

THE EVALUATION OF *FOOD PYRAMID GAMES*, A BILINGUAL COMPUTER NUTRITION EDUCATION PROGRAM FOR LATINO YOUTH

Elena L. Serrano
Virginia Polytechnic Institute and State University

Jennifer E. Anderson
Colorado State University

The purpose of this study was to determine the effectiveness of Food Pyramid Games, a bilingual nutrition education software program for Latino youth. The computer program was designed to introduce children to general nutrition topics and the Food Guide Pyramid (FGP) and provide interactive opportunities to apply the FGP to planning meals and snacks, using constructs from the Theory of Intrinsically Motivating Instruction, such as games, story-telling, and songs. Changes in knowledge, skills, attitudes, and behavior intentions among students who completed the program (experimental) were compared with students who were administered only pre- and post-tests (control). The effects of cultural orientation/acclimation were also examined. The study involved 115 children from nine fifth grade classrooms in Colorado, an experimental group of 63 and a control group of 52. Findings demonstrated that the program was effective in strengthening knowledge, skills, and attitudes about nutrition and the FGP, regardless of cultural orientation.

Childhood Nutrition

Optimal nutrition is critical for the development, growth, and overall health of children. It helps ensure optimal cognitive and physical development, prevent sickness and illness, and promote overall well-being (Nicklas & Johnson, 2004). Despite the benefits of healthy eating, only 30% of youth meet the dietary recommendations for fruit, grains, meat, and dairy and 36% for vegetables (Munoz, Krebs-Smith, Ballard-Barbash, & Cleveland, 1997), based on the Food Guide Pyramid. Further, sixteen percent of youth did not meet any recommendations, and a meager 1% met all recommendations (Munoz et al., 1997). The Food Guide Pyramid is a guide for achieving the nutrients needed for optimal growth and healthy weights (US Department of Agriculture, 1996b).

School-based Nutrition Education

Every school day, more than 29 million young people attend elementary school (Jamieson, Curry, & Martinez, 1999). School-based programs can play an important role in promoting healthy lifestyles and diets among students and teachers alike – through “direct” and “indirect” avenues. These include formal health and nutrition curriculums and school lunch programs and other provisions of foods, respectively (Passmore, 1996). Several studies have shown that children are interested in learning about nutrition and generally believe nutrition is important to good health (Murphy, Youatt, Hoerr, Sawyer, & Andrews, 1994). In one school-based program, students rated “learning about nutrition” as very important for good health. Based on a one to ten scoring, with 1 not important and 10 extremely important, the average

score among fifth grade students was 8.8. Less than 50% of students knew the recommended number of servings from all groups of the Food Guide Pyramid, however. This is alarming, considering that over half of fourth and fifth graders reported that they prepare their own breakfast, lunch and dinners, with low-income children being responsible for more food preparation than their middle and high income counterparts (Baranowski, Domel, & Gould, 1993; Crockett & Sims, 1995). Results from focus groups conducted with limited resource Latino and non-Latino children in Colorado schools mirrored these findings (Buege, 1999). It was also found that few children have the necessary skills to take on these responsibilities, yet alone prepare nutritious snacks and/or meals.

Interactive Multi-Media

Interactive computer technology and multi-media have advanced in the past ten years as growing opportunities for nutrition education (Kolasa & Miller, 1996). They have the flashiness of mass media – with animations, video, and music – and provide avenues for “promoting learning and behavior change” (Lytle & Achterberg, 1995). Additionally computer-assisted education allows for self-paced learning (Carroll, Stein, Byron, & Dutram, 1996), messages (Brug, Steenhuis, van Assema, Glanz, & DeVries, 1999; Campbell, Honess-Morreale, Farrell, Carbone, & Brasure, 1999) and consistent and reliable nutrition information (Gould & Anderson, 1999).

Theory of Intrinsically Motivating Instruction

Outlined in the Theory of Intrinsically Motivating Instruction (TIMI), Malone (Malone, 1981) points to the inclusion of intrinsic – immediate and short-term – rewards in educational materials in order to promote children’s interest in computer programs and curricula in general. Specifically he cites fantasy, curiosity, and challenge as key components of “effective” educational materials – also defined as entertaining. In other studies, fantasy, curiosity, and challenge have equated with audiovisual effects, level of difficulty, randomness, surprise elements, and funny characters and voices (Buege, 1999; Matheson & Achterberg, 1994).

Definitions of “intrinsic” differ between Malone and health education research. Health education research has used these factors to explain health behaviors – such as locus of control (Buege, 1999; Wallston, Wallston, Kaplan, & Maides, 1976) – while Malone uses them to describe qualities in educational materials. Still, there is value in applying TIMI to nutrition education. Intrinsic rewards may be more influential in engaging a child, since long-term benefits will not be seen in the short-run (Perry, Mullis, & Maile, 1985; Bandura A & Schunk, 1981). Visual and auditory stimulation may also help children remember the messages better (Atkinson & Shiffrin, 1971). To date, many curricula have applied these principles – even if unknowingly using the TIMI framework – to the development of materials. Matheson and Spranger (2001) found that in reviewing 30 curricula including five computer programs, over half of curricula included these intrinsic elements. They also suggested that it was easier to address these using media, such as computer programs and videotapes.

