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Developing and Evaluating the Impact of an Extension-Based Train-the-Trainer Model for Effectively Disseminating Food Safety Education to Middle School Students

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Abstract: *Adolescents are an understudied, but meaningful, population when it comes to food safety education. With the proliferation of pathogenic microbes and changes in eating habits of Americans, today's youth are more at risk of contracting a foodborne illness than previous generations. Hands On: Real World Lessons for Middle School Classrooms provides effective food safety education for adolescents. However, rapid expansion of the program created the need for a train-the-trainer model of professional development. The study reported here evaluated the efficacy of a train-the-trainer model. Results indicate that the model can effectively train classroom teachers to implement the Hands On program.*

Introduction

An estimated one in six Americans becomes sick from foodborne illness in the U.S. annually (CDC, 2011). This is especially appalling statistic given that proper food handling practices could significantly reduce the number of cases of foodborne illness. Previous studies suggest that a large part of the problem is that many people do not receive sufficient education on safe food handling (Anderson, Shuster, Hansen, Levy, & Volk, 2004; Bruhn & Schutz, 1999; Coulston, 1999; Williamson, Gravani, & Lawless, 1992). With the proliferation of pathogenic microbes and the changes in

eating habits of Americans, today's youth are more at risk of contracting a foodborne illness than previous generations (Byrd-Bredbenner et al., 2007; Coulston, 1999).

Adolescents are an understudied, but meaningful, population of high priority when it comes to food safety education. The critical developmental years between ages 12-17 are an ideal time to teach food safety. At this developmental stage, students are in the formative process of establishing life-long habits; therefore, they are more likely to synthesize new food safety knowledge in a way that will lead to the development of positive life-long behaviors (Richards, Skolits, Burney, Pedigo, & Draughon, 2008). Adolescents today have notable food handling responsibilities both in the home and in the food service sector. As such, their behaviors are essential in safeguarding the health of consumers (Byrd-BredBenner et al., 2007). Providing adolescents with the knowledge and skills needed for safe food preparation would significantly benefit the population as a whole.

While the research on adolescents' food safety knowledge, attitudes, or behaviors is sparse, it has shown that a significant gap exists between food safety knowledge and self-reported food safety behaviors (Haapala & Probart, 2004; Richards et al., 2008). Furthermore, during adolescence this gap is similar to that found within adult populations (Byrd-BredBenner et al., 2007; Haapala & Probart, 2004). This suggests there is a strong need to improve food safety knowledge within adolescent populations through educational outreach programs. Richards et al. (2008) demonstrated that implementing a food safety curriculum that also meets state-mandated content standards as a regular part of classroom instruction (Hands On: Real World Lessons for Middle School Classrooms) can significantly raise adolescents' food safety knowledge and improve their food handling attitudes and behaviors.

Significant growth of the Hands On program created a need to develop effective training for a large number of teachers to implement the program across a diverse geographical region. Over the course of 6 years, the program has expanded from serving five schools with approximately 500 students to over 50 schools and 8,000 students annually. This growth is a common challenge encountered among successful projects. The validated success of an innovative, small-scale, pilot project creates demands to scale up project implementation efforts for replication at other sites (Rogers, 2003). Often, multiple, geographically disbursed sites are involved in adopting the innovation through the scaling up process. The designers and original trainers associated with the pilot project are typically not available or able to address all the implementation needs for new sites, and an alternative delivery and support approach (including the provision of training) is needed (Weiss, 2010).

Thus, the purpose of the study reported here was to determine the effectiveness of a train-the-trainer model using county Extension agents to train teachers to implement the Hands On curriculum. Specifically, the research examined the extent to which the Extension agent-trained teachers' attitudes, behaviors, and knowledge increased as compared to those trained by project staff.

