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The Association Between Duration of School Garden Exposure and Self-Reported Learning and School Connectedness

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Abstract

When students feel connected to their school, they experience positive health and academic outcomes. In contrast, school disengagement is a predictor of dropout, delinquency, and substance use. School garden programming has the potential to help children achieve academic outcomes and feel connected to their school. Unfortunately, most school garden research has been conducted with white, affluent study participants. We describe the results of a secondary analysis utilizing data from an evaluation of a university-supported community school garden program (CSGP). Using a cross-sectional survey study design, we examined the impact of school garden programming in Title I schools on primarily Latino/a (Hispanic) elementary student self-reported learning and feelings of school connectedness by comparing students with ≤1 year exposure to those with >1 year. Social cognitive theory formed the conceptual basis for the analysis. Duration of school garden exposure did not have a significant association with self-reported learning or feelings of school connectedness. Regardless of past exposure, fifth-grade students, females, and those who identify as Latino/a (Hispanic) felt that school garden programming improved their learning. Latino/a (Hispanic) students who participate in school garden programming may also feel a greater sense of connection to their teachers and peers at school. Qualitative results demonstrated that most students enjoyed spending time in the garden and indicated that participating in the program helped them learn new things and feel connected to their school. If individuals who may be disadvantaged because of systemic racism, such as Latino/a (Hispanic) students, can benefit from school garden programming, such interventions should be further investigated and prioritized.

Keywords

school garden, learning, school connectedness, elementary school

School connectedness is "the belief by students that adults and peers in the school care about their learning as well as about them as individuals" (Centers for Disease Control and Prevention, 2009a). A greater sense of school connectedness is associated with a reduction in numerous health-compromising outcomes among students including: suicidal thoughts and behaviors (Marraccini & Brier, 2017), substance abuse (Resnick et al., 1997; Weatherson et al., 2018), risk of unintentional injury, school absenteeism, and violence (Resnick et al., 1997). In addition, evidence demonstrates that school connectedness is related to improved academic performance (Bradley et al., 2021; Centers for Disease Control and Prevention, 2010; Daily et al., 2019).

School garden programming has the potential to help children successfully achieve academic outcomes and feel connected to their school (Korchmaros et al., 2017) School gardens appear to have a positive impact on students' grades, knowledge, and attitudes (Williams & Dixon, 2013). In a randomized controlled trial, children who participated in school garden programing showed a greater increase in science knowledge compared to the control group (Wells et al., 2015). Exposure to school garden programing can also have a positive effect on students' interpersonal relationships (Malberg

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Dyg & Wistoft, 2018; Sands & Summer, 2017; Waliczek et al., 2001) and feelings of school solidarity (Moore et al., 2015).

Objective

Most school garden research has been conducted with white, affluent participants (Turner et al., 2016). To provide a different perspective, we describe results from a school garden intervention focused primarily on students who are Latino/a (Hispanic)[1] and live in poverty-stressed households. We conducted a secondary analysis of data from an evaluation of the University of Arizona Community and School Garden Program (CSGP). Our primary objective was to determine whether duration of garden exposure was associated with third-, fourth-, and fifth-grade student self-reported learning of school subjects such as science as well as gardening abilities. Our secondary objective was to determine whether duration of garden exposure was associated with third-, fourth-, and fifth-grade student feelings of school connectedness. If gardens have the potential to influence academic outcomes and school connectedness, it is important that we understand how they impact all students.

Theoretical Framework. We used Albert Bandura's social cognitive theory (SCT) as our theoretical framework (Bandura, 1986) and for interpretation of results. In the SCT, Bandura posits that learning occurs in a social context (such as a school) with reciprocal determinism or the dynamic, give-and-take of interactions between a person (individual), the environment (external social context), and behavior (response to stimuli) (Bandura, 1986). According to SCT, goal setting and social support help to support self-regulation and the adoption of new behaviors. In this case, we considered the person to be a student, the environment to be a school garden, and the behavior to be participating in CSGP programming. Students are expected to learn not just from their own experiences with the CSGP but also by observing others' experiences with CSGP. Furthermore, it is expected that student learning and feeling connected will be positively impacted by their participation in CSGP as a result of the structured goal-focused CSGP activities that require the students to work together with guidance from, support from, and being held accountable by their teachers and garden instructors. We followed reporting guidelines for evaluations with nonrandomized designs and intervention descriptions (Des et al., 2004; Hoffmann et al., 2014).

