



More PEAS Please! Teaching Teachers How to Integrate Food-based Learning Into Preschool Science

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INTRODUCTION

Dietary quality is a driver of overweight/obesity,^{1,2} malnutrition, other diet-related noncommunicable diseases,^{3,4} and poor school readiness outcomes⁵ among preschool children (aged 3–5 years) from low-resource backgrounds.^{6,7} One-third of children entering *Head Start*, the federally funded preschool program that serves preschool children and families from low-income backgrounds,⁸ are classified as overweight or obese (body mass index \geq 85th percentile), putting them at risk for the development of chronic diseases, lower self-esteem, and psychological and social distress.⁹ These combined factors are also associated with poor health and academic performance.¹⁰

One approach for improving children's dietary intake is the repeated exposure strategy, which frequently offers children the same foods.^{11,12} Unfortunately, the number of required taste exposures needed to impact children's preferences for healthy foods, especially vegetables, is difficult to achieve, particularly for families from low-resource backgrounds because of concerns about food waste.^{12,13} *Head Start* teachers are uniquely positioned to promote daily positive dietary behaviors to young children from families of low-income. Teachers have cited themselves as "parents at school" to indicate the significant impact they can have on children's dietary quality¹⁴ through classroom experiences with food.^{15,16}

Food-based learning (FBL) approaches that use the repeated exposure method to provide opportunities for children to explore fruits and vegetables have been demonstrated as effective in improving dietary quality.^{15–18} However, *Head Start* teachers reportedly face barriers to using FBL in the classroom, such as limited time and competing school readiness priorities.^{9,19} *Head Start* teachers and administrators have previously suggested that these limitations could be overcome by integrating nutrition into other learning domains (eg, science, language) to impact children's dietary quality and school readiness outcomes.^{1,8} Early childhood teachers have also expressed a need for professional development on effectively integrating FBL across domains.^{1,8,20,21}

INTERVENTION DESCRIPTION

More PEAS Please! is a multilevel intervention that focuses on improving children's dietary quality and school readiness (science knowledge and scientific language development) through early exposure and access to healthy foods in high-quality science learning environments. High-quality science learning environments provide developmentally appropriate hands-on, child-led, inquiry-based experiences for children and professional preparation and support for educators.^{22,23} These environments engage and support the whole child with exploration and science inquiry.²⁴ The *More PEAS Please!* intervention was developed by multidisciplinary university faculty members with expertise in early childhood education and development, nutrition

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and nutrition education, language development and literacy, science education, and early childhood teacher professional development.

Based on the Social Cognitive Theory²⁵ and Interconnected Model of Teacher Professional Growth²⁶ (ICMTPG), the goal of our intervention is to improve the quality of children's early language and science learning experiences by supporting teachers' instructional practices focused on integrating nutrition into other learning domains (eg, science, language) through FBL. Social Cognitive Theory emphasizes agency within an environment, the sense of control over one's actions and experiences.²⁵ Specifically, the integration of Social Cognitive Theory constructs enabled our team to examine the influence that individual experiences and environmental factors have on teacher practices. The ICMTPG presents teachers' change and growth in their classroom/center environment through ongoing cycles of reflection and enactment through 4 domains (personal domain, external domain, domain of practice, and domain of consequences).²⁶ The ICMTPG model is instrumental in understanding *Preschool Education in Applied Sciences* (PEAS) teachers' learning trajectory and how this trajectory changes over time throughout their participation in the intervention.

With an emphasis on evidence-based teaching practices vs a conventional curriculum, each component of the intervention focuses on 1 of 4 areas: implementing high-quality science learning (practice science); engaging children in food-based experiences (engage the senses); developing language skills (apply science talk); and supporting children's learning using developmentally and culturally appropriate strategies (support learning) (Figure 1). Teachers were also encouraged and provided with ideas on extending learning through family and community engagement, such as sharing classroom work with families and inviting parents and/or community members as guest speakers.