Still, it is unclear whether “entertainment” equates with improved health knowledge, attitudes, and behaviors. Matheson and Spranger reported only “content” of the programs, not impact. And while several fun and entertaining nutrition education software and online programs have been developed for children (Baranowski, Baranowski, Cullen, Morreale, & Congdon, 2000; DiSogra & Glanz, 2000b), few have reported impacts in peer-reviewed journals (Matheson et al., 2001).

Finally, the educational impacts and applicability of TIMI – and more broadly – interactive multi-media to diverse audiences, such as Latinos, have not been fully explored, particularly in the nutrition field, although it appears to be an effective educational medium for Latino children (Bellman & Arias, 1990; Padrón & Waxman, 1996). Latinos represent a growing segment of the U.S. population (U.S. Bureau of the Census, 2000) with unique dietary and cultural patterns (Flegal, Ezzati, Harris, Haynes, & colleagues, 1991; Guendelman & Abrams, 1995).

Evaluation of Nutrition Education Interventions

To date, evaluations of school-based nutrition education programs have primarily used a pre-, post-test, treatment-control design (Contento, Manning, & Shannon, 1992). Based on a comprehensive review of nutrition education interventions, Contento found that all general nutrition education studies measured knowledge, such as awareness about food and nutrition and the use of a food group system to select nutritious meals (Contento, Randell, & Basch, 2002). The most common “mediating variable” studied for this form of education and population was attitudes, measured in 65% of studies with questions such as, “I am willing to try new foods.” A variety of techniques were used to assess behavioral impacts on the diet, including dietary recalls, food recalls, and observations of food choices.

Purpose of the Study

The purpose of this research paper is to present an overview of the development and evaluation of Food Pyramid games, a bilingual nutrition software program developed by Colorado State University, based on the TIMI framework. The objectives of the research study were to:

1. Compare changes in knowledge, skills, attitudes, and behavior intentions among students who completed the program (experimental) with students who were administered only pre- and post-tests (control); and
2. Determine if any differences in knowledge, skills, attitudes, and behavior intentions existed in learning based on cultural orientation (measured by acculturation level).

Method

Development of Computer Program

It has been estimated that less than half of individuals (including children) in the U.S. recognize the Food Guide Pyramid (Levy & Derby, 1995). Even fewer are familiar with the number of servings from the different food groups (Murphy et al., 1994) and actually follow the recommendations (Baranowski et al., 1997; Lytle et al., 1996; Murphy et al., 1994; Nicklas, Elkasabany, Srinivasan, & Berenson, 2001; Wilkinson, Mickle, & Goldman, 2002).

The developers of the *Food Pyramid Games* software program established the following learning objectives: children would be able to identify the different food groups; children would be able to apply the Food Guide Pyramid to planning meals and snacks; and children would increase their self-efficacy towards using the Food Guide Pyramid. As a result, the computer program was designed to introduce children to the Food Guide Pyramid concept (Super Sorter), provide interactive opportunities to “apply” the Food Guide Pyramid to planning meals and snacks (More or Less), and present other nutrition-related topics (Food Guide Pyramid, Food Adventurer, Variety), based on TIMI constructs, such as games, story-telling, infomercials, and

songs. Table 1 outlines the objectives and TIMI constructs addressed in each module.

Serving sizes were depicted visually. In Super Sorter, each food that appeared was the equivalent to one serving size. The same was true in More or Less. Overall the software program contained five bilingual modules – two games and three songs. On average, it took approximately 2 ½ hours to complete these modules. Songs were animated with words appearing at the bottom of the screen. Infomercials were approximately 20 seconds in length and appeared between rounds of Super Sorter.

Platform

Food Pyramid Games was developed for Apple™ computers using Macromedia Director.™ The software program was initially developed for classroom use. Apple™ computers were the predominant platform in southern Colorado schools during development.

Translations

All of the scripts and storyboards were translated by two native Spanish speakers and reviewed by a third translator for accuracy and appropriateness. The Hispanic population in this region of the U.S. is comprised mainly of individuals of Mexican descent. As a result, a narrator with a Mexican dialect was used for the Spanish component.

Table 1

Outline of Computer Nutrition Education Program

Name	Object	TIMI Construct
Super Sorter Organizador Estupendo	Foods appear and the child clicks on the group of the Pyramid where the food belongs. The game gets faster and more complicated with each additional round.	Game with Challenge (Goal)
More or Less Más o Menos	A number of meals and menus are presented and the child needs to determine if he/she needs “more” or “less” foods from different food groups. The Food Guide Pyramid is reinforced in this game, as well as serving numbers.	Game with Storyline
The Food Guide Pyramid La Guía Pirámide de Comidas	Colorful graphics illustrate the importance of the Food Guide Pyramid and different food groups ...”When you get hungry where do you go, what do you eat.”	Song
The Food Adventurers Aventureros de Comida	This space age animation features children taking the challenge of trying new foods... This is our mission, to find new foods.”	Song
Variety Variedad	This can-can song illustrates fruits, vegetables, and other foods dancing to the show-tune “variety” ... “Variety, variety, eat something new today”	Song
Infomercials Titulares	A total of six infomercials appeared teaching children about a range of topics: 1) Choose fruit juice instead of fruit drink; 2) Don’t let an empty plate stare back at you – Eat breakfast; 3) Candy bars – the sometime but not always food; 4) Salsa – fun to say and fun to eat; 5) This game has been brought to you by water: the drink that goes with everything! 6) What are these french fries and chips hiding? Fat	Animations

