteering in the program, educational materials designed for parents, and homework assignments for students that involve parent input and promote familial discussion about food choices. Attempts to influence familial food practices should find ways of integrating traditional foods from ethnic and cultural groups represented at the school (Project Food, Land, & People, 2000).

In general, it would be expected that school garden programs focused on improving student nutrition will be most effective if they can promote (a) positive attitudes toward fresh produce by providing experiences of eating high-quality, fresh produce, some of which they may have helped to grow; (b) knowledge of the health benefits of more nutritious eating and the health risks of less nutritious eating; (c) peer and family norms that are supportive of healthful eating; and (d) environmental conditions in the school and, ideally, at home and in community that provide healthful food options and limit the ready accessibility to less healthful options.

School Bonding and Attachment

The construct of school "bonding" has not been used to describe the potential effects of school gardens on students, nor has the impact of school garden programs on students' level of school bonding been studied thus far. But anecdotal claims regarding the effects of school gardens reflect dimensions of students' feelings of attachment, pride, and belonging to their school as well as a sense of attachment to adults in the school setting. Garden coordinators and teachers have described students' referring to the space as "our garden" or students showing up early at school to see any changes that had happened in the garden overnight. In some schools, the school garden is open during lunch and after school, and it is place where some students come—outside of their time in the garden class—to help the garden coordinator and to spend time in the garden. One garden teacher talked about students "finding refuge" in the garden, particularly those who didn't fit in at the rest of the school or who did not appear to feel safe among the sometimes-rough physical play on the blacktop.

A growing body of empirical literature provides evidence that students' level of bonding or connection to school is related to a range of important health and achievement outcomes throughout adolescence and adulthood. Findings from the National Longitudinal Study of Adolescent Health indicate that adolescents who report feeling more connected to school show lower levels of emotional distress, risk behavior, and aggression (Resnick et al., 1997). Interventions that increase children's bonding to school have shown long-term results of lower substance use, delinquency, violence, academic problems, and sexual activity in adolescence and young adulthood (Hawkins, Guo, Hill, Battin-Pearson, & Abbott, 2001). The theoretical rationale underlying this approach is that students who become emotionally attached to their teachers and to their school will adopt the prosocial values espoused by the school; this social bond and internalized values will then serve to promote prosocial behavior and to inhibit anti-social behavior inconsistent with the values of the institution. Thus, attachment to school—in addition to attachment to family—serves as a key process for positive socialization that would be expected to influence a range of behaviors. If school garden programs *are* able to strengthen students' perceived connection and bonding to school,

the effects of these programs could extend well beyond nutrition to a range of other key academic, behavioral, and health domains.

Academic Performance

Potential Direct Effects on Academic Performance. Some school garden programs are focused on providing hands-on inquiry to promote learning about scientific and other concepts consistent with state-mandated learning objectives, or “standards.” For example, to understand how light is reflected, elementary school students use foil to reflect light onto some of the plants in a garden and compare the rates of growth between those that received light versus those that didn’t (Life Lab, 1990). To understand decomposition of matter, they study scavengers and identify the actions of decomposers (California Department of Education, 2002). Educators also developed garden-based curricula to support learning in math, social sciences, history, and other areas. For example, math skills are put into practice by selling produce from the garden or by graphing the results of an experiment in which students compared two identical crops grown with and without compost. Gardening itself also provides opportunities for naturalistic and “emergent” scientific inquiry (Rahm, 2002).

Potential Indirect Effects on Academic Performance. There are multiple indirect pathways by which school garden programs could affect students’ general academic behavior and performance. Global achievement should be most appropriately viewed as a distal outcome that would not necessarily be *expected* to change considering the small amount of time students spend in the school garden relative to the classroom. School garden programs could improve achievement, however, through the pathway of strengthening school bonding because children who are more invested in school are likely to care more about how their teachers view them and to engage in behaviors rewarded by the school such as attending classes and doing their homework (Hawkins et al., 2001).

