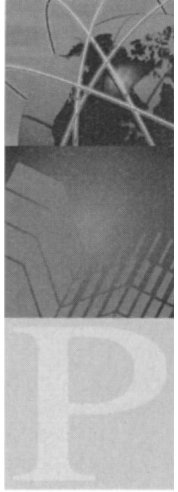


Design, development, and formative evaluation of "Put Nutrition Into Practice," a multimedia nutrition education program for adults

DEBORAH J. CARLTON, MS, RD; JANA R. KICKLIGHTER, PhD, RD; SATYA S. JONNALAGADDA, PhD; MARY B. SHOFFNER, PhD

ABSTRACT

The purpose of this study was to design, develop, and formatively evaluate a computer-based multimedia nutrition education program for adults based on the Dick and Carey model of instructional design. The 4 phases of the study included analysis, design, development, and evaluation. Seventy-two volunteers from the US Air Force, aged 18 to 50 years, participated in focus groups, an E-mail survey, or a dietitian survey to establish the program's instructional goal of applying the principles of the Food Guide Pyramid to daily food choices. Objectives, assessment instruments, content, examples, and practice questions with feedback were written in the design phase. Four modules of instruction—Familiarization with Food Groups, Serving Sizes, Modifying a Menu, and Vitamins and Minerals—were programmed using Hyperstudio. Eighteen subjects aged 22 to 40 years, with at least a high school education and an average knowledge of nutrition volunteered to participate in 1 of 2 formative evaluation phases. All subjects completed a pretest, 2 posttests, 3 embedded tests, and an attitude questionnaire to ascertain program weaknesses. One module was deleted after phase 1 because the material lacked relevance to subjects. In phase 2, only 4 of 15 subjects could identify serving sizes in module 2 and only 6 of 15 subjects could do the same on posttest 1. Back buttons and review screens were added to modules 2 and 3 to facilitate identification of serving sizes. We conclude that dietetics professionals should use systematic models of instructional design, such as the Dick and Carey model, to design effective nutrition education programs for the public. *J Am Diet Assoc. 2000; 100:555-563.*

The role of diet in the prevention of chronic disease has been well established over the past 10 years (1,2). However, many of the Healthy People 2000 nutrition objectives related to nutrition are not being achieved (3,4). The American Dietetic Association (ADA) and the Society for Nutrition Education (SNE) provide frameworks for educating the public on diet and nutrition (5,6). Both organizations acknowledge the need for resource development and creative new programs to reach and influence consumers. To be successful, the programs should be behaviorally based, meet a need within the target population, be personalized, and involve active learner participation by teaching skills consumers can use.

Computers offer a viable means for educating the public about diet and nutrition. Computer programs have been effective and well received when used to teach adults about nutrition (7-13). Despite these findings, usage in nutrition education remains limited (7,14,15). According to Kolasa (14) and Byrd-Bredbenner and Bauer (7) there is a dearth of standalone software programs designed with the adult learner in mind. Although computers have been used extensively for nutrient calculations, a limited number have been used for nutrition education in schools, clinics, and homes; even fewer programs have been developed specifically for adults (16).

Computers offer many advantages that appeal to an adult's learning preferences (17-19). Adults bring life experiences to the learning environment, making their perspective on learning different from that of children. As learners, adults are self-directed, skill-seeking, internally motivated problem solvers (20). Computers offer privacy, a high degree of learner control, 24-hour availability, and self-paced, individualized learning

J.R. Kicklighter is an associate professor and S.S. Jonnalagadda is an assistant professor in the Department of Nutrition, and M.B. Shoffner is an assistant professor in the Department of Middle/Secondary Education and Instructional Technology at Georgia State University, Atlanta. D.J. Carlton is chief of clinical dietetics at the David Grant Medical Center at Travis Air Force Base, Calif. At the time of the study, she was a graduate student of nutrition at Georgia State University, Atlanta.

Address correspondence to: Deborah J. Carlton, MS, RD, 999 Marshall Rd, Suite 108, Vacaville, CA 95687.

Focus group and E-mail survey
1. Have you heard of the Food Guide Pyramid, and what do you know about it?

2. What nutrition topics are you most interested in?

3. What motivates you to learn about nutrition?

4. How comfortable are you with using a computer for education?

5. How long should a computer program about nutrition be?

6. What features would help you translate the information from the computer program to your daily lives?

Dietitian survey
1. What topics are typically covered in a counseling session on basic nutrition?

2. Do you see a need for a computer program that provides basic nutrition information? If no, why?

3. What basic nutrition topics would you like included in a nutrition education computer program?

4. How long should the program be?

FIG 1. Summary of questions presented in focus groups and E-mail and dietitian surveys

(16,18). Tutorial programs that include practice and feedback appeal to an adult's need for active participation.

To ensure the development of effective and innovative nutrition-education computer programs, systematic models of instructional design should be used. The Dick and Carey (21) model of instructional design uses a systematic, step-by-step approach that novice programmers and nonprogrammers can use to design effective instruction. This model, in use since 1968 (22), is based on more than 25 years of research on the learning process and instructional design. Its initial focus is on what the learner must know or be able to do upon completion of the lesson. Because it is a systems-based model, it offers congruency from objectives through evaluation. Data are collected to determine which instructional segment, if any, is not working, and through formative evaluation the instruction is revised until it works as intended.

