Building the Capacity of Classroom Teachers as Extenders of Nutrition Education through Extension: Evaluating a Professional Development Model

Jessica D. Linnell
Oregon State University

Sheri Zidenberg-Cherr
Rachel E. Scherr
Martin H. Smith
University of California, Davis

Utilizing teachers as extenders may maximize the reach of Extension nutrition education programs; however, there is a need to identify effective professional development (PD) strategies to ensure quality implementation. Lesson study is a PD model that demonstrated improvements in school teachers' self-efficacy and knowledge in various disciplines. In this study, fourth-grade teachers at two schools delivered nutrition education in their classrooms. Lesson study was examined to improve self-efficacy, content knowledge, and use of inquiry-based teaching strategies. While teachers at one school followed the lesson study model, teachers at the other school did not. Teachers reported time, resources, and funding were barriers to using lesson study and implementing the curriculum. Teachers who reported teaching nutrition previously declined in self-efficacy and knowledge. It is possible that they underestimated what would be required to teach this curriculum, resulting in a higher pre-test rating of self-efficacy compared to ratings after teaching the curriculum. This shift may have affected their motivation and willingness to participate fully in the lesson study process. Increasing teacher access to content experts during PD may improve teacher self-efficacy. Providing additional support and materials may increase the likelihood that teachers participate as extenders of Extension nutrition education programs.

Keywords: nutrition education, teachers, professional development, lesson study, Extension

Introduction

Research indicates that youth in the United States are consuming inadequate amounts of several essential nutrients and 32% are overweight or obese (Krebs-Smith, Guenther, Subar, Kirkpatrick, & Dodd, 2010; Ogden, Carroll, Kit, & Flegal, 2014). Extension is uniquely situated to provide

Direct correspondence to Martin H. Smith at mhsmith@ucdavis.edu

nutrition education outreach to help youth develop the knowledge and skills necessary to make evidence-based decisions about their diets. The Extension system is designed to extend research and education from land-grant universities to broad audiences and provide practical applications of knowledge and skills (Gould, Steele, & Woodrum, 2014). More specifically, Extension professionals have subject-matter expertise and a national network through which research-based programming can be extended (Morgan & Fitzgerald, 2014).

Many nutrition education programs developed by Extension have demonstrated improvements in youth health and nutrition when implemented in school settings, including school enrichment and afterschool programs. For example, the *Shaping Healthy Choices Program*, *Nutrition to Grow On,* and *Growing Healthy Kids* are garden-enhanced programs developed and tested through Extension that improved nutrition knowledge and behaviors among youth in grades K-5 (Morris & Zidenberg-Cherr, 2002; Scherr et al., 2017; Vieregger et al., 2015). Additionally, *Up for the Challenge* **(**Kemirembe, Radhakrishna, Gurgevich, Yoder, & Ingram, 2011) and *ACTIVITY* (Phelps, Hermann, Parker, & Denny, 2010) are afterschool programs that advanced nutrition knowledge, dietary behaviors, and physical activity among participating youth.

School teachers, volunteers, or paraprofessionals are often relied upon by Extension as extenders to implement education programs with clientele. One advantage of this approach is that it helps increase Extension's outreach. However, it is recommended that Extension become more effective in working with extenders (Laughlin, 1990; Laughlin & Schmidt, 1995). Therefore, it is important to identify effective professional development strategies to ensure high quality program implementation and improve extenders' knowledge and teaching skills.

Most professional development opportunities for educators are one-time events, occur out of context, and are led by experts external to the program and intended audiences (Fleischer & Fox, 2003; Penuel, Fishman, Barry, Yamaguchi, & Gallagher, 2007; Smith & Schmitt-McQuitty, 2013). These strategies are considered largely ineffective in engendering change in educators' practice (Penuel et al., 2007). In contrast, professional development using Communities of Practice has been shown to be effective in advancing educators' knowledge and skills (Lieberman & Pointer-Mace, 2010). Communities of Practice involve groups of educators that meet regularly over an extended period of time, whereby participants engage with one another to advance their practice by addressing authentic issues in a systematic and intentional manner. Specifically, educators base their Communities of Practice discussions on observations, reflections, and student artifacts collected as part of their teaching. They use this information to help inform changes in their teaching aimed at improving learner outcomes (Lieberman & Miller, 2011; Wenger, McDermott, & Snyder, 2002).