School garden programs could also potentially affect academic achievement and behavior through other indirect pathways, such as student nutrition and parental involvement. Prior research indicates that children’s level of attention and academic performance are affected by their nutritional intake, particularly at breakfast (Pollitt & Mathews, 1998). There are consistent findings linking parental involvement in children’s schooling to their academic achievement (Eccles & Harold, 1996; Hill et al., 2004; Steinberg, 1996). As there are multiple pathways that may link school gardens to achievement, research and evaluation in this area should use the ecological framework discussed earlier to study relevant mediators and their potential independent and combined effects on outcomes.

Conservation and Ecological Commitment

Some school garden programs teach concepts and values related to promoting the sustainability of the natural environment and the conservation of natural resources. This curricular approach reflects an integration of science learning about biological ecosystems with values related to land stewardship (Project Food, Land, & People, 2000; see The Edible Schoolyard online at www.edibleschoolyard.org/classroom.html). Through curricular activities such as visits to local farms, farm-to-school lunch programs, recycling, and composting, students learn about how food production and consumption patterns impact the natural environment. According to Earthworks (2004), participating

students develop an “appreciation of the value of all living creatures and become protectors of the orchard. . . . Youth who once ripped plants out of the garden for fun now weed, water, and protect the garden and orchard crops.”

Characteristics of the School Setting

Rationale for Schoolwide Approach. One of the most promising aspects of school gardens as a model of school-based intervention is its potential to strengthen the school environment as a whole, beyond the health behavior of individual students. Prior research on school-based health promotion with youth demonstrates the effectiveness of programs that include a schoolwide component (Center for the Study and Prevention of Violence, 1998). If a school garden program succeeds in influencing the norms of the school, then these norms will support individual students’ efforts at maintaining the behavior and activities taught in the garden (e.g., consumption of healthful food, conservation of resources). As noted earlier, broader school policies and practices can serve to either reinforce or undermine the lessons in the school garden. When teenagers learn about nutrition, for example, their confidence in putting new knowledge and skills into practice in their real lives will depend on their expectations regarding the consequences of their behavior (Bandura, 1997). They are unlikely to engage in behavior that is going to have major costs for them in terms of how they see themselves, how others view them, and how they feel. Working for school-level change is consistent with ecological principles of intervention design that emphasize the importance of improving settings and institutions that influence human development in order to yield long-term benefits for the health and well-being of the population (Kelly et al., 2000; Vincent & Trickett, 1983).

Meaningful Dimensions of School Environment. Prior study of the social ecology of schools identifies multiple domains important for the functioning of schools and the academic and social development of the students. In the psychosocial domain, important features of the school environment noted in prior research include the quality of student interpersonal relationships and of student-teacher relationships in academic and social domains, achievement motivation, the sense of school community, order and discipline, opportunities for students’ meaningful participation, and parent involvement (Higgins-D’Alessandro & Sad, 1997; Solomon, Battistich, Watson, Schaps, & Lewis, 2000; Trickett & Moos, 1995). Important aspects of the school physical environment include the physical safety of students, cleanliness, and resources. Assessment of the school environment is generally conducted by aggregating the perceptions of students and staff as well as through observational methods. Anecdotal claims regarding the impact of school garden programs are most relevant to the school physical environment, sense of school community, students’ opportunities for meaningful participation, students’ interpersonal relationships, and parental involvement.

Physical Environment. The potential influence on the school physical environment is most obvious because the garden represents a new physical setting within the school. Schools differ widely in the availability of spaces with vegetation where children can play or sit; some urban school sites have only a concrete blacktop space. It makes intuitive sense that the creation of a school garden could substantially improve the aesthetics of some schools more than others depending on the preexisting resources for outdoor play and the size and landscaping of the garden. Some small school gardens consist of only a few raised beds or pots that may be adequate for learning and brightening the aesthetics but

don't create a "green space." Other school gardens consist of acres of plantings and structures that make a major aesthetic improvement and create a setting for new kinds of social interactions. Regardless of the size of the growing space, however, students and others may feel "ownership" and pride of the garden; thus, there could be a deepening sense of community and pride.