Methods

University of Arizona Community and School Garden Program (CSGP)

Since 2011, the University of Arizona CSGP has worked to enhance learning by establishing gardens in 22 schools where university students intern to support garden programming . University and K-12 students work together to foster curiosity and integrate hands-on learning techniques. Each 16-week university semester, undergraduate and graduate students participate in a service-learning course, attending weekly classes and interning 3 to 12 hours per week in a CSGP school. Students from numerous majors (e.g., public health, nutrition, environmental studies, etc.) take the course. The class is cross-listed in nine departments across campus. For some departments, it is an elective, and for others, the class satisfies the university engagement requirement. The course is based in the School of Geography, Development, and Environment.

The CSGP provides the interns and teachers with grade-appropriate and subject-specific, garden-based lesson plans. The CSGP team developed the lessons according to Common Core standards (Arizona Department of Education, 2021) while also following the principles of place-based education (Sobel, 2014). The interns and/or teachers select lessons based on the season, intern interest or expertise, and current classroom curricula. In addition, the CSGP provides workshops for teachers on gardening and how to apply the lesson plans. Garden lesson plan materials can be accessed on the CSGP website (https://schoolgardens.arizona.edu/).

Exposure

At the time of the evaluation, School A had used their garden for at least a decade. School A also contains a city-block of undisturbed desert land that became a learning laboratory. The CSGP supported project-based learning in the School A garden and learning laboratory for six of those years through interns and/or teachers who brought students to the garden on a weekly basis to conduct both regular garden maintenance such as watering or weeding, as well as educational tasks like observing insects and their relationships to growing plants.

At the time of the evaluation, the current garden at School B was 8 years old. Located in an abandoned lot across the street from the school in a historically Mexican American neighborhood, the garden features local plants and a shrine representing the community's values and traditions. In addition to vegetable plots and a chicken coop, School B also has an aquaponics system in the library. Teacher interest determined student participation in the CSGP. When classrooms were involved, students usually went to the garden at least once a week and took part in activities such as planting seeds, composting, learning about ecology, and eating garden vegetables.

When the primary data were collected, the garden at School C was 11 years old. Located in the school courtyard, School C has the most garden infrastructure including vegetable plots, a chicken coop, compost piles, an aquaponics system in a greenhouse, a desert tortoise habitat, and a native species garden. School C also has its own independent farmers market where students sell the produce they grow. All teachers at School C are trained in how to incorporate the garden into their classroom. Students at School C interact with the garden daily by planting seeds, watering, tending the chickens, and turning compost.

Participants

Elementary school teachers at schools A, B, and C sent third-, fourth-, and fifth-grade students home with consent forms. Over 30 days, school staff reminded parents and guardians to sign and return the forms when they picked their children up from school. Out of 499 third-, fourth-, and fifth-grade students attending the three participating elementary schools during the 2016–17 school year, 128 students had signed consent forms (25.6%). To attain equal representation from each class participating in the evaluation and to enable timely collection of data, CSGP staff generated randomly ordered class lists and instructed the interns to survey 8 to 10 students with signed consent forms per classroom. The interns surveyed 89 students in total. We excluded individuals from the quantitative analysis who chose not to share their gender identity ($n = 2$) due to sparseness. Eighty-eight students (including one student who did not share their gender identity) answered the open-ended questions. Thus, the sample size for the quantitative analysis was 87 students (17.4% of study body) and the sample size for the qualitative analysis was 88 students (17.6% of study body). CSGP evaluators collected data at three elementary schools with majority Latino/a (Hispanic) students. All three schools have Title I designation, meaning more than 75% of students are eligible for the free and reduced-priced lunch program, a commonly used indicator that students live in a poverty-stressed setting.