Lesson study is a professional development model that utilizes Communities of Practice, involving educators working collaboratively over time to adapt and refine curriculum activities

to improve student learning (Lewis, Perry, & Hurd, 2004). This model has been reported to improve classroom teachers' self-efficacy, deepen their subject matter knowledge in various disciplines (e.g., science, mathematics, social studies), strengthen pedagogy, and advance student achievement (Lewis & Perry, 2014; Lewis, Perry, & Friedkin, 2012; Lewis, Perry, & Murata, 2006; Marble 2006; Rock & Wilson, 2005; Stigler & Hiebert, 1999). In Extension, lesson study has demonstrated improvements in content knowledge understanding and pedagogical practices among 4-H volunteers teaching a science curriculum (Smith, 2013).

The lesson study model involves group meetings at regular intervals structured around the lesson study cycle (Figure 1) (Lewis & Hurd, 2011). Participating teachers hold an initial meeting to identify learning objectives and plan their first lesson implementation. After this meeting, teachers implement this lesson and collect formative data through observations of student behavior (e.g., learner-centeredness; engagement; evidence of understanding), as well as authentic data (i.e., work generated by students during an activity). During their next lesson study group meeting, teachers discuss these formative data and use them to inform and plan the implementation of the subsequent lesson. Lesson study group meetings followed by activity implementations continue as an iterative process until the curriculum is completed.

Many Extension programs utilize classroom teachers as extenders to teach nutrition programs in schools; however, there are a number of barriers to utilizing teachers in this capacity, including insufficient knowledge of nutrition, low self-efficacy, lack of formal training, and inadequate instructional time (Graham & Zidenberg-Cherr, 2005; Jones & Zidenberg-Cherr, 2014; Stang, Story, & Kalina, 1998; Telljohann, Everett, Durgin, & Price, 1996). To overcome these obstacles, there is a need to build the capacity of classroom teachers who deliver Extension nutrition programs, and lesson study may be a promising approach to help accomplish this. The purpose of this study was to evaluate the potential of lesson study to improve self-efficacy in teaching nutrition, increase knowledge about nutrition, and improve teaching practices among fourth-grade teachers implementing a nutrition curriculum developed by University of California Cooperative Extension and University of California, Davis researchers.

Methods

Participants

Fourth-grade teachers were recruited from two public elementary schools, A and B, within one district in California. Of the 11 full-time fourth-grade teachers, nine elected to participate through a passive informed consent process. One teacher at school B failed to complete post-questionnaires; thus, data from this teacher were excluded from analysis. The final sample size was eight teachers.

