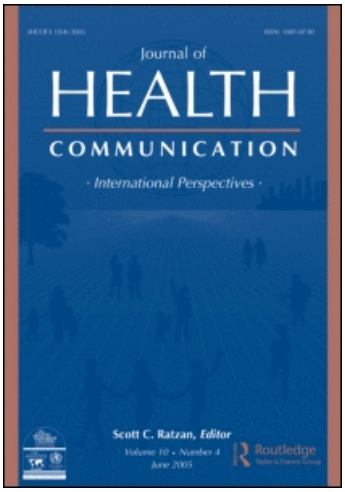

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Comparison of Online and Face-to-Face Dissemination of a Theory-Based After School Nutrition and Physical Activity Training and Curriculum

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Comparison of Online and Face-to-Face Dissemination of a Theory-Based After School Nutrition and Physical Activity Training and Curriculum

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In fond memory of Dr. Rick Bell.

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This study was conducted to compare two different online delivery methods to train after school program leaders (ASPLs) to implement a nutrition and physical activity curriculum for children to each other and to a face-to-face (FTF) training model. A three-group design was used in which ASPLs from 12 states were randomized to either standard (n = 34) or an enhanced interaction (n = 31) online training, while a FTF group (n = 24) served as comparison. All ASPLs completed training and implemented curriculum lessons over 16 weeks from March to June 2007. Weekly evaluations and pre and post-intervention questionnaires compared number of lessons implemented, subjective ratings of lesson success, and pre and post leader nutrition and physical activity knowledge. Multivariate linear regression analyses were used for among-group comparisons, paired T *tests for within-group knowledge change. Knowledge scores increased significantly (*$p < .001$*) within each group. All ASPLs fulfilled the goal of conducting at least 9 lessons, and they rated 64% of lessons successful. After adjustment, knowledge change and success scores did not differ among groups. Implementation was significantly higher for FTF (+2.23 lessons,* $p = .013$*) than for enhanced interaction, but not for standard. Online training for ASPLs, such as the standard condition, are viable means of nutrition and physical activity education and program dissemination.*

Childhood obesity, one of the most significant public health threats facing children (James, Thomas, Cavan, & Kerr, 2004; Lobstein & Baur 2005; Summerbell et al., 2005), is said to be partly a product of inadequate engagement in daily activity that is sufficient to balance energy intake (Klesges, Klesges, Eck, & Shelton, 1995; Weinsier, Hunter, Heini, Goran, & Sell, 1998). Thus, effective strategies to bring children into energy balance are needed (James et al., 2004; Lobstein et al., 2005; Summerbell et al., 2005). Several before-, during-, and after school nutrition and physical activity programs have demonstrated effectiveness in obesity reduction and prevention in such a manner (Foster et al., 2008; Gortmaker, Cheung, et al.,1999; Gortmaker, Peterson, et al., 1999; Luepker et al., 1996; Yin, Gutin, et al., 2005; Yin, Hanes, et al., 2005).

Initiatives targeting *after* school time are particularly attractive because they require little change in the heavily mandated institutional structures and practices and do not infringe on already tight academic schedules and achievement requirements. After school initiatives such as Georgia FitKid have demonstrated effectiveness in reducing overweight, increasing physical activity, and improving overall health in children (Kelder et al., 2005; Yin, Hanes, et al., 2005). In a randomized, controlled 8-month after-school intervention among third graders, significant reductions in percent body fat (−.76) and heart rate (CVF; −4.4 bpm), and an increase in bone mineral density (.008 g/cm^2) were demonstrated, when compared with the control group (Yin, Gutin, et al., 2005).

The after school nutrition and physical activity curriculum "HEAT Club" (Healthy Eating and Active Time), which was implemented and tested as part of a larger controlled community intervention (Economos et al., 2007), was the focus of this present investigation. The HEAT Club curriculum and accompanying leader training are based on the Social Cognitive Theory (Bandura, 1986; Perry, Baranowski, & Parcel, 1997) and aim to increase children's physical activity and consumption of fruits, vegetables, whole grains, and nonfat/low-fat milk products, as well as to decrease children's sedentary time and consumption of saturated fat and sugar. Both the curriculum and leader training were carefully evaluated for usability and acceptability in the target population and, based on qualitative program leader reports and site visit observations, were well received (Economos et al., 2007). The

HEAT Club subsequently was implemented in numerous programs throughout Massachusetts and New Jersey.

The Role of Leader Training in the Replication and Dissemination of Effective Programs

Despite initial success, many programs and interventions, such as those mentioned above, ultimately fail when transferred out of the research environment, due to lack of planning for maintenance and long-term sustainability (Glasgow, Vogt, & Boles, 1999). This has been among the most frequent criticisms of otherwise effective randomized, controlled trials (Rothwell, 2005), particularly childhood obesity intervention trials (Klesges, Dzewaltowski, & Glasgow, 2008). Such evidence suggests the need for greater attention to effective program replication and dissemination.