Procedure

University of Arizona staff and professors used a cross-sectional survey study design to assess the impact of the CSGP. We used quantitative survey data to test the hypotheses that school garden exposure will positively influence students' self-reported learning and/or feelings of school connectedness. We used qualitative survey data (open-ended questions) to build on our quantitative findings by searching for learning and school connectedness themes in students' responses to questions exploring their likes, dislikes, and suggestions for change in their school garden. The inclusion criteria were parental or guardian consent, student assent, and attendance at one of the CSGP schools participating in the evaluation. This evaluation was conducted in 2017 when interns and teachers delivered CSGP lessons face-to-face, in group settings in the school gardens.

Based on current literature and the evaluators' expertise as well as the priority population, evaluators developed survey questions to examine the following theoretical constructs of interest: school-related connectedness; education-related gains (e.g., motivation); community connectedness; appreciation of earth's processes and social and environmental justice; gardening, nutrition, and environmental knowledge; gardening and nutrition-related behavior; emotional well-being; and satisfaction with the program. Sitting in the garden, CSGP interns orally administered questionnaires (including both the closed and open-ended questions) to the participants in a one-on-one, private, in-person setting at one time point during their participation in the garden program. They orally administered the questionnaires to eliminate the influence of reading literacy on the data collected (Bowling, 2005). The interns asked students to reflect on their school garden experience. Thus, the data collection was based on the elementary school students' current feelings and opinions. The surveys were not recorded and transcribed. Students needed about 15 minutes to complete the survey. The interns collected the information on iPads using a university-supported online survey platform. The CSGP did not provide incentives for participation in the study. Results from the original evaluation are reported elsewhere (Korchmaros et al., 2017). In this manuscript, we describe a secondary analysis of these data.

Quantitative Measures

Primary Outcome. Our primary outcome variable for the secondary analysis of the CSGP evaluation data was self-reported learning. To measure learning, we combined relevant questions from the original CSGP evaluation survey into one 7-item learning scale. These items are presented in Table 1. The response options for each of the seven items on the questionnaire were a 5-point Likert-type scale ranging from (0) "not at all" to (4) "very much." The sum of the seven items had a possible score ranging from 0 to 28, with higher scores indicating more self-reported learning. The internal consistency, as measured by Cronbach's alpha, was 0.74.

Secondary Outcome. Our secondary outcome for the secondary analysis of CSGP evaluation data was feelings of school connectedness. To measure school connectedness, we used three questions from the original evaluation survey that each captured one component of school connectedness: desire to attend school, teacher connectedness, and peer connectedness (Table 1). As the internal consistency for these three questions was low (Cronbach's alpha = 0.59), we did not create a general school connectedness scale but rather modeled each subcomponent of school connectedness separately. The self-reported learning and school connectedness questions had the same 5-point response scale with higher scores indicating more school connectedness.

Exposure to School Garden Programming. We operationalized exposure to school garden programming as duration of time students were involved in the school garden. The categorical response options were new during the evaluation year (less than 1 year) ($n = 9$), 1 year ($n = 14$), and more than 1 year ($n = 64$). To address sparseness, we dichotomized the response as: either 1 year or less ($n = 23$) or more than 1 year ($n = 64$).

Covariates. We included the following covariates in our models: gender (female; male), grade (third and fourth; fifth), ethnicity (identified as Latino/a [Hispanic]; did not identify as Latino/a [Hispanic]), and language spoken at home (English;

Table 1. Categorization of Survey Items From the University-Supported School Garden Program Evaluation for Use in the Present Study.

Survey items Likert-type scale response ranging from *not at all* (0) to *very much* (4)	Constructs utilized in the present study
The school garden helps me to learn subjects like math, reading, culture, and science.	Self-reported learning
Working in the garden makes me want to learn about plants, water, animals, and other things.	
I feel confident that I could make a plant grow.	
Having a school garden has taught me about what foods help me to be healthy.	
Having a garden has taught me how important biodiversity is.	
Having a garden at school makes it easy to learn.	
Working in the garden makes me think about how the rain and water is important to growing food.	
Working in the garden makes me want to come to school.	Desire to attend school
Learning in the school garden makes me feel closer to my teacher.	Teacher connectedness
The garden makes me feel close to my classmates.	Peer connectedness

Language other than English). We chose these covariates a priori because we expected that they were related to both duration of school garden exposure as well as self-reported learning and school connectedness. Thus, we anticipated that these covariates would explain at least some of the overlap in variance between the exposure and outcome variables.