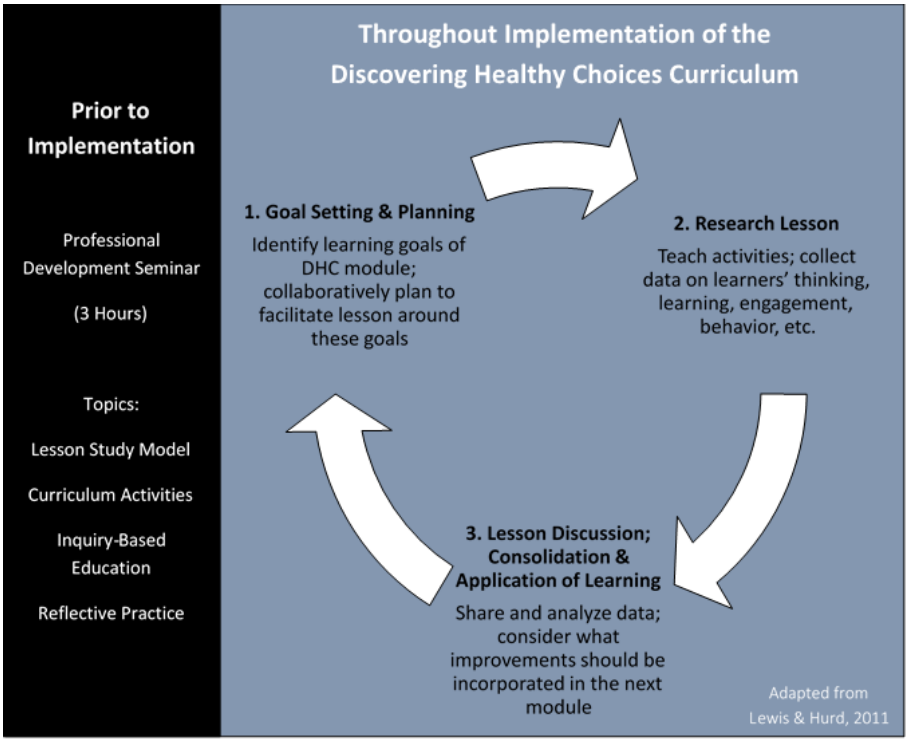
Intervention

Participating teachers implemented *Discovering Healthy Choices* (DHC), a garden-enhanced, inquiry-based nutrition curriculum (Linnell et al., 2016; Linnell, Smith, & Zidenberg-Cherr, in press) developed for the Shaping Healthy Choices Program, a multi-component nutrition education intervention (Scherr et al., 2017). This curriculum was designed for children in grades 4-6 to improve their nutrition knowledge, advance their reasoning skills, and enable them to make evidence-based decisions about their diets. The pedagogical approach of DHC, guided inquiry, is a learner-centered strategy where teachers facilitate problem solving and utilize open-ended questions to prompt students to draw on their experiences to discover concepts and explain them using their own words (Minner, Levy, & Century, 2010). The comprehensive curriculum includes eight sequential modules, each containing classroom, garden, goal-setting, and take-home extension lessons for a total of 34 activities. Teachers in this study tracked and reported the activities they implemented to establish degree of completion of the curriculum.

Professional Development

Researchers introduced the lesson study model and the DHC curriculum during an initial three-hour workshop. Subsequently, participating teachers established a schedule of group meetings and followed the lesson study cycle to plan and implement DHC in their classrooms (Figure 1) (Lewis & Hurd, 2011).

Figure 1. Lesson Study Professional Development Model



Throughout the project, researchers were available to teachers for consultation by phone, email, and in-person meetings. At the mid-point of the project, researchers held a one-hour meeting to discuss teachers' progress in using lesson study and implementing the curriculum. Support provided included reviewing curriculum procedures, nutrition content, and lesson study methods.

Study Design

A convergent, parallel, mixed methods study design was used (Creswell & Plano Clark, 2011) that included quantitative and qualitative strands that were complementary and given equal priority. Quantitative and qualitative data outcomes were mixed during interpretation. The University of California, Davis, Institutional Review Board determined the protocol was exempt.

Quantitative Strand

Demographics. At baseline, teachers reported age, gender, level of education, teaching experience, and ethnicity. Percent of students participating in free and reduced-price meals and diversity index were obtained through Ed-Data.org (Sacramento, CA).

Experience. Teachers completed survey questions about previous experience teaching nutrition and the resources they have used to plan nutrition lessons.

Degree of completion. The percent of completed DHC curriculum activities was self-reported by participating teachers. Teachers recorded which of the 34 activities they implemented in their classrooms and provided that information at the end of the study.

Self-efficacy. Self-efficacy of teaching nutrition was measured using a 17-item pre-/post-questionnaire. Items were selected from a questionnaire that measured self-efficacy of teaching health education determined to be valid and reliable among K-6 public school teachers (Telljohann et al., 1996). Nutrition-related questions were selected for use in this study. Questions about concepts unrelated to nutrition were included but adapted to focus on nutrition (i.e., "I understand health concepts well enough to be effective in teaching elementary health education" was changed to state, "I understand nutrition concepts well enough to be effective in teaching elementary nutrition education." Measures include two domains: efficacy (10 items) and outcome expectations (7 items). Answer choices were scored using a five-point Likert scale of 1 = *strongly disagree,* 2 = *agree,* 3 = *neither disagree nor agree,* 4 = *agree,* or 5 = *strongly agree* with a total possible score of 85. Examples of questions:

- I believe I can do a good job teaching students about nutrition.
- I believe if I do a good job teaching, the students I teach will be more knowledgeable about nutrition and health.