The purpose of this study was to design, develop, and formatively evaluate a computer-based multimedia nutrition education program for adults based on the Dick and Carey (21) model of systematic instructional design. The program was designed to teach the skill of analyzing and then modifying a person's diet based on serving-size recognition and principles of the Food Guide Pyramid (23); thus, it was named "Put Nutrition Into Practice" (PNIP). This program is offered as an innovative nutrition education strategy that will enable adults to make dietary behavior changes consistent with Healthy People 2010 objectives.

METHODS

Study design included 4 phases—analysis, design, development, and evaluation—and was approved by the Institutional Review Board at Georgia State University in Atlanta. The target population was adults, aged 18 to 50 years, with at least a high school education and an average knowledge of nutrition. Informed consent was obtained from all study subjects.

Phase I: Analysis

The purpose of phase 1 was to determine the overall instructional goal based on needs of the target population. A 3-tiered needs assessment encompassed 2 focus groups, an E-mail survey, and a registered dietitian survey. Sixteen volunteer subjects completed a demographic data questionnaire and participated in the focus groups. Seven subjects were obtained through either selection from a personal roster at Maxwell Air Force Base (Montgomery, Ala) or voluntary participation. Nine subjects were from a convenience sample at Dobbins Air Reserve Base (Atlanta, Ga). The group was diverse in their nutrition knowledge, education levels, and ages. All subjects met target population criteria, were 21 to 39 years old, had a minimum of a high school education, and were not clients of the dietitians who were later surveyed. Eleven of the 16 subjects had never received any form of nutrition education. Two participants had received weight-loss counseling from a dietitian, and 3 reported learning about nutrition in high school. Focus-group questions are shown in Figure 1. Focus groups were conducted and data were analyzed in accordance with procedures outlined by Krueger (24). Each tape-recorded session lasted approximately 1 hour. Information was transcribed and common themes that emerged were identified.

Similar data were collected using a modified Delphi technique (E-mail survey) (25). A convenience sample of US Air Force (USAF) personnel (n=12) was asked to forward the same questions used during the focus groups to 2 or more people they knew. Twenty-five people responded and, by virtue of responding, agreed to participate in the study. Similar responses on nutrition topics of interest and factors facilitating transfer of learning were combined. These responses were sent back to 10 randomly selected subjects from the original 25 respondents. Participants either agreed or disagreed with the topics, then ranked them in order of importance. The most requested nutrition topic and factor that would improve transfer of learning were selected from the final responses received.

Needs assessment surveys were sent to 35 registered dietitians. The sample was obtained from a roster of USAF dietitians who occupied positions in health and wellness centers and outpatient nutrition clinics. Thirty-one subjects completed the survey. The main survey questions are shown in Figure 1. Results from focus groups and the E-mail survey are shown in Table 1. Dietitian survey results are shown in Figure 2.

When requested information from the target population was compared with dietitian responses, there was a gap between what nutrition information was wanted and what was being provided, particularly in the areas of meal planning and vitamin and mineral requirements. This led to the overall instructional goal of PNIP: the learner will choose to apply the principles of the Food Guide Pyramid to his or her daily food choices.

Phase II: Design

The purpose of the design phase was to outline the lesson in complete detail before actually developing the materials. It consisted of 5 steps: instructional analysis, analysis of the learner and context in which the learner will perform the skill, writing performance objectives, developing assessment instruments, and developing the instructional strategy.

In the instructional analysis, the instructional goal from phase 1 was broken down first into 5 steps (Figure 3). Second,

each step was divided into subskills by asking: "What does the learner have to know or be able to do in order to perform this step?" Figure 4 shows the initial breakdown of the second step in the instructional goal. The analysis of learners' prior knowledge, motivational factors, and comfort level using a computer came from focus groups and E-mail participants during phase 1, as shown in Table 1.

Each step in the subskills analyses (Figure 4) was further broken down (Figure 5 shows the complete breakdown of step 2.1). For every step, a performance objective was written in the 3-part format outlined by Mager (26), which included the skill or behavior identified in the instructional analysis, conditions existing while the learner carried out the task, and criteria used for evaluation.

The assessment instruments included a pretest, 2 posttests, and an attitude questionnaire. For each objective, 1 to 2 parallel test items were written and used in the development of the pretests and posttests. To determine if learners possessed entry-level behavior skills or any knowledge about lesson content, the pretest contained 10 items: 3 measured entry behaviors and 7 measured selected skills from Figure 4. Posttest 1 contained 12 items: learners were given a 24-hour food record and the daily servings goals of a tall, lean, active man. Six questions asked the subjects to identify the number of servings from each food group; 4 questions required them to calculate deficient servings; for 2 questions they chose foods, in the correct portion sizes, to supply the missing servings. Posttest 2 consisted of 2 items per vitamin or mineral reviewed. First, learners identified good food sources of vitamins or minerals, then selected a food list that would increase the vitamin or mineral content of a given menu. An attitude questionnaire was also developed to assess learners' attention to content, material relevance, confidence in using skills, and satisfaction with and clarity of the program. The questionnaire contained 29 items and used a 1 (strongly negative) to 5 (strongly positive) Likert-type scale. All assessment instruments were reviewed for content validity by 2 nutrition professionals and for design validity by an instructional designer. Reliability was not established because of the small number of questions on each test and the desire to keep evaluation time efficient.

The last step in the design phase, developing the instructional strategy, consisted of making decisions related to how much information to present at one time, testing the information, selecting preinstructional activities, writing content to be presented for each objective, and planning activities to aid in the transfer of learning.