Foods

Illustrated foods were systematically chosen, based on research with 228 Latino children living in southern Colorado (Serrano, 2001) and several other studies (Block, Norris, Mandel, & DiSogra, 1995; Koehler, Harris, & Davis, 1989; US Department of Agriculture, 1996a; US Department of Agriculture, 1998), to represent different degrees of cultural orientation. This region of the state (and the U.S.) – the San Luis Valley, the Arkansas Valley, and Pueblo – has a strong Hispanic/Latino heritage and a growing immigrant population (mainly from Mexico). Correspondingly, the program showed a range of traditional Mexican American foods – such as posole, chilaquiles, atole, and jicama – to popular and widespread foods in the U.S. – like pizza, cereal, hamburgers, and orange juice.

Alpha-Testing

Alpha-testing (pilot-testing) was conducted with sixteen 4th and 5th grade children in Ft. Collins, Colorado. Children were asked to play freely with all of the games and songs. During this time, researchers observed which modules were preferred (and not preferred) and documented comments and reactions towards different modules and graphics. After 30 minutes, the researchers asked for their candid feedback on the following characteristics: likes/dislikes of each module, infomercial, and song; character appearance; voices; and usability/ease of use.

Beta-Testing

Revisions were made based on results from alpha-tests. The software program was then beta-tested to ensure that the program and database were fully operational. This final stage of testing was conducted with ten nutrition and media researchers. Following beta-testing, the final product was pressed onto CDs.

Recruitment

Four schools – two control (C) and two experimental (E) – were recruited based on number of Hispanics (a cut-off of at least 50% of students considered Latinos), number of immigrants in community, ability to administer the program (e.g. computer platform and enough computers for one person at each computer), and interest to participate in the study. Control and experimental schools were matched for percentage of Hispanics and socio-economics of their respective communities. Letters of interest were obtained from all four principals and schools.

Implementation

The principal investigator installed the software program on all of the computers in the classrooms, tested the program and evaluation, and trained the classroom teachers ($n = 9$) and children ($n = 115$) on the research protocol. They were instructed to complete the software program over a three week period in the following order: 1) pre-test then Super Sorter; 2) More or Less; and 3) songs then post-test. It was expected that teachers would devote one computer class per week (each approximately 45 minutes long) for three weeks for this software program. The control group participants were asked to complete the post-test three weeks after the post-test to match the pre- and post-test administration of the experimental group.

Evaluation

Each child was assigned a user number to ensure confidentiality; he/she was required to type this number in upon entry to the main menu and tests. All data were collected on the

computer. The pre-test included questions in three areas: demographics, acculturation, nutrition knowledge, skills, attitudes, and behavior intentions. Questions on demographics and acculturation were omitted in the post-test to prevent redundancy.

Additionally, a tracking system was incorporated into the software program, so that data on the date and time of access to modules/tests (by user number) could be obtained. This allowed us to determine if children completed all of the modules and the pre-/post tests in the appropriate sequence and as scheduled. In the case of the More or Less module, children's food choices for different activities could also be examined.

Follow-up discussions were held with control and experimental participants and teachers (who participated in the program). Teachers were questioned about programmatic issues, such as compliance, ease of use. The experimental groups were asked about their likes and dislikes related to Food Pyramid Games. Since the control groups did not complete any of the modules, we only asked about their feedback on completing the survey using a computer (computer-based assessments were not common in these schools).

Acculturation Level

Acculturation level was assessed using the 12-point Short Acculturation Scale for Hispanic Youth (SASH-Y) (Barona & Miller, 1994). The total acculturation score can be compared to a normative data grid, which classifies the individual as low, moderate, or high acculturation. In this paper we refer to these as Mexican, Mexican-American, and Euro-American orientation, respectively. The SASH-Y was tested with parents and children in southern Colorado prior to implementation of the software program and determined valid and reliable (Serrano, 2001).

Nutrition Questions

Each module had corresponding knowledge, skills, attitude, and/or behavior intention question, as shown in Table 3. All of the questions were obtained from an instrument with test-retest correlations of .72 to .75 (Auld, Romaniello, Heimendinger, Hambidge, & Hambidge, 1998). The general design and technique for our evaluation followed similar protocol as with other general nutrition education programs targeting school-age youth (Contento, Kell, Keiley, & Corcoran, 1992).

Follow-Up Assessment

An informal assessment was conducted in each classroom to obtain feedback from each classroom. The control group was asked questions about the evaluation. The experimental group was asked questions about likes and dislikes.

Data Analysis

Only data from subjects that followed the research protocol (order of pre-tests and modules and timing) were included in data analysis (see evaluation). To determine if any differences existed between children in the control and experimental groups, chi-square analyses were run for all of the demographic variables. Paired *t*-tests determined differences within group from pre- to post-test time periods. A combination of repeated measures analysis and analysis of covariance were used to look at covariates and correlations between different factors and total scores. These tests were run for scores related to knowledge, skills, self-efficacy, attitude, and behavior intention. Knowledge and skills scores were also combined to determine if any

demographic variables contributed to differences in knowledge or skills scores. All analyses were conducted using SPSS™ for Windows 10.0.