Hands On: Real World Lessons for Middle School Classrooms is a comprehensive curriculum embedded within core academic areas that delivers quality food safety instruction to middle school students. The Hands On curriculum integrates basic concepts of safe food handling with state curriculum standards that are evaluated by grade-level accountability tests. By integrating food safety instruction into pre-existing core curricula, these concepts are reinforced from multiple content areas, thus increasing retention of food safety knowledge and skills (Donovan & Bransford, 2005; Vars, 2001; Venville, Rennie, & Wallace, 2004). Students who study food safety in Language Arts, Math, Science, and Social Studies classes receive more exposure to these concepts than those receiving nonintegrated curricula, creating a more in-depth, integrated understanding. This leads to greater opportunities for affecting changes in food safety behaviors and attitudes (Berry et al., 2005; Blumenfeld et al., 1991; Brown & Campione, 1994).

By learning food safety concepts in a variety of ways, adolescents will be empowered

to change their behaviors and reduce occurrences of foodborne disease in their own lives. In addition, exposure to food safety across core academic areas may encourage students to develop interests and possibly pursue a career in food safety, leading to a larger and more informed group of food safety professionals in the future.

The Hands On program begins with an intensive 2-day training workshop for teachers designed to raise background knowledge of food safety and introduce teachers to the interdisciplinary elements of the curriculum. The 2-day workshop has three objectives: 1) convince teachers that food safety is an important concept to teach young people; 2) demonstrate that the topic of food safety can be easily addressed through pre-existing standards in the curriculum by introducing teachers to the proposed integrated unit and modeling new instructional strategies; and 3) ensure effects of the program are not compromised by inconsistent curriculum implementation. The workshop design reflects current literature on effective professional development by providing a combination of modeling of lessons and instructional strategies, hands-on participation in activities, and a seminar style discussion. This method of delivery allows teachers an opportunity to learn, apply, analyze, synthesize, and evaluate the new content knowledge, as well as novel instructional strategies (Astor-Jack, McCallie, & Balcerzak 2007; Birman, Desimone, Porter, & Garet, 2000; Galbo, 1998; Kinnucan-Welch, Rosemary, & Grogan, 2006).

In its third year, interest in the validated Hands On curriculum expanded into six states, making it impractical for the lead project staff to train each interested classroom teacher. Individualized and small group training is a significant component to what makes Hands On successful. Several training delivery options were considered. One potentially effective alternative for delivering information and training classroom teachers appeared to be recruitment and training of Extension agents to work with classroom teachers in their communities. This alternative appeared to be economically viable, supportive of the Extension mission of community education, and readily sustainable.

Health care professionals, community organizations, private industry, food industry workers, and educational outreach providers have all successfully employed train-the-trainer (TTT) programs (Barrett, Penner, & Shanklin, 1996; Chee, Dash, & Noguchi, 1998; Hahne, Noland, Rayens, & Christie, 2002; Levine et al., 2007; Martin, Knabel, & Mendenhall, 2002; McClelland, Irving, Roger, Bearon, & Webber, 2002; Mutchler, Anderson, Taylor, Hamilton, & Mangle, 2006; Orfaly et al., 2005). One of the distinct advantages of a TTT model is that, once trained, Extension agents could then offer Hands On workshops within their own counties and districts, thus minimizing travel expenses and allowing greater flexibility in scheduling training workshops. Previous research on TTT models indicates that they can be highly successful if participants are carefully trained in, not only the curriculum, but also in the educational theory behind the curriculum (Trabeau, Neitzel, Meischke, Daniell, & Siexas, 2008). In addition, it is important that programs, such as Hands On, have effective, but flexible, implementation strategies. The TTT model employed in the study reported here heavily incorporated evidence-based strategies from existing literature.