Peer Relationships. Garden learning is frequently conducted via group learning. Students often work together to achieve tasks such as planting, weeding, or building. Garden projects also draw on skills and interests not necessarily associated with high achievement in the regular classroom: for example, physical strength, visual-spatial skills, or experience in building. Garden teachers anecdotally comment that some students who struggle with classroom learning "shine" in the garden. Group work in the garden may temporarily reshuffle the patterns of classroom peer interactions based on classroom achievement, such that students in different reading groups are now working together. Cooperative group learning, involving small teams of students of different ability level as learning partners and providing recognition for group performance, has been associated with better peer relationships as well as higher academic achievement in the classroom (Marr, 1997; Moskowitz, Malvin, Schaeffer, & Schaps, 1983; Slavin, 1995). If school gardens are able to improve peer relationships, cooperative learning activities could serve as the mechanism. Documentation of school garden programs should include systematic observations of students' interactions in the garden. If garden activities are successful in promoting higher levels of cooperation or integration of students than the regular classroom, it would be important to study whether these positive interactions are sustained beyond the garden setting and how these interactions might be reinforced in other school settings.

Capacity and Collective Efficacy of School Community. The dimensions of community capacity and collective efficacy are relevant concepts for the study of the impact of school garden programs. Community capacity, as currently used in the public health and community development fields, generally refers to the knowledge and skills that the community can draw on to address issues of concern to them (Goodman et al. 1998). Perceived collective efficacy refers to a group's shared belief in its capabilities to act together to achieve desired outcomes or goals (Bandura, 1997). Like individual efficacy, collective efficacy is conceptualized not as a fixed, global characteristic but rather as a dynamic dimension specific to particular domains of functioning. A recent review on the health implications of community gardens emphasizes their capacity-building effects, although systematic research to evaluate the impact of community gardens on this and other social dimensions such as connectedness has been lacking (Twiss et al., 2003). Study of the effects of school gardens on school capacity and collective efficacy would benefit from rigorous assessment of the specific domains expected to be influenced to address questions regarding what kinds of skills and knowledge are enhanced and the areas in which collective efficacy beliefs are strengthened.

As discussed earlier, developing and sustaining school garden programs often rely on donations from parents and community members and involve staff, students, families, and community members in planning, fundraising, and work in the garden. The program thus provides opportunities for cooperation (and conflict) and could strengthen social networks within the school. If stakeholders are able to work effectively, they may feel more confident in working toward other goals. An unsuccessful attempt at working together, however, could undermine the sense of collective efficacy.

Parent Involvement

Parents' involvement in activities at their children's school site has been linked to students' higher academic achievement and lower dropout (Eccles & Harold, 1996; Hill et al., 2004; Snow, Barnes, Chandler, Goodman, & Hemphill, 1991; Steinberg, 1996). In the survey of Los Angeles school gardens, most (63%) but not all schools reported parent involvement in the garden. Because some garden programs often rely on parent and community volunteers during garden classes, for weekend work days, and for tending the garden during school vacations, there can be numerous opportunities for parent involvement at the school site. There is anecdotal evidence that school garden programs *can* increase the involvement of parents who—because of low levels of formal schooling or limited English skills—are not comfortable volunteering in classroom activities such as tutoring or working with reading groups. As in the case of students, the garden setting provides roles for parental involvement that draw on skills not necessarily tapped in classroom settings, such as physical strength, agricultural knowledge, and visual-spatial problem-solving skills. There is always the possibility, however, that the same group of parents who are already actively involved in other school activities would be those who volunteer to work on the garden. Prior research indicates that parents with lower incomes and greater financial pressures are less likely to be involved in the classroom, come to school open houses, and participate in the PTA (Gutman & Eccles, 1999). To expand parent participation, school garden programs will likely need to explicitly engage parents in the program by hosting events for families in the garden, having students bring home garden produce for tasting or cooking, or providing students with at-home assignments that require family participation.