After ensuring that collinearity did not exist between grade and school garden exposure or ethnicity and language spoken at home, we adjusted several variables due to sparseness. We combined the third- and fourth-grade students into one group because the data from School B did not include any third-grade students. We also added the students who selected Not Latino/a (non-Hispanic) with those who chose the response option "Do not want to answer" to form the group "Did not identify as Latino/a (Hispanic)." While we reported on race in our descriptive statistics, we did not include race as a covariate because numerous students chose not to answer the question (49%). The faculty who conducted the original evaluation noted that many people do not distinguish Latino/a (Hispanic) ethnicity from race (i.e., many people identify as Latino/a or Hispanic alone, not as Hispanic and white or another race). Similarly, we merged those who reported speaking Spanish at home with the students who responded that they spoke other languages apart from English or Spanish at home ($n = 7$) into the "Language other than English" group.

Qualitative Data

The CSGP evaluation included the following open-ended questions: what do you most like about the garden program? Is there anything you do not like about the garden program? and what would you change about the garden program?

Analysis

Quantitative

Primary Analysis. To examine whether school garden exposure was associated with individual student self-reported learning, we first conducted an unadjusted linear mixed model (without additional covariates) with garden exposure as a fixed effect, and school as a random effect to account for nonindependence within each school. Mixed models are common regression method that is used when the assumption of independent observations does not hold (for example, repeated measures on the same person or clustering by schools or clinics) (Laird & Ware, 1982; Snijders & Bosker, 2011). Second, we conducted an adjusted mixed model (with covariates) with school again as the random effect and garden exposure, gender, grade, ethnicity, and language spoken at home as the fixed effects.

Secondary Analysis. To examine whether school garden exposure was associated with individual student feelings of school connectedness, we repeated our unadjusted and adjusted linear mixed models. Again, school was included as a random effect and garden exposure, gender, grade, ethnicity, and language spoken at home were the fixed effects.

Sensitivity Analysis. We performed two sensitivity analyses. First, we examined whether our decision to dichotomize the exposure variable (duration of garden involvement) changed the effect of the CSGP on self-reported learning and school connectedness. We recategorized our exposure into three categories: new this year (less than 1 year) ($n = 9$), 1 year ($n = 14$), and more than 1 year ($n = 64$). Second, to determine whether influential observations impacted our results, we removed observations with self-reported learning scores that were more than three standard deviations from the mean, considering these to be outliers ($n = 2$). To conserve space within this manuscript, we have included the results of the sensitivity analyses in a supplementary file (Supplemental Appendix A). We conducted all analyses using Stata version 16.1 (College Station, TX; see Supplemental Appendix B for relevant Stata code).

Qualitative

We adapted Maguire and Delahunt's (2017) 6-step qualitative analysis methods for our small data set. The first (A.M.L.) and

Table 2. Characteristics and Program Outcomes of a University-Supported, School Garden Program in the Southwest United States: Third-, Fourth-, and Fifth-Grade Student Evaluation Participants ($N = 87$).