Teacher participation in *More PEAS Please!* consisted of (1) attending an initial 1-day training

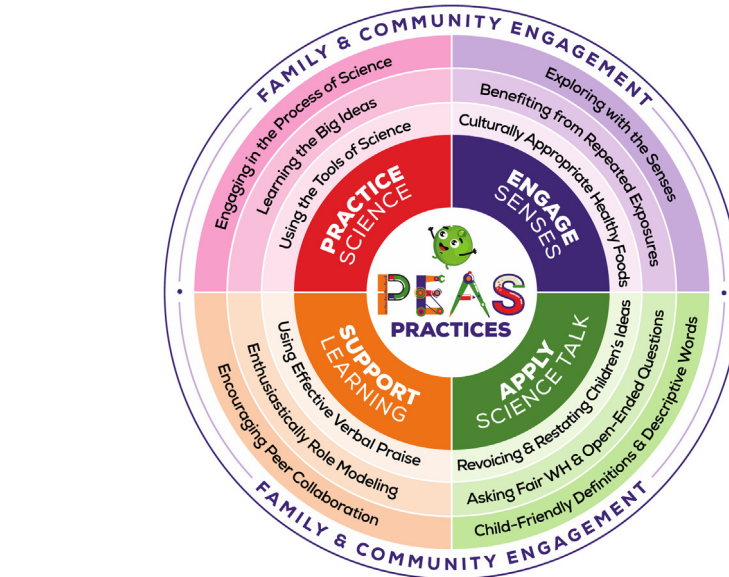


Figure 1. Preschool Education in Applied Sciences (PEAS) teaching practices.

workshop, (2) completing 6 learning modules (online or paper-based), (3) implementing 16 science learning classroom activities to practice key PEAS strategies using fresh vegetables, and (4) receiving ongoing support from the research team and professional learning communities. Figure 2 describes the program's components in more detail.

The 1-day workshop introduced teachers to the program and our team during their inservice training before the start of the school year. As teachers progressed through the program, they watched engaging hand-drawn whiteboard videos for each learning module featuring the 3 evidence-based strategies for each PEAS practice (Figure 1). Each module had 4 accompanying model science learning activities designed to support teachers' ability to practice evidence-based strategies by integrating nutrition, science, and language instruction in the classroom. Each module's activities focused on a single topic (eg, living vs nonliving, seeds, plants, plant parts) and ended with an opportunity for children to taste test 4 target vegetables (carrot, tomato, spinach, and peas). Fresh vegetables were funded through *Head Start's* participation in the *Child and Adult Food Care Program*, and we

coordinated with *Head Start* Nutrition Managers to order food throughout the year. We provided environmental support by improving the quality and variety of foods offered to children and teachers during meals and snacks²⁷ and providing teachers with all materials, teaching guides, and instructions needed for the 16 PEAS model activities. These activities were designed to model science learning, support language development, promote school readiness, reduce teacher-identified barriers,¹⁸ and facilitate uptake by aligning with the Next Generation Science Standards and *Head Start's* Early Learning Outcomes Framework.^{28,29} Furthermore, teachers received direct support from our research team during monthly virtual professional learning community (PLC) meetings. These meetings were teacher-driven, researcher-supported, and held on school-designated teacher workdays. Topics of discussion ranged from teachers' current progress in the program to issues with modules and activities that teachers were encountering. Teachers who chose to participate in the PLC meetings were compensated an additional \$15/meeting for their time. Working with teachers, our research team brainstormed solutions for



Program Components

1-day Kick-starter Pre-service Workshop

- 1-day kick off workshop during pre-service training prior to the start of the school year
- Workshop introduced teachers to the program's mission and goals; provided teachers with hands-on learning focused on the PEAS Practices; and established center-based Professional Learning Communities (PLC)
- At the end of the workshop, teachers are provided with all materials, books, and instructions needed to implement the intervention.