Informed Consent

Informed consent was obtained from all children and their parents, per protocol set by the Office of Regulatory Compliance. All eligible students participated and returned consent forms.

Findings

Participant Information

A total of 115 children from four schools and nine classrooms participated in the study, as shown in the following table. Only one student did not complete the program (she moved out of state); her data is not included in any computations. Fifty-two (45.2%) were in the control group (C) and 63 (54.8%) in the experimental group (E). Chi-square tests indicated that there were no significant differences in proportions between C and E children for gender, age, and acculturation level. There were differences based on language preference (for this variable, Fisher's Exact Test for small cell sizes was conducted). Six children from the E group chose Spanish and none from the C group, a statistically significant difference ($p = .031$). Language preference was found to be highly correlated ($p < .01$) with total acculturation score and acculturation level, but there were no differences in proportions in number of children at different acculturation levels.

Table 2

Participant Demographic Information

	Control <i>n</i> (%)	Experimental <i>n</i> (%)	Total <i>n</i> (%)	Chi-Square Values* (<i>df</i> , <i>N</i>) (<i>p</i> value)
Gender				
Male	29 (55.8)	30 (47.6)	59 (51.3)	.757 (1, <i>N</i> = 115) (<i>p</i> = 0.455)
Female	23 (44.2)	33 (52.4)	56 (48.7)	
Age				
10	11 (21.2)	19 (30.2)	30 (26.1)	3.123 (3, <i>N</i> = 115) (<i>p</i> = .373)
11	38 (73.1)	37 (58.7)	75 (65.2)	
12	3 (5.8)	6 (9.5)	9 (7.8)	
13	0 (0)	1 (1.6)	1 (.9)	
Cultural Orientation				
Mexican	1 (1.9)	5 (7.9)	6 (5.2)	2.103 (2, <i>N</i> = 115) (<i>p</i> = .349)
Mexican-American	10 (19.2)	12 (19.0)	22 (19.1)	
Euro-American	41 (78.8)	46 (73.0)	87 (75.7)	
Language Choice				
English	52 (100.0)	57 (90.5)	109 (94.8)	5.225 (1, <i>N</i> = 115) (<i>p</i> = .031)
Spanish	0 (0)	6 (9.5)	6 (5.2)	
Total	52	63	115	

* Measure of difference in proportions between control and intervention groups

Knowledge about the Food Guide Pyramid (Super Sorter)

Children in both C and E groups improved their knowledge about the Food Guide Pyramid and the food groups significantly ($p < .05$) from pre- to post-test based on repeated measures analysis, adjusting for differences in pre-test scores, as shown in the following table. The C group demonstrated a mean increase of .57 points and the E group 4.1 points. Despite

significant increases in both groups, the adjusted post-test I scores were significantly higher ($p < .01$) than the C group's scores. The E group had a post-test score equaling 89.1% of total possible points, while the control group only obtained 43.6% of all points. There were no significant differences between groups at the pre-test time period.

Skills Related to Using the Food Guide Pyramid (More or Less)

Significant differences were found between children's scores in the C and E groups at post-test. See Table 3. The E scores increased by 0.3 and the C scores decreased by 0.4. Based on group mean scores, the E group achieved 66.9% of seven total points and the control group 61.4%.

Combined Knowledge and Skills Scores (Super Sorter and More or Less)

Scores were computed by totaling knowledge and skills scores. Consistent with the findings reported above, the E group demonstrated significantly higher post-test scores than the C group ($p < .05$) with a combined score of 12.78, compared to 7.18 for the C group. (Both post-test scores were adjusted for pre-test differences.) Significant increases were also exhibited from pre-test (7.67) to adjusted post-test (12.78). The C group scores did not increase significantly from pre- (7.98) to post-test (7.18) at the $p < .05$ level.

Using analysis of covariance (ANCOVA), we found significant main effects ($p < .05$) for age and acculturation (covariates) and pre-test knowledge scores (dependent variable). As age increased, mean scores decreased. Children classified as Mexican orientation had the highest pre-test scores, followed by children considered Euro-American and Mexican-American orientation. Gender and language did not prove to be significant. The R^2 for this model was 0.118. Results of ANCOVA with post-test as the dependent variable, group as the fixed effect, and pre-test and acculturation as covariates, determined that post-test scores differed between C and I groups at the $p < .01$ level. The other demographic variables were not significant. The R^2 was .566 – much higher than for the pre-test model.

Self-Efficacy in Applying the Food Guide Pyramid

Self-efficacy improved among the I group related to the statement, "I can plan meals and snacks using the Food Guide Pyramid." This was the only attitude that improved, as a result of the program.

Behavior Intention in Using the Food Guide Pyramid

The E scores for using the FGP to plan meals were significantly higher than the C scores at post-test, but significant differences existed at pre-test and changes from pre- to post-test for the E group were not significant.