Knowledge. Knowledge about nutrition was measured using a pre-/post-questionnaire with 66 multiple-choice questions that was previously validated for use among teachers in California (Jones & Zidenberg-Cherr, 2014; Jones et al, 2015). These questions included a *not sure* response option and captured information in four domains: dietary recommendations, nutrients, and health benefits. To calculate total knowledge score, *correct* answers were scored as a 1 and *incorrect* and *not sure* as a 0. Examples of questions:

- Based on what you know, what is the amount of vegetables MyPlate (the government's food guide) recommends an adult should eat?
  A. 1 to 2 cups each day, B. 2 to 3 cups each day, C. 6 to 7 cups each day, D. 5 to 6 cups each week, E. Not sure
- Based on what you know, which of the following are some calcium-rich alternatives to milk?
  A. Calcium-fortified juice, B. Canned fish with bones (such as sardines), C. Kale and collard greens, D. All of the above, E. Not sure

Teaching practice. Teachers' use of inquiry-based education strategies was measured using a 20-item retrospective questionnaire adapted from previous research (Gejda & LaRocco, 2006). There were 20 questions with two parts: the first part asked the respondent to rank their present use of inquiry-based education strategies; the second part asked respondents to rank their use of inquiry-based strategies before the introductory meeting. Responses were scored as 1 = *almost never*, 2 = *sometimes*, 3 = *usually*, or 4 = *almost always*. Example questions:

- Part I: I ask probing questions to redirect students' investigations, when necessary.
- Part II: *Before participating in this project* I asked probing questions to redirect students' investigations, when necessary.

Quantitative data analyses included descriptive statistics; paired t-tests to evaluate changes in nutrition knowledge, self-efficacy, and inquiry-practice; and Spearman's correlation to evaluate relationships. Stata statistical software version 12 was used for analyses (Stata Corp, College Station, TX); statistical significance was set at $p < .05$.

Qualitative Strand

Structured interviews. Following the implementation of DHC, researchers conducted structured interviews to gather information in four predetermined categories: perceptions of the curriculum, challenges during implementation, use of the lesson study professional development model, and prior experience participants had teaching nutrition. Data from interviews were organized into the four predetermined categories and analyzed within each category using the constant comparison method (Hatch, 2002). Through this inductive approach, explanatory patterns were identified through repeated evidence that emerged.

Results

Quantitative Data

Demographics. Table 1 displays demographics of schools, students, and participating teachers.

Table 1. Demographics of Teachers by School

	School A	School B
Participating teachers (n)	4	4
Participating classrooms (n)	4	4
Student eligibility for Free and Reduced Priced Meals (%)	34.3	26.6
Student Diversity Index*	76	64
Teacher age (mean years)	45	50
Teacher sex (% female)	100	100
Teacher ethnicity (n)		
Caucasian	4	3
Hispanic	0	1
Teaching experience (mean years)	15	16.5
Teachers with degree in health (n)	0	0
Teachers who taught nutrition before (n)	3	3
Teachers with degree in biological science (n)	0	0
Teachers who took nutrition in college (n)	2	3
Teachers with advanced degrees (n)	1	2

*Student Diversity Index measures ethnic/racial diversity of students using a scale of 0-100, with 100 indicating a fairly even distribution and 0 indicating a single ethnic/racial group.

Experience. Teachers reported the most common resources they used previously for planning nutrition lessons were Dairy Council materials (n = 5), other teachers (n = 5), friends and family (n = 4), and existing curricula (n = 4).

Degree of completion. Mean degree of completion of DHC curriculum activities by participating teachers was 93.8% (range: 85.3 – 100%).

Self-efficacy. No significant differences in means of self-efficacy were observed (Table 2).

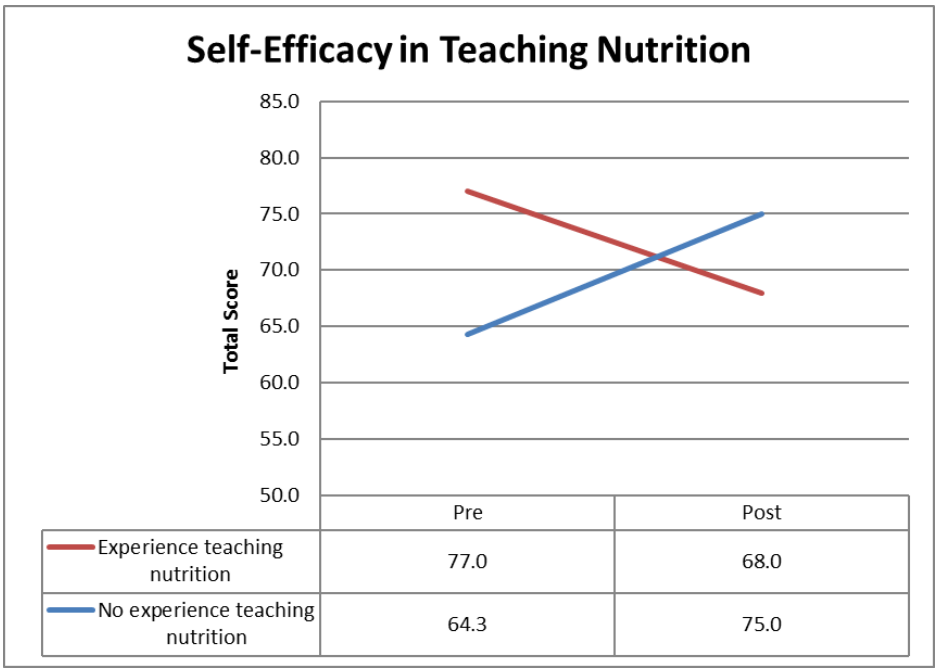
Table 2. Teachers' Self-Efficacy Before and After Participating in Lesson Study