First, similar performance objectives within step 2 (Figure 4) were grouped, resulting in 3 sections or modules of information: "Familiarization with Food Groups," "Serving Sizes," and "Modifying a Menu." The complete breakdown of step 4 in the instructional analysis (Figure 3) contained 2 similar objectives; therefore it became the fourth module, "Vitamins and Minerals." The fourth module posed questions to help learners identify vitamins and minerals of concern, taught food sources of the vitamins and minerals, and instructed how to incorporate these foods into a menu.

An embedded test was developed for modules 1, 2, and 3. These tests allowed the designer to assess the program's effectiveness after a small number of objectives were taught, providing additional insights into possible instructional weaknesses. All tests were reviewed for content validity by 2 nutrition professionals.

Table 1
Summary results from focus groups (n=16) and E-mail survey respondents (n=25)[a]

Topic	Focus groups	E-mail survey
Prior knowledge of the Food Guide Pyramid	■ 10 subjects knew of the the pyramid. ■ 15 subjects could not name the food groups or daily servings.	■ 21 subjects knew of the pyramid. ■ 4 subjects knew "Foods higher up on the pyramid should be eaten less often." ■ 12 subjects knew the pyramid represented food groups and daily servings but could not name them.
Nutrition topics of interest	■ Vitamins and minerals ■ Long-term consequences of daily eating habits ■ Meal preparation ■ Healthful fast foods ■ Fad diet claims	■ Meal planning ■ Food links to disease ■ Nutrient requirements
Motivators[b]	■ "Attention-getting statements" ■ Living a long life ■ Weight maintenance ■ Personal appearance ■ Anecdotal evidence of success ■ Humor	■ Preventing disease ■ Staying healthy ■ Maintaining or losing weight ■ Fallacies on diet in the literature ■ Children ■ Getting fit
Comfort level using a computer and length of program	■ All felt comfortable ■ 15 to 20 minutes per module	■ All felt comfortable ■ 15 to 30 minutes at a time
Learning transfer topics	■ References to obtain additional information ■ Goal setting ■ Family support ■ Keeping food records	■ "Plain English" ■ Printable worksheets ■ Meal planning ■ Menus

[a]This information, when compared to the RD survey results, was used to establish the needs of the population, which is then used to establish the goal of the instruction.
[b]Information on motivation and attention was incorporated into step 1 of the instructional analysis.

Preinstructional activities involved informing learners of objectives and motivating them to continue the program. The motivational strategy used was the ARCS (attention, relevance, confidence, and satisfaction) model developed by Keller (27). To gain the learner's attention and show the relevancy of the instruction, statistics on life span, incidence of heart disease and cancer, prevalence of obesity and its health risk, and nutrition's role in preserving quality of life were provided (28). Learners were informed of the program's objectives, which were stated in a problem-solving manner to appeal to learning characteristics of adults. The length of each module was given so learners could feel more in control of how much time they spent completing the program. Strategies to increase learner confidence and satisfaction were also incorporated throughout the lesson. During the next step of the instructional strategy, all content needed to perform each objective was written. Examples, nonexamples, and 1 to 2 practice questions with feedback were also written.

To aid in the transfer of learning, a handout containing food groups and daily servings was provided, examples and practice

Topics typically covered in basic nutrition counseling
Food groups (n=31)[a]
Serving sizes (n=30)
Label reading (n=25)

Topics rarely covered in basic nutrition counseling
Vitamins and minerals (n=23)
Meal planning (n=22)
Exercise recommendations (n=13)

Need for a computer program that provides basic nutrition information
Yes, there is a need. (n=23)
No, for the following reasons: (n=8)
- Existing education materials
- Diet technicians accomplish this job
- Existing commercial software
- Fear of losing job
- Preference for client-counselor interaction

Nutrition topics requested in a computer program
3 most requested topics:
- Identifying food groups
- Identifying serving sizes
- Practice questions

Program length
30 minutes (n=28)

FIG 2. Summary results from dietitian survey (n=31).
[a]Number in parentheses indicates how many respondents (n=31) listed each item.

questions were written in the context that the learner would perform the skill, and memory aids were developed to identify food sources of vitamins and minerals.

Phase III: Development

During the development phase the instruction was programmed into the computer by the first author using Hyperstudio (version 3.1, 1997, Roger Wagner Publishing, Santee, Calif), an authoring software program. Approximately 575 hours were needed to develop the program. Principles of effective screen and computer-aided design were incorporated into the program (29-31), which was developed in a tutorial format. Modules were introduced by stating the objectives and practical application of the information. Information was presented followed by examples and nonexamples. One to 2 practice questions for each objective were programmed immediately after learners reviewed the information. Appropriate feedback was provided based on each learner's individual response. When learners answered correctly, applause was sounded, and additional information was provided to enrich the lesson. For incorrect responses, corrective feedback was provided, including proper responses and the reasons behind them. Navigation buttons (forward, back, exit, and main menu) appeared on every screen. Branching was also programmed in as much as possible to individualize the lesson; branching was designed for a selected response to lead to a new segment of information. The first draft of the program was reviewed by 2 nutrition professionals, an instructional designer, and a member of the target population. Spelling errors, navigational errors, content clarity, and screen design suggestions were made, and the program was revised prior to evaluation by the target population.

Phase IV: Formative Evaluation

Formative evaluation—the collection of data and information during the development of instruction—is used to improve the effectiveness of instruction (21). The formative evaluation consisted of 2 phases: a one-to-one evaluation and a small group evaluation. In both phases, subjects completed a pretest, 3 embedded tests, 2 posttests, and an attitude questionnaire.