Methods

Development and Delivery of the Train-the-Trainer Workshop

Participating Extension agents attended a 3-day professional development workshop to learn how to effectively train teachers to use the Hands On curriculum. The workshop was held on the campus of the Institute of Agriculture at the University of Tennessee, Knoxville on January 7-9, 2008. Teachers who implemented Hands On in the pilot phase participated in the training with Extension agents. The workshop was designed to model best practices in adult learning and professional development (Table 1). The delivery method of the workshop offered a combination of modeling the lessons, hands-on participation in activities, and seminar-style discussions. This delivery method provided agents with an opportunity to learn, apply, analyze, synthesize, and evaluate the new content knowledge, as well as novel instructional

strategies (Galbo, 1998). This design also allowed for small group interactions among Extension agents and teachers who had piloted Hands On so they could strategize for recruiting new schools.

Day one of the training focused on introducing agents to the curriculum and raising background knowledge on instructional theory for adolescents. For example, the afternoon session was devoted to Robert Gagne's Nine Events of Effective Instruction and demonstrated to agents the importance of instructional planning and sequencing of events in a classroom lesson (Gagne, 1985). During days two and three of the workshop, Extension agents actively participated in each of the activities in the Hands On curriculum and learned the instructional theory behind each activity as well as background information to enhance their food safety knowledge. The afternoon session of day three provided Extension agents with the tools necessary to conduct their own training workshops with teachers in their districts such as detailed training agendas, a question and answer session with experiences Hands On teachers, and a binder of resource materials.

Table 1.
Key Professional Development Elements Employed in Study and Related Literature

Delivery of instructional theory behind curriculum
Gersten, Vaughn, Deshler, & Schiller, 1997
Hands-on participation in completing curricular activities
Astor-Jack, McCallie, & Balcerzak, 2007; Birman, Desimone, Porter, & Garet, 2000; Borko, 2004; Cook, Landrum, Tankersley, & Kauffman, 2003; Desimone, Porter, Garet, Kwang, & Birman, 2002; Kinnucan-Welch et al., 2006; Loucks-Horsley, Hewson, Love, & Stiles, 1998
Seminar style discussion of instructional strategies and possible classroom roadblocks
Astor-Jack et al., 2007; Birman et al., 2000; Desimone et al., 2002; Kinnucan-Welch et al., 2006
Informal discussions with the researchers to determine teachers' level of comfort and address concerns or implementation issues
Astor-Jack et al., 2007; Birman et al., 2000; Desimone et al., 2002
On-site instructional support during the initial implementation of the curriculum
Astor-Jack et al., 2007; Boudah, Logan, & Greenwood, 2001; Cook et al., 2003; Fuchs & Fuchs, 2001; Gersten & Dimino, 2001; Guskey, 2000; Kinnucan-Welch et al., 2006; Stichter, Lewis, Richter, Johnson, & Bradley, 2006; Penuel and Means 2004; Penuel et al. 2007;
Small group training held on-site at each school
Galbo, 1998; Kinnucan-Welch, Rosemary, & Grogan, 2006; Correnti, 2007

Nine Extension agents from Tennessee were recruited to participate in the study. These agents were contacted by their respective Extension specialist and area supervisor and invited to participate. The selection process was primarily based on the level of the agents' involvement in food safety education and experience in

working with schools within their counties. The agents then attended the 3-day professional development workshop conducted by Hands On project staff to learn how to effectively train teachers to use the Hands On curriculum. The Extension agents then recruited teachers from their counties who were interested in Hands On and subsequently conducted their own 2-day professional development workshops for those teachers.

Participants

Of the nine agents trained, six successfully recruited and trained classroom teachers (n=39) within their counties representing a total of six schools. The other three agents expressed difficulty in getting school administrators to allow teachers to participate. The Hands On program provided all the necessary materials and supplies for agents to conduct their training workshops, as well as $500 to cover other expenses (travel, copies, etc.). These supplies helped to ensure that the training sessions were consistent from one agent to the next. The teachers trained by project staff (n=41) were recruited from the population of teachers attending Hands On concurrent sessions at state or national teachers' association conferences or through association newsletters. These 41 teachers, representing a total of eight schools, were all trained by project staff at separate training workshops conducted from May 2008 to March 2009.