	Pre		Post		
	M	***SD***	***M***	***SD***	***p***
Total self-efficacy (total = 85)	70.8	5.9	70.8	8.6	0.47
Self-efficacy (total = 50)	42.9	5.8	40.8	7.3	0.72
Outcome expectations (total = 35)	29.4	3.3	29.8	4.8	0.81

However, responses differed in two distinct groups (Figure 2):

- Three teachers' scores increased significantly (mean = 10.6 ± 4.1 $p < 0.05$), and
- Five teachers' scores decreased (mean = -9.0 ± 6.2 $p = 0.10$).

Figure 2. Mean Self-Efficacy Between Pre/Post by Subgroups: Experience Teaching Nutrition and No Experience Teaching Nutrition (Total possible = 85)



Teachers who demonstrated decreases in self-efficacy were those who reported previous experience teaching nutrition. Those who showed increases in self-efficacy reported no previous experience teaching nutrition. There were no significant differences in change in self-efficacy between schools.

Knowledge. No significant differences in means of knowledge about nutrition were observed (Table 3).

Table 3. Teachers' Nutrition Knowledge Before and After Participating In Lesson Study

	Pre		Post		
	M	***SD***	***M***	***SD***	***p***
Total Knowledge About Nutrition (total=66)	39.3	10.4	40.0	15.8	0.83
Recommendations (total=24)	16.0	3.4	15.8	4.8	0.91
Nutrients (total=26)	16.5	6.0	15.1	7.6	0.69
Health benefits (total=16)	6.8	2.3	9.1	4.3	0.19

Note: Results reported for pre and post scores are represented as mean (standard deviation).

However, responses differed in two distinct groups:

- Four teachers' scores increased significantly (mean = 9.0 ± 5.2 $p<.05$), and
- Four teachers' scores decreased (mean = -7.5 ± 3.9 $p=.10$) (Figure 3).
- Changes in nutrition knowledge were correlated strongly with changes in "not sure" responses (r = -0.91 p<.05) (Figure 4).

Figure 3. Individual Scores of Nutrition Knowledge by Teachers Who Increased and Teachers Who Decreased (Total possible = 68)

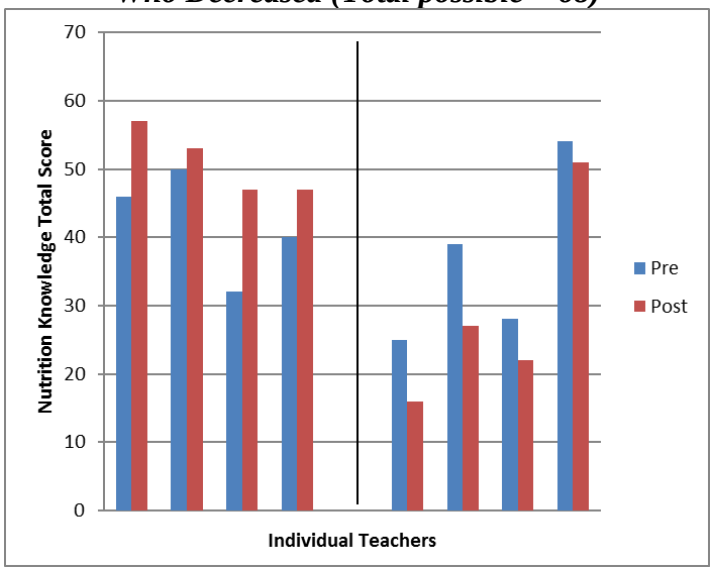
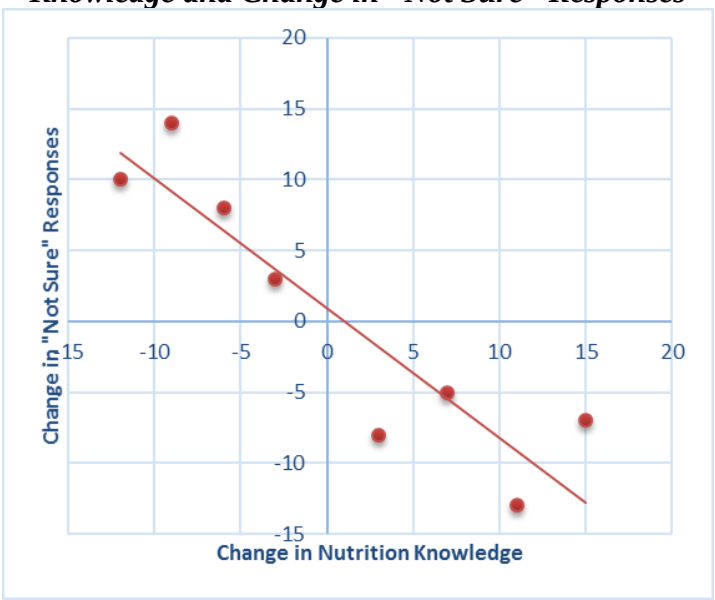