Adequate training of the individuals on the forefront of implementation has been shown to be a key predictor of program maintenance. Such training is also needed to ensure leader competence and sustained fidelity to intervention protocols in both research and replication phases (Bell et al., 2007; Kelder et al., 2003). One study of an initially successful school-based program cited insufficient training of teachers as the most important barrier to sustained program success (Kelder et al., 2003). Similar scenarios have been highlighted by others (Glasgow, Bull, Gillette, Klesges, & Dzewaltowski, 2002). The HEAT Club leader training, like many similar theory-based program models, features live, face-to-face (FTF) training, curriculum manuals, and on-going support. The costs associated with this type of leader training often preclude replication and widespread dissemination. Indeed, to date, dissemination of the HEAT Club has been limited due to lack of dedicated resources and the fact that academic infrastructure is ill-suited to support long-term program maintenance (Glasgow et al., 1999).

Alternatives to FTF trainings exist and have been utilized by some nutrition and physical activity programs (Gortmaker, Cheung, et al., 1999; Sallis et al., 1997; Gortmaker, Peterson, et al., 1999). These include dissemination via program training manuals and audio/video materials distributed on CD-ROMs. These options, however, preclude the ability to progressively adapt and update the curricula, as well as to respond to differing program needs. Further, these types of dissemination models are limited to one-way transmission of information. Without some degree of contact and support in the training process, there can be no assurance of fidelity to the theoretical bases on which the programs were developed or adherence to protocols. If original training protocols are not replicated in subsequent dissemination rounds, even the most successful programs cannot be expected to yield consistent results (Kelder et al., 2003).

Web-Based Dissemination of Programs and Trainings

Web-based delivery holds potential as an efficient and cost-effective means of delivering nutrition and physical activity programs and trainings (Silk et al., 2008; Wallner, Kensall, Hillers, Bradshaw, & Medeiros 2007; Whalen & Wright, 1999). It also may provide the advantages of flexibility for the learner, content adaptability, and the ability to instantly access outside resources and up-to-date information (Bennett & Glasgow, 2009; Sigulem et al., 2001). While most widely used in formal, postsecondary education (Allen & Seaman, 2003; National Center for Education

Statistics [NCES], 2003), online learning is increasingly being employed as a vehicle for health information dissemination. Formal web-based models have been found to be successful for training medical (Curran & Fleet, 2005), public health (Umble, Cervero, Yang, & Atkinson, 2000), and nutrition professionals (Curran, Gulliver, Landells, & Hatcher, 2000; Silk et al., 2008; Wallner et al., 2007). A recent review of web-based learning studies among health professionals suggested that educational outcomes are similar, when compared with traditional education methods (Cook et al., 2008).

Further, several health education and behavior theories support the use of web technology to disseminate such programs. For instance, web-based delivery allows for learner convenience; flexibility; the ability to access content and trainings regardless of time or location; the capacity for dynamic interactions to take place, both with the online medium and with fellow learners; and space for observational learning and reinforcement to take place. These attributes are hallmarks of Consumer Information Processing and Social Marketing Theories (Glanz, Rimer, & Viswanath, 2008; Shelton & Saltsman, 2005). Further, distributing course materials and trainings online permits content adaptability, frequent updating of material, provision of instant feedback, and tailoring of content to individual learners (Bennett et al., 2009). These are important components of the Social Cognitive Theory, the Transtheoretical Model, and the Health Belief Model (Cook, 2007; Glanz et al., 2008).

There are, however, drawbacks to web-based education. Learners often complain of a *lack of motivation* without the FTF stimulation and immediate feedback of the traditional classroom setting (Moore & Keasley, 1996). In a factor analysis study of online learning barriers, lack of social interaction and low personal motivation emerged as the most significant individual barriers for students (Muilenburg & Berg, 2005). Without the advantage of FTF contact, high attrition rates have been reported (Carr, 2000; Parker, 1995).

Further, despite encouraging results among professionals, there is a dearth of evidence to support use of web-based training among *lay providers* of health information (Latner, Stunkard, Wilson, Jackson, & Zelitch, 2000). The few studies featuring *online* training of lay providers have focused on caregivers (Bass, McClendon, Brennan, & McCarthy, 1998; Bernhardt, Runyan, Bou-Saada, & Felter, 2003; Glueckauf, Ketterson, Loomis, & Dages, 2004; Umble et al., 2000), not educators or program administrators. This is an unfortunate gap in the literature since several promising studies have demonstrated that dissemination of nutrition and physical activity programs by traditionally trained laypersons can be as effective as dissemination by health professionals, and at lower costs (Brownell, Strunkard, & McKeon, 1985; Earp et al., 1997, 2002; Eng & Young, 1992; Yu et al., 2007).