	Elementary School			
Characteristic[a]	School A 26 (30)	School B 20 (23)	School C 41 (47)	Total 87 (100)
Gender, *N* (%)				
Female	12 (46)	14 (67)	22 (52)	48 (54)
Grade, *N* (%)				
3rd	8 (31)	0 (0)	19 (46)	27 (31)
4th	10 (38)	12 (60)	13 (32)	35 (40)
5th	8 (31)	8 (40)	9 (22)	25 (29)
Ethnic identity, *N* (%)				
Identified as Latino/a (Hispanic)	10 (38)	15 (75)	28 (68)	53 (61)
Did not identify as Latino/a (Hispanic)[b]	16 (62)	5 (25)	13 (32)	34 (39)
Race *N* (%)				
White students	11 (42)	5 (23)	6 (15)	22 (25)
Students of color[c]	6 (23)	6 (26)	11 (27)	23 (26)
Do not want to answer	9 (35)	9 (45)	24 (59)	42 (48)
Language spoken at home, *N* (%)				
English	21 (81)	14 (70)	17 (41)	52 (60)
Language other than English	5 (19)	6 (30)	24 (59)	35 (40)
Duration of exposure, *N* (%)				
One year or less	2 (8)	3 (15)	17 (41)	22 (26)
More than 1 year	22 (92)	17 (85)	24 (59)	63 (74)
Self-reported learning, mean (*SD*)[d]	21.6 (5.0)	24.5 (2.9)	23.5 (4.3)	23.2 (4.3)
Desire to attend school (*SD*)[e]	3.4 (0.9)	3.5 (0.9)	3.4 (1.1)	3.4 (1.0)
Teacher connectedness (*SD*)[f]	2.5 (1.1)	3.0 (0.8)	2.8 (1.0)	2.7 (1.0)
Peer connectedness (*SD*)[g]	3.0 (1.1)	3.4 (1.1)	3.0 (1.1)	3.1 (1.1)

Note. *SD* = standard deviation.

[a]The percent missingness was between 0% and 2%. [b]The "Did not identify as Latino/a (Hispanic) group includes students who self-identified as Not Latino/a (Non-Hispanic) and students who selected 'Do not want to answer'." [c]The Students of Color group includes students who self-identified as black, Native American/Alaska Native, Asian/Pacific Islander, and/or Other. [d]The possible score range for self-reported learning is 0–28, higher scores mean more learning. [e]Using Likert-type scale responses ranging from *Not at all* (0)—*Very Much* (4), we measured desire to attend school using the question statement: Working in the garden makes me want to come to school. [f]Using Likert-type scale responses ranging from *Not at all* (0)—*Very Much* (4), we measured teacher connectedness using the question statement: Learning in the school garden makes me feel closer to my teacher. [g]Using Likert-type scale responses ranging from *Not at all* (0)—*Very Much* (4), we measured school connectedness using the question statement: The garden makes me feel close to my classmates.

last (J.K.) authors read through the qualitative data, generated codes, searched for additional themes, reviewed and defined the themes, and wrote up our results (Maguire & Delahunt, 2017). We used the SCT constructs (personal, environment, and behavior) to deductively develop codes about self-reported learning resulting from the reciprocal determinism of students participating in CSGP at their school (e.g., elements that supported learning included feeling calm in garden space [personal], school garden flora and fauna [environment], and the opportunity to try something new through CSGP programming [behavior]). In addition, we inductively created codes about school connectedness and garden program feedback. As the data set was only 2,132 words total, we conducted the analysis in Microsoft Excel (version 16.45). After individually coding the responses, the two coders reached 94% agreement. We discussed our disagreements and together decided on the most appropriate codes. The qualitative analysts work at the University of Arizona, identify as white and female, and focus their research on social justice issues that prioritize historically resilient populations.

Results

Results of Quantitative Analyses

Study Participants. Of the 87 evaluation participants, the majority attended School C (47%). The schools varied in terms of grade (third, fourth, and fifth), ethnicity (Latino/a [Hispanic] or not Latino/a [Hispanic]), as well as language spoken at home (English or a language other than English) (Table 2).

Self-Reported Learning. The overall mean score of self-reported learning was 23.2 out of 28 and was similar between

schools (Table 2). We examined the relationship between school garden exposure (≤1 year vs. >1 year) and self-reported learning. In our unadjusted model, school garden exposure did not have a statistically significant association with participants' self-reported learning (1.00; 95% confidence interval [CI] = −1.14, 3.15). In our adjusted model, school garden exposure was also not significantly associated with participants' self-reported learning (−0.11; 95% CI = −1.93, 1.72). Grade level, gender, and ethnicity showed statistically significant associations with self-reported learning. Being a fifth-grade student resulted in a 2.75-point higher score (95% CI = 0.94, 4.56) than third or fourth graders. Identifying as female resulted in a 1.92-point higher score (95% CI = 0.31, 3.53) compared to identifying as male. In addition, identifying as Latino/a (Hispanic) resulted in a 3.36-point higher score (95% CI = 1.53, 5.19) than not identifying as Latino/a (Hispanic) (Table 3). The sensitivity analyses produced similar results: students' self-reported learning was not associated with school garden exposure (Supplemental Appendix A).