On-demand Learning Modules

- Following the workshop, teachers continued program activities through engagement with 6 learning modules (available online and paper-based).
- Module 1 reviewed the program. Module 2-5 introduced each of the PEAS Practices. Module 6 discussed how to create food-based science learning activities using the PEAS Practices.
- The core learning modules (2-5) asked teachers to set goals, implement model learning activities (see below), and reflect on their experiences.



Food-based Life Science Learning Activities

- Teachers "practiced" using the PEAS Practices by implementing model learning activities that modeled how to use food to teach science and develop language.
- Teachers were asked to implement 4 units (16 activities) Learning focused on the Life Sciences.
- Topics included: Living and Non-Living Things (Unit 1); Seeds (Unit 2); Plants (Unit 3); and Plant Anatomy (Unit 4).
- Fresh vegetables were integrated into learning activities: spinach, tomatoes, carrots, and peas.



Environmental Supports

- PEAS staff provided teachers with feedback and technical support virtually and in-person throughout the year.
- PEAS staff worked with the program's Nutrition Manager to integrate target vegetables into the existing school menu and make fresh vegetables available to teachers in support of learning activities.
- PEAS staff supported teachers as they form PLCs focused on science in their home centers. The goal of each PLC is to facilitate the implementation of PEAS Strategies in the classroom and provide a supportive small group with which to discuss challenges.

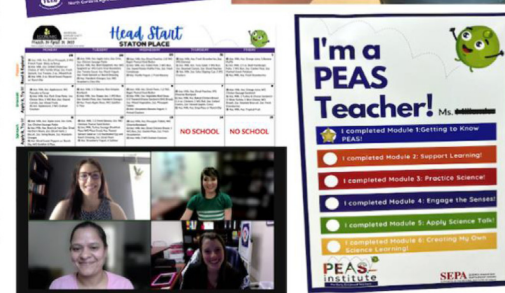


Figure 2. Preschool Education in Applied Sciences (PEAS) program components.

barriers teachers encountered. In between PLC meetings, teachers received in-person, informal support from the project coordinator, who communicated with teachers during

site visits. The project coordinator followed up on issues discussed during PLC meetings, provided informal feedback on progress in the program, assisted teachers in writing goals,

answered questions, and provided a general check-in for teachers.

The Institutional Review Board (IRB) at East Carolina University reviewed and approved the study

protocol under expedited review (IRB no. 21-001272). We obtained written consent from teachers. After consent was given, teachers were provided a brief demographic questionnaire in which they were asked to self-report race and ethnicity from a list including White or European American, non-Hispanic; Latino(a), or Spanish; Black or African American, non-Hispanic; Asian or Asian American, non-Hispanic; American Indian or Alaskan Native, non-Hispanic; Middle Eastern or North African; Native Hawaiian or Pacific Islander; multi-ethnic; or other (specify). Participants were allowed to select multiple responses to accurately reflect individuals' self-designation. The demographic survey followed the US Office of Management and Budget protocols which guide the collection of race and ethnicity data in the US.^{30,31} Participants open-endedly self-reported their gender. Demographic data were collected solely to describe the sample of participants.

Regarding children's participation in PEAS, caregivers gave implied permission. That is, caregivers were given IRB-approved documentation (informational letter to families, waiver of caregiver permission form) in English or Spanish, and caregivers signed and returned the document only if they did not want their child to participate. Because of the children's age and following IRB protocols, child assent was not required. This article focused primarily on the process evaluation of the project.

INTERVENTION EVALUATION AND RESULTS

We implemented the intervention over the school year. A total of 24 *Head Start* teachers (lead and assistant) from 4 centers in 3 Eastern North Carolina counties participated in the preservice workshop at the beginning of the school year. Approximately 227 children within the 13 participating classrooms engaged in the 16 food-based science model learning activities during the intervention over 5 months. Nineteen teachers completed all 6

teacher-training modules, and 5 additional teachers completed at least 1 of the teacher-training modules. All participants ($n=24$) were female and were an average age of 46.00 ± 11.53 years at the time of the intervention. Teachers' races were predominantly Black/African American (87%) and White (4%). Teachers' ethnicities were non-Hispanic (91%). Many teachers held either an associate's (52%) or a bachelor's (30%) degree. Teachers worked at *Head Start* for an average of 7.00 ± 6.21 years.