Each team of teachers was trained at their own school to allow teachers to be in their own classrooms and establish a feeling of familiarity and comfort. Training at each school individually allowed for small groups (group sizes ranged from 2-8 teachers). The delivery method followed the same model by which the Extension agents were trained and were conducted over two 6-hour days. The workshops followed a set agenda designed to move efficiently through the food safety curriculum covering new content material and instructional strategies in depth and to ensure consistency in training. Teachers were compensated at a rate of $100 per day for their participation in these workshops. As an added incentive, schools were provided with all the materials and supplies necessary to implement the Hands On curriculum in their classrooms.

Data Collection Instruments

An instrument was developed to measure attitudes toward teaching food safety, food safety behaviors, and food safety knowledge. The attitudes items were designed to measure how teachers felt about teaching food safety as part of their regular classroom instruction and as a means of meeting state required content standards. For example, one of the attitude items asked teachers to consider the extent to which, "I see direct connections between food safety and the content and skills mandated by the state curriculum for my discipline." The behavior items sought to measure the extent to which each participant practiced positive food handling behaviors (e.g., washing hands, reheating leftovers) and included items such as "I use a meat thermometer when cooking to ensure that meat is thoroughly cooked." For the purposes of the study, knowledge was defined as a working understanding of the core concepts related to food safety: cooking/cooling temperatures, personal hygiene, sanitation, cross contamination, and identification of pathogens. One knowledge question was "Bacteria grow *most rapidly* at what temperatures: a. At zero degrees; b. Below 40 degrees; c. Between 40 and 140 degrees; d. Above 140 degrees."

To establish content validity of the instrument, items were developed by project staff and submitted for expert review to a panel (n = 6) with expertise in educational assessment, food safety, food microbiology, and teacher professional development. Each expert was asked to review questions and make recommendations for item deletion or modification. The revised items were then field tested to establish reliability of the instrument through a pre-post assessment design using the same pilot participants. There was no significant difference between the test and retest means (p = 0.594), suggesting that the instrument was providing a consistent,

reliable measurement.

The final instrument contained seven Likert-scale items (with five response options ranging from strongly disagree=1 to strongly agree=5) to measure attitudes toward teaching food safety, 14 Likert-scale items to measure food handling behaviors (with four response options ranged from never=1 to always=4), nine true/false questions and nine multiple-choice items to measure knowledge. The instrument was administered to each classroom teacher immediately before and after the Extension agent-led or project staff-led workshops to determine changes in food safety attitudes, behaviors, and knowledge. The scores of each Extension agent-trained teacher were compared to those of all teachers who had been trained by project staff.

Data Analysis

Teacher pre- and post-tests were hand scored by two project staff members to reduce the likelihood of scoring error. The data were cleaned, verified, and itemized by attitude, behavior, and knowledge and then entered into SPSS v.17. Descriptive means were calculated by section (attitudes, behavior, and knowledge). Scores for the attitudes items were calculated by summing the total of raw score responses (i.e., an answer choice of 1=strongly disagree was scored as 1 point) for a total possible attitude score of 32 points. The 14 Likert-scale behavior questions were scored the same way with a maximum possible score of 56 points. Knowledge questions were scored by assigning a 1-point value for correct responses and a 0-point value for incorrect responses. The total possible knowledge score was 18 points. Paired samples t-tests were calculated to determine the significance of changes from pre-test to post-test within each group of teachers. Independent samples t-tests were calculated to determine if the differences in growth between extension agent trained and project staff trained teachers were statistically significant.

Results and Discussion

Each team of teachers trained by either project staff or Extension agents implemented the Hands On curriculum in their classrooms at some point during the 2008-2009 school year. This suggests that both groups of teachers received adequate training to feel confident using the curriculum. In addition, both groups showed significant gains in attitudes, behaviors, and knowledge (Table 2).