School Connectedness. The overall mean scores, out of 4 points of desire to attend school (3.4), teacher connectedness (2.7), and peer connectedness (3.1) were also similar between schools (Table 2). We examined the relationship between school garden exposure and student feelings of school connectedness. In our adjusted models, length of school garden exposure was not significantly associated with desire to attend school (−0.29; 95% CI = −0.77, 0.19), teacher connectedness (0.01; 95% CI = −0.50, 0.48), nor peer connectedness (−0.09; 95% CI = −0.62, 0.43). Ethnicity showed a statistically significant association with teacher and peer connectedness, where identifying as Latino/a (Hispanic) was associated with higher teacher connectedness (0.49; 95% CI = 0.01, 0.97) and peer connectedness (0.66; 95% CI = 0.15, 1.17) as compared to not identifying in this way (Table 4). The sensitivity analyses produced similar results: students' feelings of school connectedness were not associated with garden exposure (Supplemental Appendix A).

Qualitative

Guided by the SCT and our inductive codes, we identified three areas of interest that emerged from the qualitative data: self-reported learning, school connectedness, and garden program feedback. We noted that although we used all the codes when analyzing the data from both exposure groups, the responses from the students with more garden exposure were on average 11 words longer and, thus, more detailed than the students with less school garden exposure.

One in three students (33%) stated that they were learning a variety of subjects such as ecology and healthy habits. About 2 of every 10 students (18%) reported feelings of school connectedness, often in conjunction with self-reported learning. They described pride toward their school and a sense of connection to their teachers and peers. In contrast, in response to the question "Is there anything you dislike about the garden program?," 3% of students reported an absence of peer connectedness. They described tension and conflict between students.

Most students (75%) said they enjoyed gardening. They liked eating garden produce, participating in new opportunities, being in a calm, relaxing space, helping others through gardening, interacting with the flora and fauna, and maintaining their health through gardening. Two of every 10 students (22%) also reported things they disliked about the garden, such as getting dirty, insects, hot weather, and the possibility of getting hurt. Many students (60%) suggested changes to the program including more or different plants, animals, or infrastructure. Only 7% of students reported that there was nothing they liked, whereas 74% of students said there was nothing they disliked and 32% of students said they would not add or change anything about the garden program. These percentages are not independent, and so can sum to >100 because some students said there was nothing they disliked and that they would not change anything (Table 5).

Discussion

The objective of this evaluation was to determine whether duration of garden exposure was associated with student self-reported learning and school connectedness. Our quantitative results suggest that duration of school garden exposure was not associated with self-reported learning or school connectedness. Regardless of past school garden exposure, however, fifth-grade students, females, and those who identify as Latino/a (Hispanic) reported that school garden programming improves their learning. Latino/a (Hispanic) students who participate in school garden programming also indicated feeling a greater sense of connection to their teachers and peers at school.

Our analysis benefited from using the SCT in guiding the examination of the impact of CSGP because it provided a theoretical framework to study learning from the students' perspective. Results from the SCT directed qualitative analysis indicated that most students enjoyed spending time in the garden and indicated that participating in the CSGP helped them learn new things. In a literature review, Berezowitz et al. (2015) found similar results in that school garden exposure may favorably impact academic performance. Through inductive coding, we also learned that participating in the CSGP helped students feel connected to their school. Correspondingly, in a scoping review on the impact of school gardens on youth social and emotional learning (SEL) (which can lead to school connectedness (Battistich et al., 2004), Lohr et al. (2020) highlighted eight articles with findings suggesting that school gardens have the potential to impact SEL. In addition, in our analysis, 74% of respondents said there was nothing they disliked about the program. These findings indicate that the CSGP is meeting student expectations as part of the school learning environment and, in general, students are

Table 3. Results From the Unadjusted and Adjusted Analyses of Self-Reported Learning[a] Among Third-, Fourth-, and Fifth-Grade Students Who Participated in the University-Supported School Garden Program.