Our evaluation consisted of formative and summative components, including a formative teacher survey after each training module, a summative teacher survey at the end of the program, and in-depth telephone interviews. The measurement instruments used in this evaluation were either derived from previous existing instruments, in-depth interviews with *Head Start* teachers,³²⁻³⁴ a smaller pilot of the FBL featured in the intervention,³⁵ or developed by our team. A professional panel of 4 faculty with expertise in early childhood nutrition education and feeding, early childhood education, teacher professional development, early science education, early language development, and program evaluation examined and evaluated the instruments for face and content validity. In addition, we conducted cognitive interviews with 3 *Head Start* teachers and revised our interview questions to improve clarity on the basis of the findings from this step. In the next paragraphs, we will present our survey results with descriptive statistics and frequencies of response type and findings from our qualitative phenomenological analysis.³⁶

In the formative surveys using open and closed-ended questions, we asked teachers for feedback regarding the information and resources presented, which model science learning activities they taught (or why they could not teach the activities), and what difficulties and supports they encountered during that module. Approximately 83% of teachers ($n=19$) completed all the formative surveys. Teachers' responses revealed that lack of time in teachers' schedules was the most difficult challenge in

implementing the intervention across modules. In addition, the most important support teachers experienced was children's interest in the topic.

In the summative survey, teachers were asked to rate the helpfulness of each resource and PEAS activity, the program's impact on their ability to teach science education, the program overall, and if they would continue to use or recommend PEAS teaching practices and programs to others. Nineteen teachers completed the summative survey. Teachers' responses indicated that teachers found value in the program, which positively impacted their science teaching practices, and were likely to continue using integrative teaching strategies. This analysis revealed that the most helpful resources for teachers were the teaching videos (27.8%) and the PEAS teaching guide with model science learning activities (27.8%). The least helpful resource was the on-demand learning modules on the online platform (33.3%), likely because of researcher-observed challenges with technology (eg, reliable Wi-Fi access, teachers' prior experience, and comfort with online learning). Teachers reported that the most valuable program incentive was access to the PEAS training resources (eg, PEAS teacher guide and electronic resources on the program website) (38.9%) and the new science materials for their classroom (33.3%), followed by the gift cards (16.7%) and access to food for science activities at their center (11.1%). All teachers agreed or strongly agreed that the program positively impacted their ability to provide engaging science using healthy foods as a teaching tool. Half of the teachers who implemented PEAS rated their overall experience excellent, and the other half rated it good. All teachers were highly likely (HL) or likely (L) to continue using the teaching strategies: practice science (HL, 55.6%; L, 44.4%), engage the senses (HL, 61.1%; L, 38.9%), apply science talk (HL, 61.1%; L, 38.9%), and support learning (HL, 55.6%; L, 44.4%). Most teachers said they were HL (38.9%) or L (44.4%) to recommend PEAS to other teachers they know, whereas 3 teachers (16.7%) said they were

highly unlikely to recommend it to others. Most teachers (77.8%) preferred to complete the modules using paper copies instead of the online platform; both formats featured identical content.