Considerations in Developing Web-Based Trainings

While evidence-based delivery methods have not yet been established (Cook, 2005; Crutzen et al., 2008), some investigations in the field of education may provide useful models for design, implementation, and evaluation of web-based trainings for lay-providers of health information (Garrison & Kanuka, 2004; Kreijns, Kirschner, & Jochems, 2002; Rourke & Anderson, 2002; Swan, 2002; Tu, 2002). Mounting evidence suggests that, rather than using the computer as a mere delivery mechanism for content that learners passively absorb, online learning should equip and motivate

participants to interact with fellow learners and with the online medium, and to construct knowledge in personally relevant ways (Alvani, 1994; Kreijns et al., 2002; Swan, 2002). Although standard, noninteractive forms of online learning allow the learner more flexibility than collaborative learning, which creates interdependence and accountability, there is evidence that collaborative learning stimulates meaning for students and increases motivation (Alvani, 1994; Cohen, 1994; Johnson, Maruyama, Johnson, Nelson, & Skon, 1981). This may be particularly true when learners must collaborate on assignments or the creation of group products (Alvani, 1994; Cohen, 1994; Johnson et al., 1981). Examples of group products are collaborative writing assignments (Bers & Best, 1999) and group-constructed virtual learning environments (Bers, 2008). In sum, enhancing interaction in online training environments may improve learning outcomes (Alvani, 1994; Kreijns et al., 2002; Swan, 2002).

Research Aims

The aims of this study were to create two online forms of an after school program leader training to implement an online nutrition and physical activity curriculum: an enhanced interaction condition (EI) and standard-delivery (STND) and to compare leaders in these two conditions both with each other and with leaders in a group that received a FTF training and print version of the curriculum, from which the online versions were adapted. Comparisons were based on leader nutrition and physical activity knowledge change, lesson implementation rates, and leader's perceptions of lesson success. It was hypothesized that program leaders trained via the FTF format would demonstrate a higher level of success on all outcomes than leaders trained via the STND model, while those trained via the EI model would demonstrate a higher level of success than either of the other two groups.

Methods

Study Design

A three-group design was used in which two groups were randomized, according to a randomly determined computer sequence generated by a blinded staff member, to receive either the STND or EI online training, while a concurrent nonrandomized FTF training group served as a comparison condition (De Jarlais, Lyles, Crepaz, & Abbasi, 2004). Online participants were made aware of their group assignment via email and were enrolled in their respective online courses. Recruitment took place during winter 2006, and the intervention during spring 2007.

Participants

Figure 1 shows the flow of participant recruitment. Participants for the online groups were nominated for participation via a national corporate listserve email. A total of 128 programs were nominated and subsequently contacted by study staff to assess eligibility (access to appropriate facilities, the ability to complete the program, and Internet capabilities) and willingness to participate. All programs were asked to designate one point person ("leader") for participation in the study. Fifty-seven programs declined participation. Seventy-one eligible programs chose

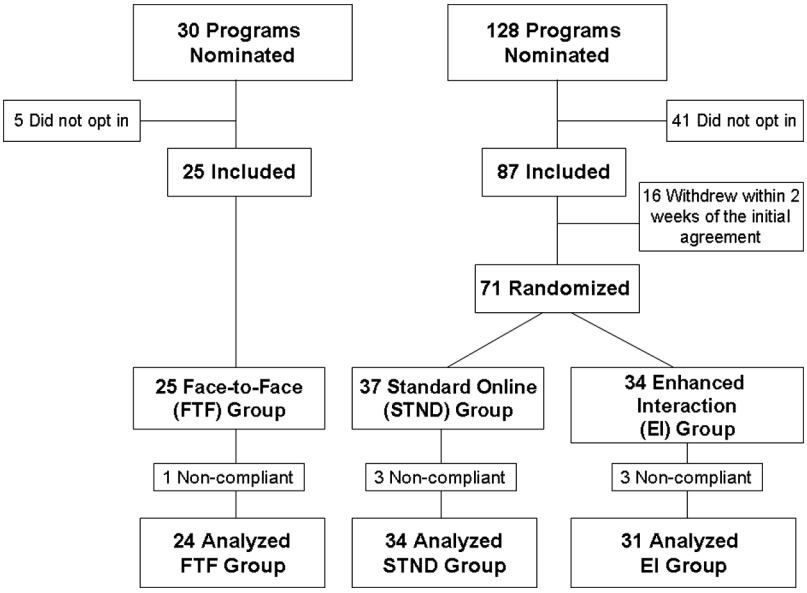

Figure 1. Participant flow chart.

to participate and were randomized to either the STND group ($n = 37$) or the EI group ($n = 34$). Six leaders, three from each of the online groups, failed to submit any of the required lesson evaluations during the course of the study and were considered to be noncompliant. Final analysis included $n = 34$ STND and $n = 31$ EI leaders.

Leaders who took part in the FTF condition were recruited in a similar manner; however, since this group was designed to replicate previous FTF model trainings and because logistical and cost constraints prevented long-distance training, all FTF programs were recruited from within a 30-mile radius of the study center. Email nominations came from a local, rather than national, listserve. Programs were screened for eligibility as described above. Thirty programs were nominated, from which 25 chose to participate, and 24 completed the intervention.