Figure 4. Relationship Between Change in Nutrition Knowledge and Change in "Not Sure" Responses



Teaching practices. Reported use of inquiry-based teaching practices showed no change. The mean response was 3.0 ± 1.2 prior to implementation and 3.0 ± 1.1 at the end of implementation.

Qualitative Results

Predetermined categories and emergent themes. Emergent themes identified within each of the four predetermined categories are shown below and examples of salient focus group interview responses for each theme are included.

Perception of the curriculum.

Theme 1. Evidence of Learning: Participants described activities as engaging and were able to observe evidence of learning (code appeared eight times).

- "Students were using "fancy" nutrition words."
- "The successes of the program were increased knowledge about nutrition and food choices, a love of gardening, and an increase in trying new vegetables."
- "My students seemed very comfortable with food labels and, hopefully, they will transfer their knowledge to making healthy choices in the supermarket and at home."

Theme 2. Application of Learning: Participants observed that students applied their newly gained knowledge in real-world situations (code appeared three times).

- "While we were on a field trip I saw a student reading the packaging of a candy bar and some chips. When I asked, 'What are you doing?' she said, 'I know these both are bad, but I want to know which one is worse.'"
- "The use of vocabulary and concepts carried over to other subject areas, including science and agriculture."
- "Parents told me they were shocked because their children were excited to try new foods at home."

Challenges during implementation.

Theme 1. Time Constraints: Participants expressed a lack of preparation time, as well as available classroom time for implementation (code appeared four times).

- "If I was given release time for preparation, it would improve my ability to teach nutrition."

- "Nutrition is our 'seventh subject.' We have to decide whether to prepare for math or nutrition."
- "Some challenges I faced with implementing Discovering Healthy Choices were often time and resources."

Theme 2. Resource Constraints: Several teachers reported that the cost of food items were a major limitation and they would need to find additional funding (code appeared four times).

- "The cost of the food materials is a challenge."
- "We don't have money for these kinds of supplies."
- "If the administration doesn't give us funds for the food items, we won't be able to teach this."

Use of the lesson study professional development model.

Theme 1. Differences in Use between Schools.

Teachers at school A did not follow the lesson study model (code appeared three times).

- "I have to be honest, the formal meetings did not happen. We only met once in the beginning."
- "We did informal sharing during lunch and after school, but not systematic or using the student data."
- "Even though we didn't meet like we were supposed to, the plus/delta sheets were really helpful to know what to change for the next lesson."

Teachers at school B followed the lesson study model, meeting as a group weekly to discuss formative data and plan lessons (code appeared four times).

- "I met with my grade-level team every Monday and Tuesday at lunch to discuss nutrition lessons (both upcoming lessons and ones that we had just taught). The main challenge was finding a time that we were all available, but we solved that problem by using part of our lunch session to devote to nutrition discussion."
- "The main benefit of using lesson study was the opportunity to hear feedback and advice from my colleagues about how they approached the lesson."
- "Reviewing my students' work did affect how I would modify the next day's or week's lesson."

Prior experience teaching nutrition.