One-to-one evaluation, used to identify obvious errors in the program, was conducted with 3 members of the target population. Subjects included one male blue-collar worker and 2 graduate students in instructional design, one male and one female, selected to add design insight. All reviewed the program with the designer. Subjects were encouraged to give candid feedback on the clarity, screen design, overall flow, terminology, and relevance of each module. Annotations were made on all feedback provided. Subjects also evaluated the clarity of directions and test items on the assessment instruments.

The phase 2 small-group evaluation—used to determine if changes made during the one-to-one evaluation were effective and if the computer program could run in the absence of the designer—was conducted with 15 members of the target population. Twelve of the subjects were from a convenience sample of college students, 22 to 40 years old and enrolled in education technology courses; they received extra credit for participation. The other 3 volunteers were members of the community. The designer acted as an observer and answered questions if asked. After completing the program, 12 of the 15 subjects were available for an interview to determine overall likes and dislikes and to have an opportunity to verbalize lengthy feedback. Proposed solutions were made to problems and responses were recorded to facilitate revisions.

RESULTS

One-to-One Evaluation

Data obtained during the formal evaluation and oral responses to individual interview questions and comments during initial evaluation were similar. The most substantial concern was the original module 2, "Calculating a serving size of an uncommon food." Subjects did not believe they would use the skill and questioned its relevance. Ratings for module 2 on the attitude questionnaire for attention, relevance, satisfaction, and clarity were between 3 and 4, the lowest ratings of all modules. All subjects thought the program was too long (each subject took 4 hours to complete the entire evaluation). Another problem was difficulty in retrieving information on serving sizes taught in modules 1 and 3. All subjects missed at least 2 of 4 serving-size questions on embedded test 1. Two of 3 subjects could not identify serving sizes on embedded test 3. On posttest 1, all subjects had difficulty identifying serving sizes from the given menu, which caused them to miss subsequent questions on adding correct portion sizes of the missing servings.

Two subjects thought the objectives were not clearly stated in the beginning of the program and wanted to know the purpose of the program as soon as possible. All subjects scored entry behavior questions on the pretest correctly; therefore, prerequisite skills were assumed correctly. Subjects' overall impression of the program was excellent and all believed the information was very useful.

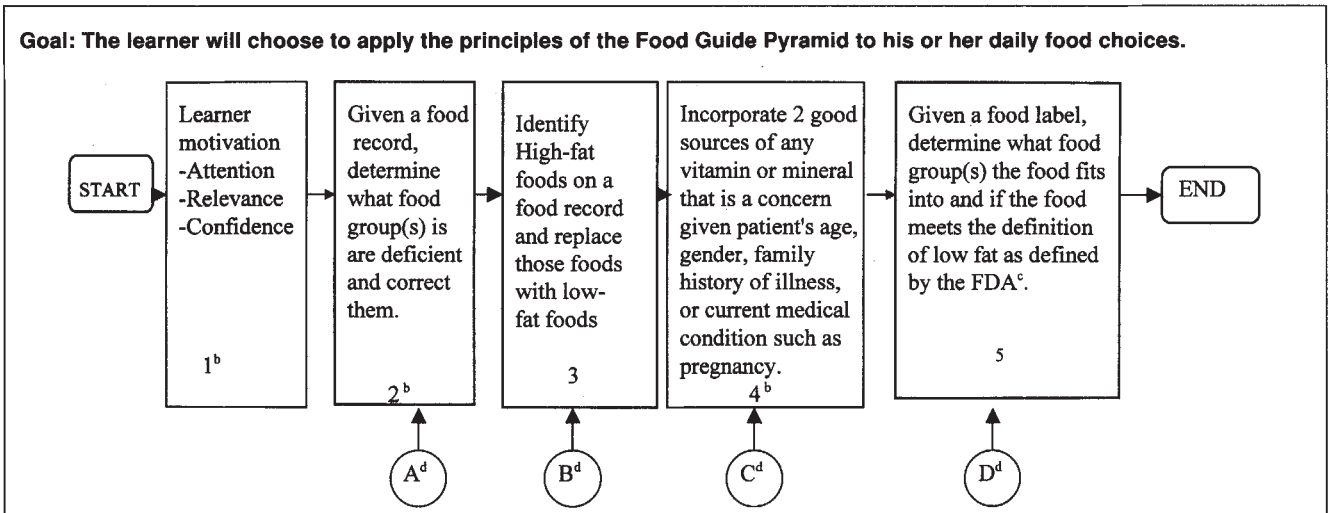


FIG 3. Instructional analysis for the instructional goal[a].
[a]Each step represents what the learner would be doing if he or she were successfully performing the instructional goal.
[b]Steps 1, 2, and 4 were programmed into Put Nutrition Into Practice.
[c]FDA: Food and Drug Administration.
[d]Connecting point for the complete breakdown of step in instructional goal.