Since FTF leaders were not randomly assigned to this condition, demographic, program, computer use, access, and experience data were collected from all study participants, to adjust comparisons between FTF and each of the online groups. The authors of this study concluded that appropriate statistical adjustments should be made, conservative conclusions drawn, and transparency used in reporting, rather than excluding the FTF group comparison, based on the scarcity of resources needed to conduct a true three-way randomization. As De Jarlais (2004) and colleagues aptly state, "Excluding data collected under [nonrandomized] conditions would undoubtedly bias the evidence toward interventions that are 'easier' to evaluate but not necessarily more effective or cost effective" (De Jarlais et al., 2004, p. 1).

Leaders in the online groups were recruited from 12 states, and leaders in the FTF group were recruited from across Eastern Massachusetts. Each program received a $500 stipend as incentive for participation. Stipends were to be used for HEAT Club or program-related expenses, such as buying food or physical activity equipment. Written, informed consent was obtained from each leader, and subject

recruitment and study procedures were fully reviewed and monitored by the Institutional Review Board at Tufts University.

Procedures

Online Adaptation of the HEAT Curriculum and Training Materials

The course websites used in both online conditions were adapted from the original FTF trainings and print curriculum. The design, delivery, and presentation of all course materials were based on Mastery Teaching Theory, which promotes a logical, structured flow of educational materials, along with frequent reinforcement (Hunter, 1982). The web courses were identical in content and featured two overview trainings in the form of audio-embedded Microsoft® PowerPoint® presentations, as well as 15 web-based learning modules, each tied in theme and educational content to a corresponding HEAT Club lesson. The purpose of the modules was to equip leaders with the background knowledge necessary to conduct the lesson. Each of the downloadable lessons was identical to those in the original print curriculum. Eight additional "appendix" sections of the site, modeled after those in the print curriculum, provided supplementary information and links to online resources and other nutrition and physical activity-related websites. The online version of the training and curriculum was pilot tested for usability and acceptability among program leaders from three different after school programs in Massachusetts and found to be acceptable prior to the intervention (unpublished data). Minor screen layout changes were made based on pilot feedback.

Program Implementation

Leaders in all three conditions progressed through the trainings and educational modules and implemented the curriculum lessons in a parallel manner throughout the 16-week intervention. They were instructed to follow a prescribed sequence through the educational modules and to conduct one lesson per week in their after school programs. Leaders in each condition received weekly email updates from study staff reminding them to submit weekly online lesson evaluations, providing specific "teacher tips" and highlighting relevant "in the news" articles pertaining to the lesson topics for each week.

Standard Online Training Condition

The intent of the STND group was to provide a forum for online learning, communication, and interactivity to unfold naturally, unprompted by study staff. As such, the STND group was neither required nor encouraged to communicate with fellow leaders and, if they chose to do so (as eight leaders did), discussions were not moderated by study staff. All email communications and weekly updates were sent to the group at large, with generic greetings and closings.

Enhanced Interaction Training Condition

The EI differed from the STND online condition in that it included peer interaction requirements and a collaborative group assignment (Kreijns et al., 2002). Leaders in the EI condition completed a supplemental online training on how to use course communication tools and were instructed to interact with fellow leaders at least once per week. They also were asked to attend "live chat" training sessions each week with study staff and to collaborate on a group assignment. For the assignment,

leaders were randomly assigned to smaller "teams" of six, in order to enhance familiarity and facilitate partnership (Cohen, 1994). Leaders in each group were required to work together to list barriers they encountered in implementing the HEAT Club, brainstorm solutions, and compose a list of relevant problem–solution pairs into their "Top Ten Tips." Leaders were informed that these tips would be shared with future leaders. This creation of a group product was intended to enhance motivation and sense of community among EI leaders (Papert, 1980). Other components designed to enhance interaction included promotional messages from study staff, based on the Theory of Reasoned Action (Fishbein & Ajzen, 1975) and the Theory of Planned Behavior (Ajzen, 1991). For instance, emails from study staff highlighted the benefits of peer interaction and attempted to positively influence attitudes and intentions toward using the communication tools. Benefits included sharing ideas and tips, the ability to "make the site their own" by posting new links and resources, and opportunities for interaction with leaders in different programs across the country. Online discussions were moderated by study staff, and specific posts and contributions from leaders were frequently highlighted in weekly emails to all participants. This was done to encourage continued participation and increase awareness of the interaction opportunities for those who had not yet logged on to the communication tools.

Face-to-Face Training Condition

The FTF group received in-person training according to the previously used HEAT Club model. Leaders attended two training sessions conducted by study staff, one pre- and one mid-intervention (at week 7). Training sessions featured basic nutrition and physical activity education, as well as curriculum-specific implementation principles and classroom tips. Finally, all weekly email updates were sent as in the STND condition.