Attitudes towards Dietary Practices

Scores for statements on variety and trying new foods were highly correlated to self-efficacy and behavior intention statements for using the Food Guide Pyramid. For example, scores for the statement, I will use the FGP to plan meals and snacks, were significantly correlated ($p < .05$) to the other attitude scores at pre-test. The highest scores at pre- and post-test for both C and E participants were towards "trying new foods." See III.3. All post-test attitude scores were highly correlated ($p < .01$) to their respective pre-test scores. The coefficients ranged from .373 to .561.

Table 3

Knowledge, Skills, Attitude, and Behavior Intention Scores for Control and Experimental Groups

Question Category	Question	Corresponding Modules	Test	Control ² Mean ± SE	Experimental ² Mean ± SE	F ³ (df)	p value ³	Range
Knowledge	Click on the correct food group for	Super Sorter	Pre-Test	3.35 ± .26 ^a	3.33 ± .24 ^d	100.9 (2)	.0001	0 – 9
	(e.g. Meats, Beans, & Eggs)		Post-Test (Adj.)	3.92 ± .22 ^{a,c}	8.02 ± .20 ^{c,d}			
	Which food groups are included in a bean burrito.....							
Skills	Say that you ate a burrito,	More or Less	Pre-Test	4.62 ± .17	4.38 ± .12	6.721 (2)	.002	0 – 7
			Post-Test (Adj.)	4.22 ± .16 ^c	4.68 ± .15 ^c			
Self-Efficacy	I can plan meals and snacks using the Food Guide Pyramid. ¹	Super Sorter More or Less Food Guide Pyramid Song	Pre-Test	3.88 ± .12	3.97 ± .11 ^b			1 – 5
			Post-Test	3.85 ± .12 ^a	4.24 ± .12 ^{a,b}			
Attitude	I like to try new foods. ¹	Food Adventurer Song	Pre-Test	3.96 ± .13	4.14 ± .10			1 – 5
			Post-Test	4.06 ± .15	4.32 ± .10			
	Choosing a variety of foods is important to me. ¹	Variety Song	Pre-Test	3.85 ± .15	4.05 ± .11			1 – 5
			Post-Test	3.92 ± .14	4.08 ± .12			
Behavior Intention	I will use the Food Guide Pyramid to plan meals and snacks. ¹	Super Sorter More or Less Food Guide Pyramid Song	Pre-Test	3.35 ± .13 ^a	3.75 ± .13 ^a			1 – 5
			Post-Test	3.44 ± .15 ^b	3.90 ± .12 ^b			

¹ These statements have five possible responses: really disagree; disagree; not sure; agree; and really agree. Responses were coded 1 – 5, respectively, for data analyses.

² Same letters denote significant differences in means, based on repeated measures analysis for that specific question: ^{a,b} p < .05 ^{c,d} p < .01 (Some differences may exist between total scores and FGP knowledge and application scores based on rounding of numerals.)

³ F-values and p-values are shown for analysis of covariance with post-test as the dependent variable and pre-test and group as the covariates.

Informal Feedback

Informally children reported liking *Food Pyramid Games* – particularly Super Sorter and the songs. In fact, some children could recite the songs by memory. Although children liked

More or Less, it was not considered their “favorite” module. The control group indicated that they enjoyed taking the computer-based tests and that they preferred that method to traditional paper-and-pencil assessments.

Discussion

Program Impacts

Our findings demonstrated that games and songs were effective in strengthening knowledge about nutrition and the Food Guide Pyramid (FGP), regardless of acculturation level, language of online test, ethnicity, gender, and age. The program was also successful in improving self-efficacy related to using the FGP even though it did not mirror their ability to use the Food Guide Pyramid, as illustrated by the skills scores. The results support the finding that intensive messages are needed to produce changes in skills and behavior in addition to knowledge and attitudes (Contento et al., 1992). Still, based on the current emphasis across the country on standards-based education, this may be difficult to achieve in a school environment unless the program is incorporated with reading, writing, and math.

Theory of Intrinsically Motivating Instruction Constructs

From a purely format perspective, our study demonstrated that a game with a challenge had a more significant impact than a game with a storyline. Additionally, children indicated that they enjoyed both modules, but they preferred Super Sorter (game with a challenge) more than More or Less (game with a storyline). The follow-up informal discussions also disclosed that some children wanted to continue playing Super Sorter to see how many “rounds” they could complete and how many points they could achieve. Still, it is difficult to distinguish “format” from “content.” Although the two games covered similar topics, they were not exactly the same. Unfortunately, the conversations did not elucidate whether their preference was attributed to the actual game format, the topics, or the appearance of the screen, etc. Our study also showed that songs were a fun method of teaching children. Combined with games, these produced measurable impacts and supported the foundations of the Theory of Intrinsically Motivating Instruction – that intrinsic rewards, visual and auditory stimulation would not only be effective in engaging the youth, but helping them remember and learn the messages (Perry et al., 1985; Bandura, A et al., 1981; Atkinson et al., 1971).