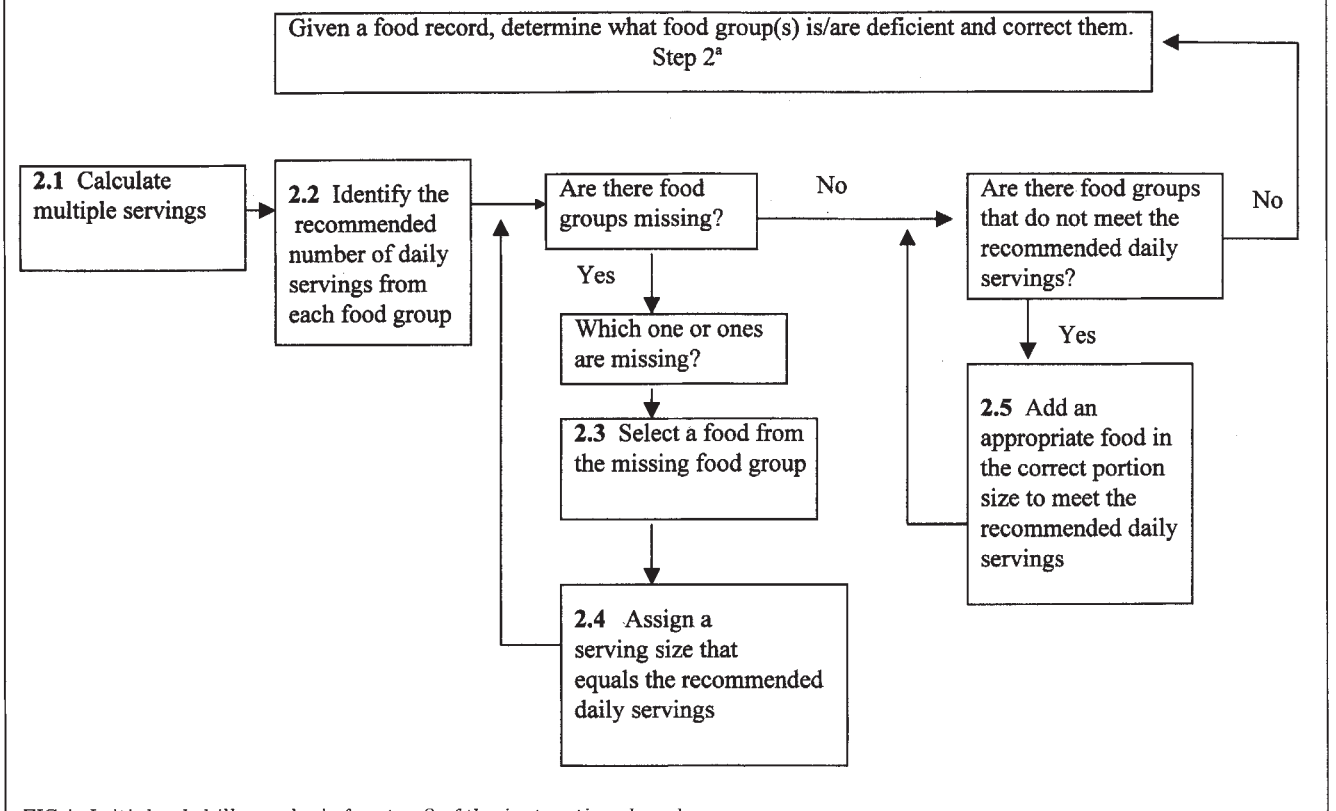


FIG 4. Initial subskills analysis for step 2 of the instructional goal.
[a]All steps reflect what the learner should know or be able to do to perform the overall goal.

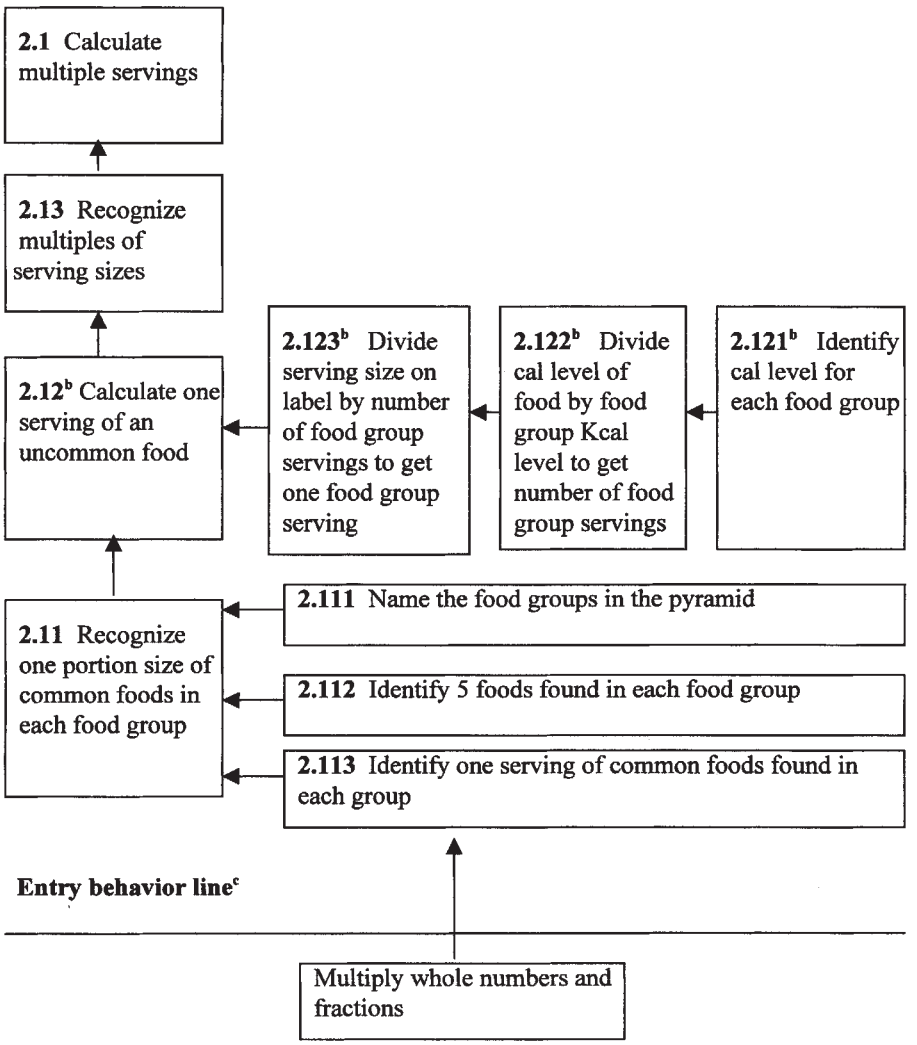


FIG 5. Complete breakdown of subskills analysis step 2.1.[a]
[a]*Each step is broken down further by asking the question: "What does the learner have to know or be able to do in order to perform this step?"*
[b]*Deleted after one-to-one evaluation.*
[c]*Skills learner is assumed to possess prior to instruction.*