Measures

Nutrition and Physical Activity Knowledge

The General Nutrition Knowledge Questionnaire for adults, in which individual items were tested for construct validity and test–retest reliability in a British population (Parmenter & Wardle, 1999), was used to assess nutrition knowledge pre-post-intervention. Fifteen questions from the original questionnaire were omitted for this investigation: five were deemed inappropriate for American respondents, and 10 were removed due to the fact that they dealt with content areas not explicitly featured in the HEAT Club curriculum, such as sodium consumption. Nine items pertaining to U.S. government recommendations for physical activity at the time of the study (Pate et al., 1995) were added in order to assess physical activity knowledge. In the final adapted questionnaire, knowledge scores were assessed out of a total of 108 items. Internal reliability was assessed for both the pre- and post-rounds of the questionnaire using Cronbach's alpha (Cronbach, 1951). For the overall questionnaire, a Cronbach alpha (Cronbach, 1951) correlation of 0.80 was found for the pre- and 0.98 for the post-round, while subsections ranged from 0.62–0.96 on pre- and post-questionnaires. Based on previous findings (Parmenter et al., 1999), we expected leaders to average 60% correct on the pre-test. We hypothesized that leaders would improve their scores by an average of five points on the post-test.

Implementation Rate

Program implementation rate was the total number of lesson evaluations, 17 questions each, submitted during the 16-week intervention period. Based on previous dissemination rounds of the HEAT Club (Economos et al., 2007; unpublished data), it was expected that leaders would implement a minimum of 60% of the 15 curriculum lessons. All submissions were completed online using a standardized lesson evaluation form. All leaders received weekly email submission reminders.

Perceived Implementation Success

Leaders were asked to give an overall success rating for each lesson in their weekly online evaluations, based on clarity of leader education components, ease of preparation and lesson execution, and acceptability by the students. Ratings were reported on a scale of 1–5, where 1 = "Poor," 2 = "Fair," 3 = "Good," 4 = "Very Good," and 5 = "Excellent." An overall success score, expressed as percent successful, was conservatively calculated as the number of lessons coded "4" or "5" divided by the lesson implementation rate.

Computer Access and Usage

A 16-item post-intervention survey was administered online to retrospectively assess leaders' computer *access* and *usage* practices before, during, and after the intervention. Fourteen items were assessed on a Likert scale, for instance, leaders were asked to report their daily access to a computer as follows: (a) less than 1 hour, (b) 1–4 hours, (c) 4–8 hours, or (d) more than 8 hours. Two items were assessed in a yes/no format; for instance, leaders were asked if their computer access was restricted in any way at their after-school program sites. A Cronbach alpha (Cronbach, 1951) correlation of 0.91 was found for the 16-item survey.

Statistical Analysis

Descriptive statistics were used to describe the sample. Chi-square tests were performed to detect differences among the groups on demographic and empirically important program variables. Since 71% of leaders classified themselves as "non-Hispanic White," the ethnicity variable was collapsed into non-Hispanic White/non-White. Implementation rate, perceived success score, and knowledge change were analyzed as primary outcomes. Implementation rate and perceived success scores were assessed as continuous variables. Knowledge change was the difference between pre and post knowledge scores. One-way analysis of variance (ANOVA; 2-tailed, $p < .05$) with post-hoc Tukey's tests were used to evaluate the differences between and among the three groups for each of the outcomes. Paired t tests were used to assess leader knowledge change within each group. Additionally, since the FTF group was not randomly assigned and since comparisons were made between the FTF and online groups, computer use, attitudes, and experience were gathered for all leaders, in order to control for these variables in regression analyses.

Variables found to differ significantly among groups ($p < .05$), along with demographic and variables that could conceptually affect outcomes, were entered into linear regression analyses. Parallel analyses were conducted for each of the three primary outcomes to test the outcome predictability of group membership, while holding other factors constant. "Group" was entered as a dummy variable, with the FTF group serving as the omitted category. Other independent variables

included ethnicity, age category (18–26, 27–37, or 38–67 years), program location (urban, suburban, rural), employment status (full- or part-time), job title (aide, teacher, or director), average number of children participating in the HEAT program, previous experience with online surveys (yes/no), and whether or not leaders sought online resources outside of the curriculum, as suggested (yes/no).

We tested a second regression model for each of the outcomes that included gender, education, and computer availability at work variables. These covariates were found to be nonsignificant, and their presence in the model had a negligible effect on other covariates. Thus, these variables were excluded from the final models.

Models also were tested using the EI group variable as the reference category and entering the FTF group variable into the model, in order to allow for comparison between the two online groups, as well as between each of the online groups and the FTF group.

All analyses were conducted using SPSS for Windows, version 14.0, 2005 (SPSS, Inc., Chicago, IL). All tests were two-sided and level of significance was set at $p < .05$. Power calculations were conducted based on 80% power using the means and standard deviations from published studies using the General Nutrition Knowledge Questionnaire (Parmenter & Wardle, 1999; Wardle, Parmenter, & Waller, 2000) and estimates of program implementation differences based on previous implementation of the HEAT Club.