Theme 1. Interpretation of nutrition programming: Teachers who reported experience using "existing curricula" on the survey as a resource to teach nutrition clarified during interviews that they were referring to the school district's nutrition education program that consisted of stand-alone lessons, monthly produce samples, annual farmers' market tours, and promotional materials (code appeared five times).

- "On the survey, when you asked about using existing curricula, I wasn't sure what you meant, but I marked it because I do the SHAPE program."

Discussion

Prior research on lesson study indicated this model can be effective in advancing classroom educators' knowledge and skills and student outcomes in several subject areas (Lewis & Perry, 2014; Lewis et al., 2006, 2012; Marble, 2006; Rock & Wilson, 2005; Stigler & Hiebert, 1999) and has also been shown to be effective with 4-H volunteers (Smith, 2013). Given the effectiveness of lesson study in other contexts, it was hypothesized that the model would also be effective for classroom teachers as extenders of Extension nutrition education programs. However, we were unable to determine this due to the presence of underlying factors that may have affected the teachers' engagement in the lesson study process, which include changes in perceptions of self-efficacy in teaching nutrition, confidence in knowledge about nutrition, and lack of motivation to adopt new teaching strategies.

It is possible that the decline in self-efficacy may have negatively influenced the teachers' motivation or willingness to participate fully in the lesson study process. This change is not likely a loss of self-efficacy as a result of participating in lesson study, but rather a possible response-shift bias whereby teachers overestimated their self-efficacy at baseline (Howard, 1980; Howard & Dailey, 1979). We postulate that those teachers whose self-efficacy scores decreased may have underestimated what would be required to teach the curriculum based on their prior experience, resulting in a higher pre-test rating of self-efficacy compared to ratings after teaching the curriculum. Consequently, when the decrease in self-efficacy occurred, there may have been a negative effect on the motivation to continue to participate in lesson study.

This rationale is further supported by qualitative data captured during interviews. Teachers reported in the surveys they had experience using "existing curricula" to teach nutrition. However, during the interviews they clarified they were actually referring to the stand-alone activities and promotional materials accessible through their school district's nutrition program. They were not referring to a comprehensive nutrition curriculum that would include a "coherent progression of educational experiences that addresses a societal issue or need" (Smith et al.,

2017). This indicated that, at baseline, the teachers may have perceived that the DHC curriculum would be similar to the materials they had used in their classrooms previously. Moreover, one teacher, whose scores on self-efficacy decreased, stated during the interview that she preferred to use her previous materials to teach nutrition because "the level of the [DHC] curriculum activities was really hard." This provided additional evidence that a shift in perception had occurred after implementing the curriculum.

In contrast, among those teachers who had not taught nutrition previously, the increase in self-efficacy indicated that they did not have a prior conception about nutrition education. Therefore, through their involvement in lesson study they increased their self-efficacy with respect to teaching nutrition using DHC. It is possible that without experiencing a response-shift bias that the improvement in self-efficacy may have positively influenced their motivation and willingness to participate fully in the lesson study process.

The changes observed in the teachers' content knowledge about nutrition may also have had an impact on their motivation and willingness to engage in lesson study. The strong association between change in scores and change in *not sure* responses indicated that the teachers whose scores in content knowledge declined consistently replaced their correct answer at baseline with *not sure* at follow-up. This suggests that there was not a loss in knowledge, but rather a loss in confidence in their knowledge after having implemented the DHC curriculum. We posit that a loss in confidence in knowledge among teachers may result in a loss of motivation to engage in professional development to teach the subject matter. Furthermore, this may also be the result of a response-shift bias, in which the facilitation of a comprehensive curriculum challenged the teachers' prior knowledge of nutrition. This could have created doubt about what they know about nutrition, ultimately resulting in a loss of confidence relative to content knowledge. This may also be linked to the decline in self-efficacy observed among some of the participating teachers and affected their motivation or willingness to engage in the lesson study process.

The absence of change in survey results pre-to-post with respect to inquiry-based teaching practices provides evidence that teachers in this sample did not adopt guided inquiry as a teaching strategy in their classrooms. In general, teachers have difficulty using methods that are different than the way they were taught (Loucks-Horsley, Stiles, Mundy, Love, & Hewson, 2003). Therefore, these results may indicate a lack of interest and motivation in exploring guided inquiry as a pedagogical strategy. Additionally, without fully engaging in the inquiry process through lesson study as a means of investigating their own practice, it is not likely teachers would adopt guided inquiry in their classrooms. Thus, we suggest that additional support is necessary to help the lesson study groups facilitate discussions related to pedagogy.