The mean total pre-test score for teachers trained by Extension agents was M=79.97, SD=8.60 out of 106 possible points (Table 2). This was significantly lower than the mean total pre-test score of teachers trained by project staff (M=84.88, SD=6.99), $t(78) = -2.804$, $p = .006$. The difference between the groups' pre-test means can likely be explained by their scores on the attitude toward teaching food safety subscale: M=22.67, SD=3.39 for Extension agent-trained teachers versus M=24.78, SD=3.48 for project staff-trained teachers. While the difference in pre-test means for attitudes was statistically significant ($t(78) = -2.746$, $p = 0.007$), pre-test means for behavior and knowledge ($t(78) = -1.684$, $p = .096$ and $t(78) = -1.333$, $p = 0.186$, respectively) were not.

The higher pre-test scores for project staff-trained teachers, especially the attitude means, may be explained by the methods in which each group of teachers was recruited for training. Teachers trained by Extension agents were actively recruited to the program through contact with school administrators and other teachers. By comparison, those trained by project staff sought out participation in the program after attending conferences sessions reporting results and benefits of Hands On. The sample of teachers who sought out the program had more willingly expressed interest in the topic of food safety education and had some minimal level of exposure to the curriculum from project staff.

Table 2.

Pre- and Post-Test Means for Extension Agent-Trained and Project Staff-Trained Teachers

	Extension Agent Trained (n=39)					Project Staff Trained (n=41)				
	Pre		Post			Pre		Post		
Mean	SD	Mean	SD	Mean	p value	SD	Mean	SD	Mean	p value
Total Instrument	79.97	8.60	93.08	6.81	<.001	84.88	6.99	96.41	5.97	<.001
Attitudes	22.67	3.39	28.00	3.12	<.001	24.78	3.48	29.56	3.12	<.001
Behaviors	44.59	5.519	48.92	4.99	<.001	46.51	4.68	50.68	4.25	<.001
Knowledge	12.92	2.24	16.16	0.823	<.001	13.59	2.20	16.17	1.28	<.001

To account for the significant difference in pre-test scores, analysis of the results is focused on the average growth (post-test mean - pre-test mean) by section and as a whole between both groups of teachers (Table 3). The mean attitude growth of Extension agent-trained teachers was M=5.39, SD=4.02 versus M=4.78, SD= 3.664 for project staff-trained teachers, thus indicating positive improvements in teachers' attitudes toward teaching food safety as part of their regular classroom instruction. While there was a greater gain in attitudes with Extension agent-trained teachers, the difference was not significant ($t(75) = .695$, $p = 0.489$). Again, we hypothesize that the more positive attitude of project staff-trained teachers on the pre-test accounts for the slightly smaller gain in attitude from pre- to post-test. These teachers came in with a stronger inclination toward the program; therefore, there was less room to improve their attitudes.

Teachers who were trained by Extension agents reported a M=4.39, SD=5.85 growth in food handling behaviors versus M=4.17, SD=3.71 for teachers trained by project staff. This difference was not significant ($t(75) = .198$, $p = 0.844$). Similarly, Extension agent trained teachers (M=3.19, SD=2.03) achieved slightly higher, but non-significant ($t(75) = 1.288$, $p = 0.202$) growth in knowledge than project staff trained teachers (M=2.59, SD=2.12). As with attitudes, the differences in the growth in behaviors and knowledge may be attributable to the lower pre-test scores of Extension agent trained teachers providing more opportunity for growth.

The mean total growth from pre- to post-test for the Extension agent-trained teachers was M=13.19, SD=8.06 compared to M=11.54, SD=6.63 for teachers trained by project staff. While the gain for Extension agent-trained teachers was slightly larger, it was not a significant difference ($t(75) = .990$, $p = 0.325$), thus indicating that teachers trained by Extension agents received similar quality training as those trained by project staff.