Variable	Unadjusted coefficient[b] $N = 80$	*P* value (95% CI)	Adjusted coefficient $N = 80$	*P* value (95% CI)[c]
School garden exposure				
(≤1 year of school garden exposure)	—		—	—
>1 year of school garden exposure	1.00	.36 [−1.14, 3.15]	−0.11	.91 [−1.93, 1.72]
Gender				
Male			—	—
Female			1.92	.02 [0.31, 3.53]
Grade				
Third and fourth			—	—
Fifth			2.75	<.01 [0.94, 4.56]
Ethnicity				
Did not identify as Latino/a (Hispanic)			—	—
Identified as Latino/a (Hispanic)			3.36	<.01 [1.53, 5.19]
Language spoken at home				
English			—	—
Language other than English			0.38	.68 [−1.42, 2.17]

Note. CI = confidence interval; — = reference group.
[a]The possible score range for self-reported learning is 0 to 28. [b]The coefficients are unstandardized. [c]The first *p* value for each outcome is for the test of difference from the adjusted model.

satisfied with their experiences. In contrast, 3% of students reported an absence of peer connectedness. This result implies the importance of student management and the need to ensure all students' well-being.

It is important to note that in the original evaluation, the evaluators found that 69% of elementary school participants reported the school garden helped them learn subjects like math. Similarly, 82% of elementary school participants felt that working in the garden motivated them to attend school (Korchmaros et al., 2017). These results indicate that the majority of students are learning and building a sense of connectedness in the school garden. Thus, the quantitate results from our secondary analysis did not indicate that CSGP participation influenced students' self-reported learning or feelings of school connectedness. However, our qualitative results as well as the findings from the original evaluation suggest that not only did students learn as a result of the reciprocal determinism that occurred when they participated in the CSGP, this experience may also have increased their feelings of school connectedness. Going forward, perhaps rather than duration of exposure as a moderator of the impact of a school garden on learning or feelings of connectedness, school culture should be examined. School culture is "the beliefs, perceptions, relationships, attitudes and written and unwritten rules that shape and influence every aspect of how a school functions" ("Glossary of Education Reform: School Culture," 2013). Examination of the influence of school culture, as well as the specific influence of particular aspects of the CSGP, such as goal-setting and social support, may inform the advancement of CSGP as well as the application of the SCT to CSGP.

Strengths and Limitations. One strength was that we collected data in a real-world setting from a population often excluded from the literature: Latino/a (Hispanic) youth who live in poverty-stressed households. In addition, to measure the impact of school gardens on learning, it is common for researchers to use objective measures (in the form of tests) to assess knowledge before and after an intervention to examine change in student learning over time. However, this method tends to favor students who are good test takers and introduces the possibility of the influence of the pretest on learning. We offered an alternative perspective by asking students whether they felt the school garden enhanced their learning. Thus, we sought to empower students to evaluate their own unique learning process.

Limitations of the evaluation included the small sample size (and therefore low power). We collected data in Title I schools where family time is strained, and research consent forms are a very low priority. Additional limitations included the absence of third graders from School B, an exposure variable that was possibly too narrow, and lack of a standardized questionnaire. Furthermore, school gardens are inherently unique and, consequently, exposure during an academic term differed by school. Thus, our results should be interpreted cautiously and may not be generalizable to other settings or populations. Finally, although being a fifth-grade student was associated with higher self-reported learning scores, this may be a result of maturity or feelings of emotional attachment as they transition from elementary to middle school rather than grade. As we did not measure these variables, we could not include them in our model.

Table 4. Results From the Adjusted Analyses of School Connectedness Among Third-, Fourth-, and Fifth-Grade Students Who Participated in the University-Supported School Garden Program.