Results

Leader and Program Characteristics

The majority of the program leaders were female (85%, 75/89), with no differences in gender, $\chi^2(2, N = 89) = 1.04$, $p = .595$, or ethnicity among groups, $\chi^2(10, N = 87) = 6.46$, $p = .775$. More leaders reported full-time employment status in the online groups (EI = 83%, STND = 88%) than in the FTF group (35%), $\chi^2(2, N = 86) = 21.89$, $p < .001$, and STND leaders were most likely to hold the title of "director" (82%) when compared with the EI (47%) and the FTF (38%) groups, $\chi^2(4, N = 87) = 15.83$, $p = .003$. The online programs were also significantly more likely than FTF programs to be in rural or suburban than in urban areas (80% and 73% vs. 29%), $\chi^2(4, N = 87) = 17.43$, $p = .002$. As well, the average number of children participating in the HEAT Club was significantly greater in the EI group (20 ± 12), compared with the FTF group (11 ± 4), $F(2,76) = 7.59$, $p = .001$ and in the STND (25 ± 17) compared with the FTF group $F(2,76) = 7.59$, $p = .037$. Table 1 shows participant and program characteristics of these and other variables of empirical importance.

As shown in Table 2, overall, the three groups were similar with regard to computer use. As expected, EI leaders were significantly more likely to use the course site communication tools (55% used the tools) during the intervention than were STND leaders (24%), $\chi^2(1, N = 65) = 6.72$, $p = .012$.

Implementation, Success, and Knowledge Change

Overall, 84% (75/89) of leaders fulfilled the implementation requirement. All three groups showed significant gains in nutrition and physical activity knowledge ($p < .001$) and reported a mean success score of 65%.

Table 1. Characteristics of participants and after-school programs in the face-to-face (FTF), online enhanced interaction (EI), and online standard (STND) conditions

Variable	FTF ($n = 24$)	EI ($n = 31$)	STND ($n = 34$)	Differences among study groups (p values)
Gender				
Female	(19) 79%	(27) 87%	(30) 88%	.595*
Age				
18–26 years	(12) 52%	(12) 40%	(9) 27%	.245*
27–37	(10) 44%	(12) 40%	(18) 55%	
38–67	(1) 4%	(6) 20%	(6) 18%	
Education				
High School/ GED	(2) 9%	(1) 3.3%	(3) 9%	.759*
Some college	(7) 30%	(11) 36.7%	(11) 33%	
College	(9) 39%	(15) 50.0%	(16) 49%	
Master's	(5) 22%	(3) 10.0%	(3) 9%	
Ethnicity				
White	(16) 67%	(22) 73%	(23) 70%	.775*
Other	(8) 33%	(8) 27%	(10) 30%	
Employment status				
Full time	(8) 35%	(25) 83%	(29) 88%	<.001*
Part time	(15) 65%	(5) 17%	(4) 12%	
Title				
Aide/assistant	(4) 17%	(2) 7%	(0) 0%	.003*
Teacher	(11) 46%	(14) 47%	(6) 18%	
Director	(9) 38%	(14) 47%	(27) 82%	
Program location				
Urban	(17) 71%	(6) 20%	(9) 27%	.002*
Suburban	(7) 29%	(21) 70%	(21) 64%	
Rural	(0) 0%	(3) 10%	(3) 9%	
Average number of students Mean (SD)	11 (4)	20 (12)	25 (17)	.001** Live-EI = .037*** Live-STND = .001***

*p value derived from Pearson χ^2; **p value derived from one-way analysis of variance (ANOVA); ***with post hoc test.

In ANOVA analyses, mean implementation rates, $F(2,86) = 7.07$, $p = .568$, knowledge change scores, $F(2,77) = 79.25$, $p = .343$, and final knowledge scores, $F(2,78) = 10.59$, $p = .936$, did not vary significantly among the three groups or between any two groups. Post hoc tests revealed significant differences in success scores between the FTF (57%) and the STND (73%) ($p = .049$). These results are reported in Table 3.

Table 2. Participants' computer access, experience, and usage in the face-to-face (FTF), online enhanced interaction (EI), and online standard (STND) conditions

Variable	FTF ($n = 24$)	EI ($n = 31$)	STND ($n = 34$)	Differences among groups (p value)*
Experience w/online courses (pre)	None (7) 33% Limited (5) 24% Moderate (6) 29% Extensive (3) 14%	None (9) 33% Limited (7) 26% Moderate (8) 30% Extensive (3) 11%	None (10) 32% Limited (11) 36% Moderate (5) 16% Extensive (5) 16%	.832
Experience w/online surveys (pre)	None (3) 14% Limited (7) 33% Moderate (8) 38% Extensive (3) 14%	None (3) 11% Limited (3) 11% Moderate Limited (14) 52% Extensive (7) 26%	None (4) 13% Moderate (16) 50% Extensive (5) 16%	.625
Daily access to computers (throughout)	<1 hr (4) 19% 1–4 hrs (4) 19% 4–8 hrs (2) 10% >8 hrs (11) 52%	<1 hr (4) 15% 1–4 hrs (7) 26% 4–8 hrs (6) 22% >8 hrs (10) 37%	<1 hr (2) 6% 1–4 hrs (6) 19% 4–8 hrs (8) 25% >8 hrs (16) 50%	.591
Computer tech support at work (throughout)	24-hr (2) 10% Regular (5) 24% Irregular (4) 19% None (9) 43% Other (1) 5%	24-hr (7) 27% Regular (8) 31% Irregular (3) 12% None (8) 31% Other (0) 0%	24-hr (7) 22% Regular (12) 38% Irregular (2) 6% None (11) 34% Other (0) 0%	.547
Used online resources (throughout)	(13) 62%	(21) 78%	(21) 66%	.670
Used course communication tools (throughout)	N/A	(17) 55%	(8) 24%	.012

*p value derived from Pearson chi square.