Recruitment and Retention

Our program yielded 100% recruitment and nearly 100% retention from beginning to end. In a study reporting the recruitment of urban young adolescents for a survey study, the researchers recruited, with daily communication with school staff and incentives, 70 to 83% of youth (measured by parental and youth consent forms), depending on the cohort (O'Donnell et al., 1997). Another study examining the relationship between participation in a school-based hepatitis B immunization program with teacher attitudes and student socioeconomic factors found that 73% consented to participate, of which 93% actually received all three doses of the vaccine (Goldstein, Cassidy, Hodgson, & Mahoney, 2001). The researchers reported that socioeconomic factors were the most important predictors of student participation in the program. Students in schools with a high proportion of students receiving free or reduced-price lunch and with low-test had lower participation rates.

In our sample of limited resource youth, neither recruitment nor retention proved to be a problem, demonstrating acceptance of the program by children and teachers alike. This could be

attributed – in part – to the program’s flexibility, a critical element of adopting a “new” innovation (Rogers, 1995). The computer program did not require preparation time or up-to-date resources, so it could conveniently fit into any “open” time slots. For example, if a teacher was sick, it could be quickly inserted as a lesson plan. Consequently, computer nutrition programs have the potential of being accessed more frequently than curriculums requiring more time and resources – considered the main barriers to teaching nutrition lessons (Uhrich & Terry, 1995). The success of this program could also be related to a positive school climate and administration supportive of research studies and/or nutrition education (Parcel et al., 2003).

Limitations

Compliance

Similar to past and current school-based programs in which teachers are trained and empowered as nutrition educators (Maretzki, 1979; Sahota et al., 2001; St Pierre & Rezmovic, 1982), this study relied on teachers’ compliance with the study’s outlined protocol, including not discussing nutrition, the software program, or the tests before the post-test was completed. While the teachers confirmed that they followed the protocol, it is possible that children discussed the program outside of class.

Serving Sizes

The researchers felt that it would be difficult to address this topic on a computer screen rather than through interactive hands-on activities, particularly the idea of fractions, which are just being taught in fourth and fifth grade in the U.S. Other research has shown that children have difficulty determining serving sizes (Baranowski, Dworkin, Henske, Clearman, et al., 1986; Baranowski & Simons-Morton, 1991) not to mention adults (Robson & Livingstone, 2000; Wolfe, Frongillo, & Cassano, 2001). As a result, the concept was indirectly taught by visually displaying one serving size each time a food was shown.

Assessment

The evaluation design employed by this study was similar to other general nutrition education studies with questions focusing on nutrition knowledge, skills, and attitudes (Contento et al., 2002). The School Health Education Evaluation has reported that 50 hours were required to achieve consistent increases in knowledge, attitudes, and behavior (Connell, Turner, & Manson, 1985). Our program resulted in only three and a half hours of intervention time; therefore behavior change was not assessed. Further, no formal questions were asked about the infomercial topics. The infomercials were only about 30 seconds in length with few expected impacts resulting from them. Still, the follow-up informal discussions with children indicated that they enjoyed these as much as, if not more than, the games. They thought they were funny and clever and they claimed that they learned things they hadn’t known, such as: “I didn’t know that fruit drink wasn’t fruit juice!” Future assessments of the computer nutrition program should incorporate evaluation questions on the infomercials.

Computer Platform

From development to implementation, the computer platforms in Colorado schools changed from Apple Macintosh computers to IBM computers. With the internet becoming increasingly accessible and capable of supporting sophisticated graphics and videos, future programs should focus on developing and testing interactive multi-media programs for the web,

such as Clueless in the Mall (Reed, Bielowicz, Frantz, & Rodriguez, 2002) and 5 A Day Virtual Classroom (DiSogra & Glanz, 2000a), or using DVD. This would avoid compatibility issues and reduce costs in developing dual platform programs.

Computer-Assisted Education

Although there are strengths to computer-assisted education, there are several limitations as well. First of all, not all subject matter lends itself to computers as the mode of communication, such as serving size. As Mas and colleagues stated, “Unfortunately, the passion to incorporate new technologies too often overshadows how people learn or, in particular, how people learn through computer technologies” (Mas, Plass, Kane, & Papenfuss, 2003). Secondly computers pose certain challenges when attempting to employ “social” components of behavior change. Health behavior models highlight the importance of social interaction and modeling in influencing health attitudes and behaviors (Bandura, 1986; Greene et al., 1999). Supplementing a computer program with learning activities and involving parents and childcare providers would certainly address this aspect of health behavior while strengthening the computer program’s impact. Finally, interactive multi-media programs require a substantial initial financial commitment. Following development, however, the computer program is self-sustainable outside of marketing and distribution.

Summary and Conclusions

Computer software programs represent a creative approach to teaching children about nutrition. Prior to this study, there were few studies that specifically measured impacts of software programs on children’s knowledge and attitudes. The fifth grade students who completed the software program enjoyed the games and songs, while demonstrating an increased awareness and about nutrition. Additionally, in this study, we found that a fun and interactive computer software program was an effective avenue for teaching children at different acculturation levels or cultural orientations about nutrition in the school setting.