	Desire to attend school ($N = 84$)[a]		Teacher connectedness ($N = 81$)[b]		Peer connectedness ($N = 85$)[c]	
Variable	Coefficient[d]	*P* value (95% CI)	Coefficient	*P* value (95% CI)	Coefficient	*P* value (95% CI)
School garden exposure						
≤1 year of school garden exposure	—		—	—	—	—
>1 year of school garden exposure	−0.29	.24 [−0.77, 0.19]	0.01	.96 [−0.50, 0.48]	−0.09	.73 [−0.62, 0.43]
Gender						
Male	—	—	—	—	—	—
Female	0.40	.06 [−0.02, 0.82]	−0.04	.85 [−0.48, 0.40]	0.23	.32 [−0.22, 0.69]
Grade						
Third and fourth	—	—	—	—	—	—
Fifth	0.29	.23 [−0.19, 0.77]	0.11	.68 [−0.39, 0.60]	−0.09	.72 [−0.62, 0.43]
Ethnicity						
Did not identify as Latino/a (Hispanic)	—	—	—	—	—	—
Identified as Latino/a (Hispanic)	−0.07	.78 [−0.54, 0.41]	0.49	.05 [0.01, 0.97]	0.66	.01 [0.15, 1.17]
Language spoken at home						
English	—	—	—	—	—	—
Language other than English	0.23	.34 [−0.24, 0.69]	0.22	.38 [−0.27, 0.70]	−0.10	.71 [−0.61, 0.41]

Note. CI = confidence Interval; — = reference group.
[a]Using Likert-type scale responses ranging from *Not at all* (0)—*Very Much* (4), we measured desire to attend school using the question statement: Working in the garden makes me want to come to school. [b]Using Likert-type scale responses ranging from *Not at all* (0)—*Very Much* (4), we measured teacher connectedness using the question statement: Learning in the school garden makes me feel closer to my teacher. [c]Using Likert-type scale responses ranging from *Not at all* (0)—*Very Much* (4), we measured school connectedness using the question statement: The garden makes me feel close to my classmates. [d]The coefficients are unstandardized.

Table 5. Qualitative Response Examples From a University-Support Community and School Garden Program Secondary Analysis.[a]

Area of interest	Question and corresponding quote
Self-reported learning	• What do you most like about the garden program? ◦ "That like it lets kids go out and learn about plants and water and eat healthy and grow their own plants at home."
School connectedness	• What do you most like about the garden program? ◦ "Getting to plant, observe and learn. Also, feeling proud about developing the tortoise habitat and seeing the whole school interact with the garden." ◦ "I like holding the chickens and the things you get to plant, and the teachers are nice to do more programs for us." • Is there anything you don't like about the garden program? ◦ "Kids get overexcited and start to push and yell."
Garden program feedback	• What do you most like about the garden program? ◦ "That during the summer we get to feed the chickens and we get to pick new plants to grow, and we use those vegetables to cook with and it keeps us healthy." • Is there anything you don't like about the garden program? ◦ "It can be a bit dangerous with cactus around and rocks to trip on. Also, I wish there were more animals to see."

[a]The evaluators asked students the following questions: What do you most like about the garden program? Is there anything you don't like about the garden program? and What would you change about the garden program?

Implications

Our findings situate a university-supported school garden program that primarily serves youth who are Latino/a (Hispanic) and live in poverty-stressed households within existing work on school gardens. Although the results showed that students reported learning and feeling connected to their school because of their exposure to the school garden, we did not find a relationship between these constructs and duration of school garden exposure. In previous

work with the same population, Lohr et al. (2020) found that longer school garden exposure influenced students' attitudes and behaviors toward vegetables. Thus, the effect of duration of school garden exposure may be specific to certain outcomes.

The results from our secondary data analysis suggest that regardless of school garden exposure, students are learning and feeling more connected to their school because of CSGP programming. This may be especially true for Latino/a (Hispanic) students. Groups such as the American Public Health Association have called for more evidence-based programming to eliminate ethnic disparities (American Public Health Association, 2001). If individuals who may be put at a disadvantage because of systemic racism, such as Latino/a (Hispanic) students, can benefit from school garden programming, such programming should be further investigated and prioritized. We encourage other researchers to examine the predictors of self-reported learning and school connectedness in the context of school garden programming.

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Supplemental Material

Supplemental material for this article is available online.

Note

1. We use Latino/a (Hispanic) to describe our priority population because this is the term used in the original evaluation survey.

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