Table 3. Implementation rate, success score, and knowledge scores by face-to-face (FTF), online enhanced interaction (EI), and online standard (STND) conditions

Outcome/Group	Mean (SD)	p^* among groups	Mean difference	p^{**} between groups
Implementation				
FTF	10.9 (3.4)	.568	FTF-EI = 456	.833
EI	10.4 (3.6)		FTF-STND = −.478	.868
STND	11.4 (3.5)		EI-STND = .934	.538
Success Score (% lessons rated "good" or "excellent")				
FTF	57% (20%)	.056	FTF-EI = −.074	.517
EI	64% (25%)		FTF-STND = −.158	.049
STND	73% (28%)		EI-STND = −.083	.374
Knowledge Change (pre/post)				
FTF	+8.3 (9.1)ŧ	.343	FTF-EI = 3.62	.312
EI	+4.7 (6.3)ŧ		FTF-STND = 2.33	.600
STND	+6.0 (9.8)ŧ		EI-STND = −1.29	.833
Final Knowledge Score				
FTF	74.9 (13.9)	.936	FTF-EI = .064	1.00
EI	74.8 (12.4)		FTF-STND = −1.01	.957
STND	75.9 (12.0)		EI-STND = −1.08	.942

*p values derived from one-way analysis of variance (ANOVA).
**p values derived from ANOVA post hoc tests.
ŧ Significant within-group difference pre/post ($p < .001$), p values derived from t tests.

Implementation

After controlling for ethnicity, age, program location, full-or part-time employment status, job title, number of children in the program, whether or not leaders sought out suggested online resources, and previous online survey experience, EI leaders implemented fewer lessons than FTF leaders ($\beta = 2.23$, $p = .013$), ($R^2 = .302$, F (12,63) = 2.27, $p = .018$). There was no difference in implementation rate between the FTF group and the STND group or between the STND and EI group, when the EI group was used as the reference category.

Leaders who described themselves as non-Hispanic, White conducted more lessons than those of other ethnicities ($\beta = 1.87$, $p = .012$), and leaders who reported moderate–extensive prior online survey experience conducted more lessons than those with limited/no experience ($\beta = 2.22$, $p = .001$). See Table 4.

Perceived Success

In the adjusted model, success score did not differ by group when either FTF or EI was used as the reference category ($R^2 = .278$, F (12,62) = 1.99, $p = .040$). See Table 4. Success scores were 17% higher for leaders of programs in urban locations than for those in suburban locations ($p = .013$). Likewise, with each incremental decrease in age category, leaders reported 10% fewer lessons as successful ($p = .033$).

Table 4. Results of linear regression analyses, testing differences between online [enhanced interaction (EI) and standard (STND)] and face-to-face groups in program implementation, program success, and knowledge change*

Dependent variable/ Independent variables	β Unstd. coeff.	SE	p	Adj. R^2
Implementation				
EI group**	−2.23	.870	.013	.169
STND group**	−1.21	.886	.176	
White ethnicity	1.87	.718	.012	
Age	−.788	.463	.093	
Urban location‡	−.719	.699	.308	
Rural location‡	−.374	1.08	.731	
Survey experience	2.22	.647	.001	
Success score				
EI group**	.076	.083	.367	.142
STND group**	.093	.084	.273	
White ethnicity	−.036	.068	.600	
Age	−.098	.045	.033	
Urban location‡	.171	.066	.013	
Rural location‡	−.053	.103	.605	
Survey experience	−.122	.062	.054	
Knowledge change				
EI group**	−3.86	2.60	.143	.247
STND group**	−3.51	2.62	.186	
White ethnicity	4.12	2.20	.066	
Age	−1.55	1.43	.286	
Urban location‡	−.814	2.08	.697	
Rural location‡	−1.72	3.76	.650	
Survey experience	−1.35	1.94	.489	
Preknowledge score	−.353	.070	<.001	

*All models were adjusted for leaders' employment status, job title, number of children in the program, and whether or not leader reported seeking out suggested supplementary online resources. Variables that were significant in any of the three models were included in each model.

**FTF Group = omitted category.

‡Suburban = omitted category.

Knowledge Change

No differences were found among the groups on knowledge change measures in the adjusted models using either FTF or EI as the reference group ($R^2 = .285$, $F(13, 58) = 2.80$, $p = .004$). With each incremental increase in preknowledge score, knowledge change decreased by 0.35 points ($p < .001$). These findings are reported in Table 4.