Teachers were also allowed to engage in a 60-minute in-depth telephone interview to discuss their experiences with the program. Interviews were conducted by a trained researcher, recorded, and transcribed verbatim. Two trained qualitative researchers independently completed open coding and identified initial overarching themes using a phenomenological approach. Phenomenology seeks to understand how human beings experience a phenomenon or the common lived experience of a group.³⁶ Interviews (n = 17) revealed teachers initially felt the time was a barrier, but time became less of an issue as they progressed through the modules. Teachers were motivated by children's enthusiasm for learning and hands-on food exploration, including observing improvement in children's willingness to try vegetables during taste-testing opportunities. Teachers suggested we increase the variety of foods presented in model science learning activities beyond the 4 selected vegetables (carrot, tomato, spinach, peas). Teachers expressed that PEAS improved their confidence in teaching science, and although children are naturally curious about scientific inquiry, teachers were surprised by children's enthusiasm, capability, and retention of science concepts. Teachers' feelings of surprise may reflect their initial beliefs and self-efficacy about science education in early childhood.³⁷ Overall, teachers identified the PEAS technical and administrative team as a major support in their ability to engage in PEAS. Teachers commented that the coronavirus disease 2019 pandemic continued to burden their engagement with the program and daily classroom routines (eg, the class being out for 2 weeks because of a positive case in child/teacher). Teachers stated that the coronavirus disease 2019 pandemic increased teacher feelings of burnout, which likely also impacted their PEAS experience and level of engagement with the program.

Finally, teachers described using PEAS as a model for their learning

and implementation. Throughout the program, teachers learned PEAS strategies, set goals to use PEAS strategies, and delivered activities to practice PEAS strategies. Teachers stated they would likely use each of the strategies in the future after the program ended.

IMPLICATIONS FOR RESEARCH AND PRACTICE

Prior studies examining *Head Start* teachers' experience using food in the classroom suggest that limited time is a common barrier to FBL.¹⁹ Program evaluation of *More PEAS Please!* revealed that limited time continues to be a barrier to completing the intervention. However, as teachers became more familiar with the program and training resources, they verbally acknowledged that the magnitude of this challenge declined over time, as noted in the qualitative interviews. Although teachers acknowledged barriers in implementing the program, they also emphasized that the continued PEAS technical and administrative support they received during its implementation was key to their successful progression through the program. Considering the future dissemination of the project, sustained programmatic support for *Head Start* teachers will be critical for teacher retention, satisfaction, and program success.

Identification, consideration, and responsiveness to teachers' needs were critical for the success of the program. For example, our learning modules were created to be implemented as on-demand, online-only modules on the basis of *Head Start* teachers' and administrators' input before designing program materials. However, once the intervention began, many teachers experienced barriers to accessing online modules (eg, trouble accessing a reliable Wi-Fi signal at their center, low technological proficiency, and a work policy regarding phone use). These barriers prompted us to convert all online materials to be available on paper shortly after the intervention began. Our data support the need to consider multiple program delivery

modalities to better meet teachers' individual needs when engaging *Head Start* teachers in future programs.

Teachers requested an increased variety of fruits and vegetables featured in the program's taste-testing opportunities. Originally, we chose 4 target vegetables to be featured throughout the 16 model science learning activities and taste tests to ensure sufficient repeated exposure.^{11,12} Prior research suggests that repeated exposure to a vegetable can improve preference and consumption of vegetables as a whole.³⁸ However, future research is warranted to determine if exposure to various vegetables (repeated exposure, but not to the same vegetables to increase variety) will still positively impact preference and consumption toward all fruits and vegetables.

NOTES

The Institutional Review Board of East Carolina University approved all study protocols (UMCIRB 21-001272). Teachers were recruited to participate in the pilot evaluation of the program on the first day of the PEAS Institute kick-starter preservice workshop. Teachers were informed of the study purpose, what types of questions would be asked, the consenting process, the incentive, and the timeline for completing pilot evaluations. Teachers deciding not to participate in the pilot evaluation of the intervention were not excluded from participating in the program. Teachers interested in participating in the pilot study provided electronic consent through REDCap. Teachers received a gift card compensation (up to \$120) for participating in professional learning community activities, completing program evaluation surveys at baseline, during, and post-intervention, and volunteering for an in-depth postinterview. The PEAS program materials are available for free on the *More PEAS Please!* website (www.morepeasplease.org). Whiteboard training videos can be found on the *More PEAS Please!* YouTube channel (<https://www.youtube.com/@morepeasplease6209/playlists>). The project was funded by a 5-year

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