The challenges reported by teachers during interviews regarding the use of lesson study and teaching nutrition through the Shaping Healthy Choices Program are consistent with findings

from previous studies, including lack of time, resources, and funding (Graham & Zidenberg-Cherr, 2005; Jones & Zidenberg-Cherr, 2014; Stang et al., 1998; Telljohann et al., 1996). To alleviate some of these constraints, Extension could prepare lesson materials in advance so there is limited time required by the teacher for preparation. Extension could also purchase and deliver food items for the lessons and cooking demonstrations so teachers do not need to find funding or spend time acquiring these materials. Providing support to teachers in these ways may increase the willingness of teachers to serve as extenders of nutrition education.

Limitations

The sample size of teachers was small and researchers do not seek to draw generalizations beyond this sample. The small sample size may have affected the ability to detect a significant difference in the quantitative analyses. The small sample size was addressed using a mixed methods study design, which allowed for a more complete understanding of study outcomes. Researchers recommend the study be replicated with larger samples and in other geographical areas. Another limitation was that participating schools followed a year-round schedule with staggered schedules, thus not all teachers were teaching the same curriculum modules at the same time. Lastly, measurements of adherence to the lesson study process and implementation of the curriculum through direct observation would have helped determine fidelity. Such observations would also have provided additional insights into inquiry-based teaching strategies and teachers' understanding of nutrition concepts. However, the researchers did not use direct observations in the study so as not to affect natural classroom dynamics during implementation.

Conclusions

Teachers play an important role in developing children's knowledge and skills to enable them to make informed, healthful choices about their diets and lifestyle. Teachers as extenders are critical to nutrition education programs in Extension. However, teachers must be well-prepared through effective professional development to achieve high quality implementation of evidence-based nutrition programs to help address children's dietary intakes and childhood obesity.

In this study, Extension researchers worked with elementary teachers as extenders to deliver nutrition education in fourth-grade classrooms. Lesson study as a professional development model was examined as an approach to improve self-efficacy, content knowledge, and use of inquiry-based teaching strategies. Instead, the study resulted in declines in perceptions of self-efficacy and confidence in content knowledge among several participating teachers, which may have affected their motivation and willingness to participate fully in the process. If teachers do not participate fully in this constructivist-based approach to professional development, they may not deconstruct prior conceptions of nutrition and nutrition education (assimilation), thus limiting the incorporation of new knowledge and skills into their teaching practice (accommodation).

From the school-level perspective, administrative support for effective professional development for teachers is imperative. However, effective strategies such as lesson study are iterative and occur over extended periods. In order for teachers to be able to participate fully, administrative support could include release time to engage in group meetings as well as financial support for curriculum materials.

Based on a body of previous research showing lesson study as an effective professional development model with teachers and 4-H volunteers, the authors propose additional research on the use of lesson study in Extension with teachers as extenders of nutrition programs. Specifically, we recommend that Extension provide teachers with increased access to pedagogy and content experts and include them directly in the lesson study process. This may lead to improvements in teacher self-efficacy and confidence in content knowledge as well as the adoption of new teaching practices. Furthermore, the authors recommend the use of lesson study be explored more broadly with Extension staff educators and volunteers across disciplines.

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Jessica D. Linnell is a faculty member in Extension Family and Community Health in the College of Public Health and Human Sciences and School of Biological and Population Health Sciences at Oregon State University. Her extension teaching and research focuses on effective strategies to improve health outcomes.

Rachel E. Scherr is a faculty researcher with the UC Davis Department of Nutrition and co-director of the Center for Nutrition in Schools; her research interests focus on nutrition education and promotion in school-aged children. Research efforts include the implementation of a multi-component, school-based intervention entitled the Shaping Healthy Choices Program.

Sheri Zidenberg-Cherr is a UC Cooperative Extension Specialist and faculty member in the Department of Nutrition at University of California and co-director of the Center for Nutrition in Schools. Her research focuses on the impact of multi-faceted approaches to nutrition education on the dietary and lifestyle choices of school-aged children.

Martin H. Smith is a UC Cooperative Extension Specialist and faculty member in the departments of Human Ecology and Population Health and Reproduction at the University of California, Davis. His research and extension teaching focuses on the development and use of effective curriculum materials and educator professional development models.