Discussion

This study aimed to compare outcomes across three delivery models for HEAT Club training and program dissemination. Results revealed that, while the FTF-trained group implemented more lessons than the EI online-trained group, the STND

online-trained group performed as well as the FTF group on all measures. Further, all three study groups achieved expected levels of implementation and knowledge change, and the overall mean success score was 65%. These results suggest that online tools, such as the STND model, are viable methods of training and program dissemination for after-school nutrition and physical activity curricula and are comparable with FTF dissemination. Given the important role of after-school environments in childhood obesity prevention and the attendant need for methods to effectively and efficiently train leaders to direct such programs, these overall results are encouraging.

The fact that the EI group did *not* demonstrate higher implementation rates, greater success scores, or larger gains in knowledge than the other groups did not support our initial hypothesis. In fact, despite the enhanced opportunities for peer interaction and support, leaders in the EI group implemented significantly fewer lessons than FTF group leaders, all else equal. There are a number of possible explanations for this. Factoring in time for peer interaction was a responsibility added to an already tight schedule for most leaders; this may have made EI requirements challenging. Indeed, while, overall, leaders in the EI group demonstrated a significantly higher rate of interaction than STND group leaders, only 17 of the 31 leaders in the EI condition used the communication tools, despite repeated prompting to do so by study staff. Kirschner and colleagues (2008) recently posited that "coercive" techniques, such as *requiring* discussion board contributions, may, in some cases, overtax participants and thus produce the opposite of the desired effect on interaction and collaboration. Further, most studies demonstrating success with collaborative online learning formats have been conducted in college and university populations (Dewiyanti, Brand-Gruwel, & Jochems, 2005; Dewiyanti, Brand-Gruwel, Jochems, & Broers, 2007; Francescato et al., 2006; Rovai, 2004). It is possible that these populations place a higher priority on, and can devote more time to, social aspects of learning than the population in this investigation (Billings, Skiba, & Connors, 2005; Donaldson, Graham, Martindill, & Shane, 2000; Kramarae, 2001). Additionally, the after-school programs represented in this study were geographically diverse. While this was beneficial for the purposes of generalizability, lack of shared characteristics may have made it difficult for leaders to collaborate in a meaningful way. Interestingly, after the conclusion of the study, several leaders reported anecdotally that they had established email and phone contact with leaders they recognized as being from their state or part of a larger program network, such as the YMCA. Perhaps for these individuals, geography or network membership provided elements on which to connect and thus were a basis for communication. There is limited evidence that online groups tend to form around commonalities, such as age and physical proximity, rather than on spontaneous or coerced bases (Wellman, 2001, 2002).

Since some contend that it is not a matter of if, but how and when, web technology will become pervasive in health education and behavior change interventions (Cook, 2007; Mandl & Kohane, 2008), further research should delineate specific behaviors and populations for which such interventions may be most effective (Brug, Oenema, & Campbell, 2003; Wantland et al., 2004). Web-based technologies provide fertile ground for individual tailoring of interventions and for the application of education and behavior theories in research and practice. Such technology allows the creation of "virtual" environments, which can be actively explored by users, thus providing opportunity for social learning and modeling, as well as operant learning and reinforcement (Bandura, 1986). In this manner, theories such as the Social Cognitive Theory (Bandura, 1986), and Diffusion of Innovations Theory (Rogers,

1983), and the Transtheoretical Model (Prochaska & DiClemente, 1983) may be operationalized in innovative ways that may not be possible with other delivery methods. Additionally, a limited number of studies have reported successful outcomes resulting from individually tailored nutrition interventions (Brug, Campbell, & van Assema, 1999).

Study Strengths and Limitations

The geographic diversity of the participating programs (12 states across the United States) lends strength to the study, as do the experimental designs employed between the online groups and the comprehensive, validated survey instrument used to obtain quantitative outcome measures. To date, few similar studies have used validated instruments, and, to these authors' knowledge, none have simultaneously compared a standard online learning condition with an enhanced interaction online condition and a live, FTF condition.

This study has limitations. Although geographically diverse, ethnicity and gender in this sample were not reflective of the general population. Additionally, while a random assignment research design was used to contrast the two online groups, regression adjustment was used to compare the online groups with the FTF group. While three-way randomization would have been ideal, monetary and logistical constraints prohibited such a design. This underscores the need for more efficient and cost-effective modes of dissemination, such as those presented in the online groups. Finally, due to the data collection constraints dictated by a controlled trial such as this, leaders' ability to work on their own schedule and at their own convenience was limited. Since convenience and flexibility are hailed as hallmarks of online learning benefits, this may have been a major limitation.

Conclusions

This study indicated that online delivery is a viable method of training and program dissemination, is comparable with traditional methods, and may be recommended for lay practitioners. Further, the fact that the EI did not perform better than the STND group suggests that elaborate websites and interactive delivery designs may not be necessary for training effectiveness. Given the widespread use of online learning and the rapid proliferation of web technologies and Internet access, further investigation and application of these tools in the areas of nutrition and physical activity training, education, and program dissemination is warranted. In particular, web-based technologies offer new opportunities to apply the principles of education and behavior theories to public health interventions. Future studies might aim to further explain the function of online communication and collaboration in online venues, particularly using newer, interactive web technologies, as well as the impact of such programs on the children and families.

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