School-Community Relationships

Many school garden programs were initiated or supported by the time or material donations of community members who do not have children attending the school. Some garden programs sell plants and other garden produce and donate the money earned to local community-based organizations and causes. In one school in Northern California, students donated their money to a nearby homeless shelter; the homeless clientele reciprocated by protecting the garden from vandalism (Eastin, personal communication, 2004). An in-depth qualitative study by Langhout and colleagues demonstrates the opportunities and barriers to school-community collaboration in a garden in a low-income Illinois school (Langhout, Rappaport, & Simmons, 2002). The garden was effective in bringing community members to the school site in the evenings and weekends, but there was little actual contact or collaboration between teachers and community members because teachers were not on-site during those times. Some garden programs explicitly focus on pressing social issues in the community. St. Elizabeth's School in Oakland, California, for example, developed a peace garden; as part of the theme, a local sculptor worked with the students to construct a large sculpture made out of guns—both real guns and toy guns—turned in by school families, community members, and students (Catholic News Service, 2004).

IMPLICATIONS FOR PRACTICE AND FURTHER RESEARCH

This review of relevant theory and research on school gardens, as well as observations from practitioners in the field, suggest several key implications for practice. First,

there are multiple pathways by which school garden programs may potentially strengthen the healthy development of students (e.g., nutritional intake, academic engagement and achievement, and sense of connection with school) while strengthening qualities of the school and the relationship of the school to the family and broader community. Although there has been very little research thus far assessing the effects of school garden programs, there is theoretical support for the potential of the program activities to directly or indirectly achieve intended outcomes. That is, the outcomes for which there is anecdotal or limited empirical support make conceptual sense; there are solid rationales for how school garden programs may exert such effects. It is uncertain, however, whether current school garden models are powerful enough to actually promote these effects.

Outcomes that depend on changes in health and social behavior—beyond gains in knowledge—are certainly more challenging to achieve. Across schools, there is wide variation in the proportion of students participating in the garden program and in the intensity of students' participation. It is not realistic to expect meaningful changes on the student or school level for a program that only engages a small number of students or engages a large proportion of the school on an occasional basis. There is likely to be much variation in the extent to which material taught in the school garden is reinforced in students' experiences in the rest of the school such as the cafeteria and classroom, at home, and in the community. It makes theoretical and intuitive sense that educational efforts limited only to the garden program are less likely to exert meaningful effects on students' actual behavior with respect to nutrition or other areas of health and social behavior. It would be important for future research and evaluation to assess the relative effectiveness of garden programs with varying levels of breadth with respect to curricular activities involving the whole school, family, and community contexts. Reinforcing the curriculum outside of the garden—in other key developmental contexts such as family and community—is likely to be less crucial for programs focused on academic knowledge gains in which the school garden is seen solely as a laboratory extension of the classroom.

Second, it is clear that school garden programs require long-term commitment and effort on the part of the principal and the school community to be adequately sustained. Programs with only one “champion” or leader at the school site are vulnerable to failure in the event of staff turnover, “burnout,” or other extenuating circumstances. Practitioners have frequently cited parent involvement during the school year and vacation breaks as essential to sustainability. The apparent need for widespread support emphasizes the importance of learning more about how effective “buy-in” can be achieved, particularly for schools with low resources and many competing demands. Thus, an important question for future research is: How do the approaches used to elicit buy-in and support from teachers, administrators, parents, and students relate to the effectiveness and long-term sustainability of the program? Losing external funding was one reason cited for the closure of several garden programs in the Los Angeles school district study (Azuma et al., 2001). If more funding is made available for school garden projects through federal or other funds, it would be important to consider how external funding could be used to strengthen rather than undermine initiative and commitment to the garden project on the part of the school community.

Third, competencies, health outcomes, and resources that school gardens can potentially affect are not randomly distributed in U.S. communities. Instead, low-income and ethnic minority children are more likely to be obese and have lower academic achievement, with low-SES (socioeconomic-status) schools in economically deprived areas less likely to have parental involvement (Gutman & Eccles, 1999; Hedley et al., 2004; Rury & Mirel, 1997; Weinstein, 2002) and financial resources from parents on which