References

- Atkinson, R., & Shiffrin, R. (1971). The Control of Short-Term Memory. *Scientific American*, 225, 82-90.
- Auld, G., Romaniello, C., Heimendinger, J., Hambidge, C., & Hambidge, M. (1998). Outcomes from a school-based nutrition education program using resource teachers and cross-disciplinary models. *Journal of Nutrition Education*, 30, 268-280.
- Bandura, A., & Schunk, D. (1981). Cultivating competence, self-efficacy, and intrinsic interest through proximal self-motivation. *Journal of Personality and Social Psychology*, 41, 586-598.
- Bandura, A. (1986). *Social foundations of thought and action*. (1st ed.) Englewood Cliffs, N.J.: Prentice-Hall.
- Baranowski, T., Domel, S., & Gould, R. (1993). Increasing fruit and vegetable consumption among 4th and 5th grade students: results from focus groups using reciprocal determinism. *Journal of Nutrition Education*, 25, 114-120.

- Baranowski, T., Smith, M., Davis Hearn, M., Lin, L., Baranowski, J., Doyle, C. et al. (1997). Patterns in children's fruit and vegetable consumption by meal and day of the week. *Journal of the American College of Nutrition, 16*, 216-223.
- Barona, A., & Miller, J. (1994). Short acculturation scale for Hispanic youth (SASH-Y): a preliminary report. *Hispanic Journal of Behavioral Sciences, 16*, 155-162.
- Bellman, B., & Arias, A. (1990). Computer-mediated classrooms for culturally and linguistically diverse learners. *Computers in the Schools, 7*, 227-241.
- Block, G., Norris, J., Mandel, R., & DiSogra, C. (1995). Sources of energy and six nutrients in diets of low-income Hispanic American women and their children. *Journal of the American Dietetic Association, 95*, 195-208.
- Brug, J., Steenhuis, I., van Assema, P., Glanz, K., & DeVries, H. (1999). Computer-tailored nutrition education: Differences between two interventions. *Health Education Research, 14*, 249-256.
- Buege, G. (1999). *Using focus groups to determine content and format for a nutrition education computer program*. Colorado State University.
- Campbell, M., Honess-Morreale, L., Farrell, D., Carbone, E., & Brasure, M. (1999). A tailored multimedia nutrition education pilot program for low-income women receiving food assistance. *Health Education Research, 14*, 257-267.
- Carroll, J., Stein, C., Byron, M., & Dutram, K. (1996). Using interactive multimedia to deliver nutrition education to Maine's WIC clients. *Journal of Nutrition Education, 28*, 19-25.
- Connell, D., Turner, R., & Manson, E. (1985). Summary findings of the School Health Education Evaluation: Health promotion effectiveness, implementation, and costs. *Journal of School Health, 55*, 316-321.
- Contento, I. R., Randell, J. S., & Basch, C. E. (2002). Review and analysis of evaluation measures used in nutrition education intervention research. *Journal of Nutrition Education and Behavior, 34*, 2-25.
- Contento, I., Kell, D., Keiley, M., & Corcoran, R. (1992). A formative evaluation of the American Cancer Society Changing the Course nutrition education curriculum. *Journal of School Health, 62*, 411-416.
- Contento, I., Manning, A., & Shannon, B. (1992). Research perspective on school-based nutrition education. *Journal of Nutrition Education, 24*, 247-260.
- Crockett, S., & Sims, L. (1995). Environmental influences on children's eating. *Journal of Nutrition Education, 27*, 235-249.
- DiSogra, L., & Glanz, K. (2000a). The 5 A day virtual classroom: an on-line strategy to promote healthful eating. *Journal of the American Dietetic Association, 100*, 349-352.
- Goldstein, S. T., Cassidy, W. M., Hodgson, W., & Mahoney, F. J. (2001). Factors associated with student participation in a school-based hepatitis B immunization program. *Journal of School Health, 71*, 184-187.

- Gould, S., & Anderson, J. (1999). Using interactive multimedia nutrition education to reach low-income persons: An effectiveness evaluation. *Journal of Nutrition Education, 32*, 204-213.
- Greene, G. W., Rossi, S. R., Rossi, J. S., Velicer, W. F., Fava, J. L., & Prochaska, J. O. (1999). Dietary applications of the stages of change model. *Journal of the American Dietetic Association, 99*, 673-678.
- Jamieson, A., Curry, A., & Martinez, G. (1999). *School enrollment in the United States -- Social and Economic Characteristics of Students* (Rep. No. P20-533). US Census Bureau.
- Koehler, K., Harris, M., & Davis, S. (1989). Core, secondary, and peripheral foods in the diets of Hispanic, Navajo, and Jemez Indian children. *Journal of the American Dietetic Association, 89*, 538-540.
- Kolasa, K., & Miller, M. (1996). New developments in nutrition education using computer technology. *Journal of Nutrition Education, 28*, 7-14.
- Levy, A. & Derby, B. (1995). *Food Label Use and Nutrition Education Survey: Selected results prepared for the Dietary Guidelines Advisory Committee* Washington, DC: Dietary Guidelines Advisory Committee.
- Lytle, L., Ebzery, M., Nicklas, T., Montgomery, D., Zive, M., Evans, M. et al. (1996). Nutrient intakes of third graders: results from the Child and Adolescent Trial for Cardiovascular Health (CATCH) baseline survey. *Journal of Nutrition Education, 28*, 338-347.
- Lytle, L. & Achterberg, C. (1995). Changing the diet of America's children: What works and why? *Journal of Nutrition Education, 27*, 250-260.
- Malone, T. (1981). Toward a theory of intrinsically motivating instruction. *Cognitive Science, 4*, 333-369.
- Maretzki, A. (1979). A perspective on nutrition education and training. *Journal of Nutrition Education, 11*, 176-180.
- Mas, F. G., Plass, J., Kane, W. M., & Papenfuss, R. L. (2003). Health education and multimedia learning: educational psychology and health behavior theory (Part 1). *Health Promotion and Practice, 4*, 288-292.
- Matheson, D., & Achterberg (1994). Ship to Shore [Computer software]. Pennsylvania State University.
- Matheson, D., & Spranger, K. (2001). Use of fantasy, challenge, and curiosity in school-based nutrition education programs. *Journal of Nutrition Education, 33*, 10-16.
- Munoz, K. A., Krebs-Smith, S. M., Ballard-Barbash, R., & Cleveland, L. E. (1997). Food intakes of US children and adolescents compared with recommendations. *Pediatrics, 100*, 323-329.
- Murphy, A., Youatt, J., Hoerr, S., Sawyer, C., & Andrews, S. (1994). Nutrition education needs and learning preferences of Michigan students in grades 5, 8, and 11. *Journal of School Health, 64*, 273-278.