Table 3.
Growth and P Values for Extension Agent-Trained and Project Staff-Trained Teachers

	Total Instrument		Attitudes		Behaviors		Knowledge	
	Mean Growth ±SD	p Value	Mean Growth ±SD	p Value	Mean Growth ±SD	p Value	Mean Growth ±SD	p Value
Extension Agent-Trained	13.19 ± 8.06	0.325	5.39 ± 4.02	0.489	4.39 ± 5.85	0.844	3.19 ± 2.03	0.202

(n=39)								
Project Staff-Trained (n=41)	11.54 ± 6.63		4.78 ± 3.64		4.17 ± 3.71		2.59 ± 2.12	

Conclusions, Limitations, and Implications

Teachers in both groups demonstrated positive increases in food safety attitudes, behaviors, and knowledge. Overall gains achieved by Extension agent-trained teachers were statistically similar to those of teachers trained by project staff. There were slight variations between the growth from pre- to post-test of teachers trained by Extension agents versus those trained by project staff; however, only the attitudes differences were significant. This difference is likely a result of a more willing and engaged population trained by project staff. A number of teachers recruited to participate in the Extension agent-led training sessions indicated that they were required to participate by their schools' administration and did not come to the workshop with high levels of personal buy-in. While these attitudes changes throughout the course of the workshop, it is possible that the negative attitudes coming into the workshop impacted the results of the study.

The study had several other important limitations. First, participating Extension agents were selected for the study based on their previous programming experience with food safety education and involvement in school within their counties. Therefore the results of the study may not be generalizable to the larger population of all Extension agents. In addition, due to time and resource constraints, we were unable to create a well-matched control group of project staff-trained teachers. As noted in the results section, project staff-trained teachers' pre-test scores were significantly higher than the pre-test scores of Extension agent-trained teachers. We hypothesize that this difference is due to the nature of how each group was recruited. While this hypothesis makes intuitive sense and has support from anecdotal evidence based on conversations with teachers in each group, it is possible that there were other undetermined causes that led to the difference in pre-test scores and that these causes may have adversely impacted the overall results of the study. Finally, it is unrealistic to assume that concrete, measurable behavior changes would occur over the span of 2 days. Thus, the instrument items related to behavior on the post-test are designed to indicate an awareness of the importance of food handling behaviors and an intent to change behavior.

Within these limitations, we believe the study reported here has several important implications for other Extension educational outreach programs. First, the study suggests it is possible to design an effective outreach program built on a train-the-trainer design. To do so, developers must clearly identify the goals of the outreach program and tightly align any training components to those goals. For example, with the Hands On program, three programmatic goals guided the development of training workshops for teachers: 1) convince teachers that food safety is an important concept to teach young people; 2) demonstrate that the topic of food safety can be easily addressed through pre-existing standards in the curriculum by introducing teachers to the proposed integrated unit and modeling new instructional strategies; and 3) ensure an accurate assessment of the program is not compromised by inconsistent implementation of the curriculum. Therefore, in designing a train-the-trainer component, project staff developed a training curriculum to provide Extension agents (who would become our trainers) with the background knowledge and grounding educational theory necessary to meet the state workshop goals. For example, without understanding the instructional theory behind the teaching strategies contained in the Hands On unit, agents would not have been prepared to "demonstrate that the topic of food safety can be easily addressed through pre-existing standards."

Second, identifying and implementing a training model that is built on research-

based best practices for adult learning and professional development is critical to the success of any training program. (Table 1 contains the model employed in the study reported here.) When relying on a train-the-trainer model, trainers can only successfully implement what they can remember and have been taught to apply. Using a best-practices model of professional development for training draws upon research strategies for ensuring the intended audience will be able to synthesize, apply, and retain the knowledge and skills necessary to repeat the training for new participants.

As with many other educational outreach programs, as the Hands On program continues to grow, the need for effective means of training teachers across multiple states will increase. Sending project staff to conduct all teacher-training sessions will become time and cost prohibitive. The results of the study reported here indicate that the train-the-trainer model using Extension agents can be an effective way to prepare classroom teachers to implement the Hands On program, ensuring sustainable growth.

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