to draw. Thus, school garden programs that are effective in achieving health and educational outcomes can serve as one relatively low-cost mechanism aimed at reducing health and educational disparities. The catch is that a sufficient level of resources is necessary to develop and sustain these largely “grassroots” garden programs. Schools with low levels of parent participation will likely face challenges in sustaining a program given the important role of parents in many school gardens; if there is sufficient parent involvement to develop the program, however, it may serve to expand the existing base. If parents or caregivers work full-time, it is clearly important for the program to provide ways for family to participate at home or during nonwork hours. Low-SES schools often characterized by lower aggregate academic achievement on standardized tests will likely need to experience major academic or social benefits of the garden program to justify the time and resources given recent U.S. federal legislation and sanctions regarding student achievement testing. For these schools, the potential benefits of the school garden in eliciting parental involvement and increasing achievement will be crucial.

Fourth, as clear from the above discussion, school garden models can differ greatly. It is essential that evaluation and research in this area document the specific components of garden programs and the ways in which these program elements are implemented and integrated into the school. If school garden programs are found to be effective in promoting any of the outcomes described above, systematic documentation of what these programs actually consisted of will be necessary to inform further development and diffusion. Above and beyond the content of program curricula and the details of the physical space, it is critical to understand the social activities and conditions created by the school garden program and the collaborative activities, conditions, and funding necessary to sustain it. These kinds of data enable diffusion efforts to focus on “best processes” (Green, 2001). Prior research on school-based programs suggests that the strength of programs can differ meaningfully within the same school (Ozer, Weinstein, Maslach, & Siegel, 1997); thus, it is crucial that evaluation and research on school garden programs *observe* what happens in school garden classes rather than assuming that implementation will be uniform.

Evaluation designs that rely on a combination of systematic qualitative and quantitative methods are needed to document the social conditions and processes generated by school garden programs and then link these processes and conditions to program outcomes. Multiple approaches to gathering data—surveys, interviews, and observations—should be used to strengthen the convergent validity of evidence for effects on the student and school level. Self-reported changes in students’ behavior, for example, could be supplemented by the report of parents or teachers and by observations as feasible and appropriate. Changes in the school environment should be assessed both by survey and interview data provided by students and staff and by systematic observations of the school setting. School records, such as unexcused absences, grades, and referrals, could also provide useful data.

Summary of Research Needed to Guide Effective Practice

There are now major gaps between research and practice with respect to school gardens. There is great enthusiasm and commitment “in the field,” and much anecdotal evidence regarding positive impact. Thus far, evidence from the small empirical literature has not provided similar support. Further research is needed to provide stronger tests of school gardens within the domains of individual and school functioning discussed here and to identify best practices and processes associated with meaningful effects and

long-term sustainability. Although school gardens may be part of a systemic response to the U.S. obesity crisis, it is important that inquiry on school gardens extend beyond nutrition to the potential effects on the psychosocial and academic development of youth and on the school as a setting for development.

Beyond investigating whether school garden programs are effective in influencing relevant health and social outcomes, it is critical to study how and why these effects might be achieved, namely: (a) the factors—on the level of the individual, family, school, and community—that might mediate or moderate these effects; (b) how short-term changes in knowledge and attitudes might relate to longer-term changes in social, academic, or health domains; and (c) the implementation factors that contribute to the sustainability of effective school garden programs. As discussed earlier, some potential effects of school gardens may occur through indirect, mediational pathways, such as the possibility that school gardens could eventually raise academic achievement by improving bonding to school, nutrition, or parental involvement. Thus, research should address questions including: Who benefits the most from school garden programs and why? Is more intensive participation associated with stronger effects? Are programs with multiple components (e.g., cooking classes or farm visits in addition to the garden) more effective? How do schools and families reinforce program learning to promote long-term effects? How do the approaches used to elicit buy-in from teachers, administrators, parents, and students relate to the long-term sustainability of the program? Another policy-relevant question is the extent to which school garden programs provide value over and above other kinds of hands-on learning curricula such as art and woodshop. In summary, school gardens are a promising approach in promoting the physical, psychosocial, and intellectual development of school-aged children while also potentially strengthening the school setting. Rigorous research and evaluation in this time of possible increases in the funding and growth of school garden programs could effectively capitalize on this upsurge of interest and provide a knowledge base to inform effective practice.

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