Table 2
Percentage and frequency of subjects correctly answering test items and mastering each objective[a]

Test coverage and type and objective	Test items												Mastering objective	
	1		2		3		4		5		6			
	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.		
Pretest														
Entry behaviors	100	15	93	14	93	14							93	14
Embedded test 1: Food groups														
Name each food group	87	13	93	14	93	14	80	12					80	12
Name foods in each group	67	10	73	11	87	13	80	12					67	10
Embedded test 2: Serving sizes														
Identify single servings	93	14	27	4	93	14							27	4
Visually identify single servings	93	14	93	14									93	14
Visually identify multiple servings	73	11	67	10									67	10
Embedded test 3: Modify a menu														
Identify daily servings	93	14	73	11									73	11
Select food from missing group	87	13											87	13
Add food in correct portion	80	12											80	12
Calculate missing serving	67	10											67	10
Add food to correct menu	67	10											67	10
Posttest 1: (Modules 1 to 3)														
Identify serving sizes	53	8	60	9	53	8	80	12	73	11	40	6	40	6
Identify missing servings	67	10	60	9	53	8	40	6					40	6
Add correct portion of missing servings	67	10	73	11									67	10
Posttest 2: Module 4[b]														
Identify food sources	80	4 of 5	100	6 of 6	88	7 of 8	86	6 of 7	57	4 of 7	100	3 of 3	57	4 of 7
Modify menu with food sources	60	3 of 5	33	2 of 6	38	3 of 8	71	5 of 7	86	6 of 7	67	2 of 3	33	2 of 6

[a]Empty cells are present if less than 6 test items were asked per objective. N=15 subjects; second number in each column is the frequency of correct responses out of 15.
[b]On posttest 2, the test question number corresponds to the vitamin and/or mineral reviewed: 1=folic acid; 2=vitamin C; 3=beta carotene; 4=calcium; 5=iron; 6=vitamin E. Subjects were required to review a minimum of only one vitamin or mineral: therefore, subject number varied. Frequency data appears as the second number in each column.

Table 3
Participants' (n=15) attitudes toward Put Nutrition Into Practice

Program component	Attention[a]	Relevance	Confidence	Satisfaction	Clarity
	← *mean±standard deviation* →				
Module 1: Familiarization with food groups	4.5±0.6	4.5±0.9	4.5±0.5	4.5±0.5	4.6±0.6
Module 2: Serving sizes	4.0±0.8	4.3±0.9	3.8±0.8	4.1±0.6	4.1±0.8
Module 3: Modifying a menu	3.9±0.8	4.5±0.8	3.9±0.9	4.1±0.8	3.9±0.7
Module 4: Vitamins and minerals	3.8±0.8	4.3±0.7	3.7±0.7	4.3±0.5	4.4±0.6
Practice questions[b]	4.5±0.6	4.5±0.6	NA[c]	NA	4.5±0.5

[a]Each item is rated on a scale of 1 to 5. 1=strongly negative; 5=strongly positive.
[b]Confidence and satisfaction were not assessed for practice questions.
[c]NA=not applicable.

Based on these results, module 2 was deleted. Single- and multiple-serving information from modules 1 and 3 were combined to replace module 2. Introductory information was streamlined and objectives were stated sooner and more clearly. Navigation buttons were placed on every screen and links between screens were modified to increase efficiency of flow between topics. All evaluation instruments were revised to match new modules.

Small Group Evaluation

Small-group scores on the evaluation test and the percentage of subjects mastering each objective are summarized in Table 2. Each item corresponded to an objective taught in the lesson. Therefore, when an item was missed by a large percentage of subjects, the section of the instruction corresponding to that objective was reviewed for effectiveness and clarity of the test item. Based on pretest scores, all entry behaviors were assessed correctly during the design phase. No problems were noted on module 1 based on embedded test 1 scores.

Subjects had difficulty identifying serving sizes on embedded tests 2 and 3, and on posttest 1. In embedded test 2, two subjects could not identify the serving sizes of rice, baked beans, and couscous. The question was reviewed for ambiguity; we determined that it was clearly stated, and therefore it was not deleted. Instead, the section of the program covering this information was reevaluated for weaknesses. In module 3, subjects had difficulty identifying the number of missing servings from the bread group and subsequently had difficulty choosing the food in the correct portion size to correct the menu. Both skills required the subjects to know the different serving sizes for the bread group. On posttest 1, subjects had difficulty identifying serving sizes for each food group from the given menu. This caused them to incorrectly calculate the number of missing servings and identify the correct portion size that would correct the menu. Both skills relied heavily on identifying serving sizes, a topic with which learners had obvious difficulty, based on embedded test scores. Correspondingly, 11 of the 12 subjects who were available for an interview after reviewing the program stated that they had difficulty remembering servings sizes and wanted "back buttons" (icons that would return them to previous screens) on practice questions. Ten subjects wanted serving-size review screens in module 3 so they could successfully modify the menu. Based on these results, back buttons were placed on all practice questions in module 2 and review screens were placed throughout module 3.