- Nicklas, T., & Johnson, R. (2004). Dietary guidance for healthy children aged 2 to 11 years: Position statement of the American Dietetic Association. *Journal of the American Dietetic Association, 104*, 660-677.
- O'Donnell, L. N., Duran, R. H., San Doval, A., Breslin, M. J., Juhn, G. M., & Stueve, A. (1997). Obtaining written parent permission for school-based health surveys of urban young adolescents. *Journal of Adolescent Health, 21*, 376-383.
- Padrón, Y., & Waxman, HC. (1996). Improving the teaching and learning of English language learners through instructional technology. *International Journal of Instructional Media, 23*, 341-354.
- Parcel, G. S., Perry, C. L., Kelder, S. H., Elder, J. P., Mitchell, P. D., Lytle, L. A. et al. (2003). School climate and the institutionalization of the CATCH program. *Health Education and Behavior, 30*, 489-502.
- Passmore, S. (1996). Nutrition education in schools--educating the children. *Journal of Human Nutrition and Dietetics, 9*, 357-362.
- Perry, C., Mullis, R., & Maile, M. (1985). Modifying the eating behavior of young children. *Journal of School Health, 55*, 399-402.
- Reed, D. B., Bielasowicz, M. K., Frantz, C. L., & Rodriguez, M. F. (2002). Clueless in the mall: a web site on calcium for teens. *Journal of the American Dietetic Association, 102*, S73-S76.
- Robson, P. J., & Livingstone, M. B. (2000). An evaluation of food photographs as a tool for quantifying food and nutrient intakes. *Public Health Nutrition, 3*, 183-192.
- Rogers, E. (1995). *Diffusion of Innovations*. (4th ed.) New York: Free Press.
- Sahota, P., Rudolf, M. C., Dixey, R., Hill, A. J., Barth, J. H., & Cade, J. (2001). Evaluation of implementation and effect of primary school based intervention to reduce risk factors for obesity. *British Medical Journal, 323*, 1027-1029.
- Serrano, E. (2001). *Development and Evaluation of a Bilingual Computer Nutrition Education Program for Latino Children*. Ph.D. Colorado State University.
- St Pierre, R., & Rezmovic, V. (1982). An overview of the national Nutrition Education and Training Program evaluation. *Journal of Nutrition Education, 14*, 66.
- Uhrich, K., & Terry, R. (1995). Nutrition education for fourth and fifth grade students: teachers' attitudes and practices. *School Food Service Research Review, 19*, 26-31.
- U.S. Department of Agriculture (1996a). *Press release: What and where our children eat - 1994 nationwide survey results* (Rep. No. Release No. 0197.96).
- U.S. Department of Agriculture (1996b). *The Food Guide Pyramid* (Rep. No. United States Center for Home and Department of Nutrition Policy Garden Bulletin Agriculture and Promotion Number 252).
- U.S. Department of Agriculture, A. R. S. (1998). *Food and nutrient intakes of children 1994-96. Online*. Agricultural Research Group.
- U.S. Bureau of the Census (2000). *The Hispanic Population in the United States: March 2000* (P20-535). U.S. Census Bureau.

- Wallston, B., Wallston, K., Kaplan, G., & Maides, S. (1976). Development and validation of the health locus of control (HLC) scale. *Journal of Consulting and Clinical Psychology, 44*, 580-585.
- Wolfe, W. S., Frongillo, E. A., & Cassano, P. A. (2001). Evaluating brief measures of fruit and vegetable consumption frequency and variety: cognition, interpretation, and other measurement issues. *Journal of the American Dietetic Association, 101*, 311-318.

About the Authors

Dr. Elena Serrano is an Extension Specialist and Assistant Professor in the Department of Human Nutrition, Foods, and Exercise at Virginia Polytechnic Institute and State University. Dr. Jennifer Anderson, PhD, RD, is an Extension Specialist and Professor at Colorado State University in the Department of Food Science and Human Nutrition. She is currently the Director of Colorado Food Stamp Nutrition Education and Colorado Nutrition Network, as well as Past President of the Society for Nutrition Education.