In module 4, "Vitamins and minerals," only 4 of 7 subjects could identify food sources of iron, yet 6 of 7 subjects could incorporate good sources of iron into the menu. When the test item on identifying food sources was reviewed for clarity, subjects may have had difficulty distinguishing between vegetable and animal sources of iron; therefore, the test item was revised. Only 2 of 6 subjects and 3 of 8 subjects could incorporate food sources of vitamin C and beta carotene, respectively, into the menu. Upon analysis of the test items for beta carotene, which gave learners choices from A to D of replacing some foods with others, there was only 1 correct response; yet subjects selected the response stating "Both A & B," which included foods that would actually decrease the level of these vitamins in the menu. One possible explanation for this could be learner fatigue. For vitamin C, the difference in the vitamin C content of each selection was very small and likely confused the learner. Evaluations took 2 hours to complete—posttest 2 was the last set of questions to be answered—and answers required critical examination of all responses. For final implementation, the program is not intended to be completed in its entirety in one sitting; however, subjects were made to review all sections during the formative evaluation. Because low scores on incorporating food sources of vitamins and minerals into a menu could possibly be explained by learner fatigue and faulty test items, no revisions were made to the program and the test items were revised.

Results from the attitude questionnaire are shown in Table 3. Subjects scored all items favorably, although they were least satisfied with the length of the program (mean=3.5±0.8). Learner fatigue was again suspected. No revisions were made to the length, however, because learners will be able to complete one module at a time when the program is implemented in its final form.

DISCUSSION

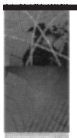
The Dick and Carey model of instructional design (21) is an effective way to design computer-based nutrition education to help adults achieve Healthy People 2010 nutrition objectives and future health objectives. Various aspects of this study, such as the theoretical model used and the extensive involvement with the target population, make it unique. The steps involved in creating PNIP are similar to those used by other researchers (7,11,15). However, the Dick and Carey model, based on more than 25 years of education research, offers a new way to design nutrition education programs for the public and supports the educational frameworks called for by the ADA and SNE. For example, the analysis of the learners, their educational needs, and the context in which they will use the information are all essential steps within the model that ensure that the target population's needs will be addressed. Also, the overall goal is behaviorally focused, which appeals to an adult learner's desire to immediately apply information they learn in an effort to solve real-life problems. In this study, the instructional goal was derived from desired nutrition topics and motivators for learning about nutrition obtained through focus groups and E-mail surveys conducted with adult learners. In contrast, many researchers identify the instructional goal without input from the target population (7,10,11,15).

Other studies have shown college-age students (7,8,15) and senior citizens (32) to be receptive to computer-aided instruction. This study bridges the gap between these 2 populations by targeting all adult learners, and it provides additional support for this type of computer-aided instruction.

Formative evaluation is necessary to produce a product that is well received and usable by the target population. The few studies that have reported on the design and development of nutrition education software (7,10,15). have included some type of formative evaluation or pilot testing and, in each case, the product was revised based on recommendations from the target population. Likewise, through the process of formative evaluation we found that our target population perceived an entire module as irrelevant. Therefore, this module was eliminated before the program's release. Also, PNIP may not be well-received by adults who are not comfortable using a computer for learning. Our focus groups, E-mail participants, and subjects who participated in the formative evaluations were very comfortable using computers for learning. This reiterates the importance of nutrition educators evaluating and pilot-testing nutrition education materials with the target popula-

tion before public release, to ensure development of a well-received and usable product.

Although our target population thought the program, as a whole, was relevant and useful, the question of whether consumers will use the information to change their dietary behaviors remains unanswered. Therefore, future research efforts should focus on answering this question and testing the program in the context of performance. Additionally, we did not test the effectiveness of PNIP in its final form by conducting a summative evaluation. This should be done by an objective third party.



APPLICATIONS

The implications of this study are far-reaching. Most previous efforts to design and develop nutrition education software have used a team consisting of both computer programmers and nutrition experts (7,15). In this study, one person with expertise in nutrition, but not in computer programming, designed and developed the program using an authoring software program. This opens up numerous new opportunities for dietetics professionals who want to develop software programs for their particular population but have limited funds or programming skills. Furthermore, dietetics students can complete design and development projects using authoring software programs and educational models to develop their core competencies in developing and reviewing educational materials.

- PNIP can be a benchmark for similar-type programs. Using PNIP as a guide, similar programs can be developed for different age groups, ethnic groups, and disease states. For example, the motivating statements in the software's introduction can be modified to appeal to a specific age group. The food lists and pictures can be changed to fit a particular ethnic group. For people with diabetes, pictures and portion sizes of foods can be modified to coincide with exchanges instead of Food Guide Pyramid servings. The program can also be loaded onto existing Web sites for nationwide dissemination to teach people how to put the principles of the Food Guide Pyramid into practice.
- Currently the US Department of Agriculture Food and Nutrition Information Center (33) has a list of nutrition related software programs that consist of games, informational programs, and nutrient-analysis programs, but there is no tutorial program specifically aimed at the adult that incorporates the principles of adult education.
- The utility of using a similar computer-assisted instruction with medical nutrition therapy protocols could be explored. For example, in the first session of the diabetes type 2 protocol, dietitians could modify PNIP to teach patients about their nutrition prescription and how to plan meals based on their prescription. Many similar applications using various medical nutrition therapy protocols are possible and should be explored as a viable option for the dissemination of nutrition information and dietary advice to the public.

References

1. *The Surgeon General's Report on Nutrition and Health.* Washington, DC: US Dept of Health and Human Services; 1988. DHHS (PHS) publication 88-50210.
2. US Public Health Service. *Healthy People 2000: National Health Promotion and Disease Prevention Objectives.* Washington, DC: US Dept of Health and Human Services; 1991. DHHS (PHS) publication 91-50212.
3. Healthy People 2000 Review 1997, Priority Area 2 Nutrition. Available at: http://www.cdc.gov/nchs/products/pub/pubd/hpzk/review/review.htm. Accessed March 21, 2000.
4. Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J. US adults' fruit and vegetable intakes, 1989 to 1991: a revised baseline for the Healthy People 2000 objective. *Am J Public Health.* 1995;85:1623-1629.
5. Position of The American Dietetic Association: Nutrition education for the public. *J Am Diet Assoc.* 1990;90:107-110.
6. Contento I. Executive summary, introduction and theoretical frameworks or models for nutrition education. *J Nutr Educ.* 1995;27:279-290.
7. Byrd-Bredbenner C, Bauer K. The development and evaluation of computer assisted instruction modules for an introductory, college-level nutrition course. *J Nutr Educ.* 1991;23:275-283.
8. Beerman KA. Computer-based multimedia: new directions in teaching and learning. *J Nutr Educ.* 1996;28:15-18.
9. Dennison D, Dennison KF, Frank GC. The DINE system: improving food choices of the public. *J Nutr Educ.* 1994;26:87-92.
10. Nielson M, Gould R. Computer-assisted instruction: an alternative approach for training school food service personnel. *School Food Service Res Rev.* 1993;17:115-119.
11. Carroll JM, Stein C, Byron M, Dutram K. Using interactive multimedia to deliver nutrition education to Maine's WIC clients. *J Nutr Educ.* 1996;28:19-25.
12. Waddell KP, Rinke WJ. Effectiveness of a computer-assisted instruction program for teaching sanitation. *J Am Diet Assoc.* 1985;85:62-67.
13. Campbell MK, Honess-Morreale L, Farrell D, Carbone E, Brasure M. A tailored multimedia nutrition education pilot program for low-income women receiving food assistance. *Health Educ Res.* 1999;14:257-267.
14. Kolasa KM. From the guest editor. *J Nutr Educ.* 1996;28:4-5.
15. Ries C, Granell J, Zemel P. Authoring a CAI lesson in nutrition education. *J Nutr Educ* . 1984;16:51-52.
16. Kolasa KM, Miller MG. New developments in nutrition education using computer technology. *J Nutr Educ.* 1996;28:7-14.
17. Shoffner BW. *Affective Design Consideration in Computer-Based Instruction for the Adult Learner* [thesis]. University Park, Pa: Pennsylvania State University; 1994.
18. Milheim WD. Using computer-based instruction with adult learners. *Continuing Higher Educ.* 1993;41:2-8.
19. Ference P, Vockell EL. Adult learning characteristics and effective software instruction. *Educ Technol.* 1994;34:25-31.
20. Knowles MS. *The Modern Practice of Adult Education: From Pedagogy to Andragogy.* 2nd ed. New York, NY: Cambridge Books; 1980.
21. Dick W, Carey L. *The Systematic Design of Instruction.* 4th ed. New York, NY: Harper Collins College Publishers; 1996.
22. Dick W. The Dick and Carey model: will it survive the decade? *Educ Training Res Dev.* 1996;44:55-63.
23. *Food Guide Pyramid: A Guide to Daily Food Choices.* Washington, DC: US Dept of Agriculture, Human Nutrition Information Service; 1992. Home and Garden Bulletin No. 232.
24. Krueger RA. *Focus Groups: A Practical Guide for Applied Research.* 2nd ed. Thousand Oaks, Calif: Sage Publications; 1994.
25. Murry JW, Hammons JO. Delphi: a versatile methodology for conducting qualitative research. *Rev Higher Educ.* 1995;18:423-436.
26. Mager RF. *Preparing Instructional Objectives.* Revised 2nd ed. Belmont, Calif. Lake Publishing; 1984.
27. Keller JM. Development and use of the ARCS model of instructional design. *J Instructional Dev.* 1987;10:2-10.
28. Monthly Vital Statistics Reports, Present to Volume 45, No. 1. Births, Marriages, Divorces, and Deaths for 1997. Vol. 46, No. 12. PHS No. 98-1120 Table 6. Available at: http://www.cdc.gov/nchswww/products/pubs/pubd/mvsr/mvsr/46-45/46-45.htm. Accessed December 9, 1998.
29. Alessi SM, Trollip SR. *Computer-Based Instruction: Methods and Development.* 2nd ed. Englewood Cliffs, NJ: Prentice Hall; 1991.
30. Schwier RA, Misanchuk ER. *Interactive Multimedia Instruction.* Englewood Cliffs, NJ: Educational Technology Publications; 1993.
31. Hannafin MJ, Peck KL. *The Design, Development, and Evaluation of Instructional Software.* New York, NY: Macmillan Publishing; 1988.
32. Dennison D, Dennison KF, Ward JY, Wu YB. Satisfaction of senior citizens in a nutrition education program with and without computer-assisted instruction. *J Nutr Elder.* 1992;12:15-31.
33. USDA's Food and Nutrition Information Center. Available at: http:/// www.nal.usda.gov/fnic. Accessed August 25, 1999.